

II

THE PRINCIPAL WORKS
OF
SIMON STEVIN

EDITED BY

ERNST CRONE, E. J. DIJKSTERHUIS, R. J. FORBES
M. G. J. MINNAERT, A. PANNEKOEK

AMSTERDAM
C. V. SWETS & ZEITLINGER





Mauritz, Prince van Oranien, Graaf van Nassau, Catzenbuijgen, Dianden
 Dietz, Meints Marguis Vander Verc En Nijmegen, etc. Gouverneur
 General der Verenichde Nederlanden, ende Ridder der Connecklike Orde der Fortiere

MAURICE, PRINCE OF ORANGE, COUNT OF NASSAU
 Frontispiece of the *Castrametatio*, 1617

THE PRINCIPAL WORKS
OF
SIMON STEVIN

VOLUME IV

THE ART OF WAR

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IV

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SIMON STEVIN

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THE ART OF WAR

OF

SIMON STEVIN



GENERAL INTRODUCTION

1. THE SIGNIFICANCE OF SIMON STEVIN TO THE MILITARY SCIENCE OF HIS TIME.

In the general introduction of the present edition (Vol. I, pp. 8, 9) it is accepted as a more or less established fact, that "Stevin served as an engineer in the States Army and acted as a tutor to Prince Maurice." This has been concluded from the almost indisputable supposition that "Stevin must have come into contact with Maurice, Count of Nassau, later Prince of Orange and Stadtholder of the United Provinces", within the period 1581-1594 between Stevin's establishing himself at Leyden and the publication of his first work in the domain of military science: *De Stercktenbouwing (The Art of Fortification)*. As a result his activity shifted from that of a private scholar and engineer to that of a person of importance in the young Republic (Vol. I, p. 8).

Maurice had come to Leyden in July 1582 and was matriculated at the university on April 19, 1583¹⁾. It is true that soon after the assassination of his father, Prince William the Silent, on July 10, 1584, he left Leyden²⁾, yet even then a period of two years or at least twelve months has been available for the establishment of a personal contact between the very young nobleman (born in 1567) and Stevin, his elder by twenty years and since February 16, 1583 a student of letters³⁾.

Still there remains the question: why is no trace to be found of such a relation in the first years after 1584, until 1593, the year in which, according to official sources, Stevin's active part in the States Army must have begun⁴⁾, in fact one year previous to the one in which his first military work, mentioned above, was published? ⁵⁾

¹⁾ According to the *Album studiosorum* together with Maurice were matriculated: Count Philip of Nassau, Philip de Merode (son of Baron de Petersem) and William de Melville; Maurice and Philip of Nassau: "nobiliss. ac Generosiss".

²⁾ Dijksterhuis, *Simon Stevin*, 1943, p. 10, note 1.

³⁾ Ibidem, p. 8 and note 3.

⁴⁾ Ibidem Dijksterhuis, p. 10 and note 5.

⁵⁾ Worth reading is certainly that which Motley in his *History of the United Netherlands* (The Hague, 1867) Vol. III, pp. 2, 3, writes *inter alia* under the heading: Intellectual training of Prince Maurice: "Not often at the age of twenty has a man devoted himself for years to pure mathematics for the purpose of saving his country. Four years long and more. . . the young Prince had spent laborious days and nights with the learned Simon Stevinus of Bruges. The scientific work which they composed in common, the credit of which the master assigned to the pupil, might have been more justly attributed perhaps to the professor than to the prince, but it is certain that Maurice was an apt scholar."

Hence we think we should do better, like Dijksterhuis⁶⁾, to assume that Stevin's close relation to Maurice did not date from their Leyden days, but should be ascribed to later years viz. about 1590, the year when Stevin is said to have moved to Delft⁷⁾, being also the year when Prince Maurice, at that time already Captain-general and Stadtholder of Holland and Zeeland, (after the departure of the British auxiliary troops and his appointment as Stadtholder of Utrecht, Guelders and Overijsel) was actually to develop his talents as a general.

So there may be some truth in the statement that a few years after 1590 the Prince is said to have summoned Stevin to the Hague⁸⁾ so that he could regularly consult him. At that moment (1590) the stadtholders William Louis and Maurice had started an extensive military training upon the example set by the Ancients, which proved to be fundamental to Maurice's first large campaign of 1591⁹⁾. We shall revert to this important fact again when discussing Stevin's significance in relation to army-tactics (battle-arrays, etc.).

It is very remarkable indeed, that it was only in the year 1594 a book was published by Stevin treating of a military subject, viz. the building of fortresses. Brialmont, whose excellent study on Stevin's military writings will often be quoted by us, gives as an explanation that this is a reaction to the fact that the Dutch system of building fortresses was gradually finding a wider application in spite of its provisional character, by which it greatly deviated from the (New-)Italian method, which, from a technical point of view, was found to be superior. It is very likely that in those days Stevin had little occupied himself with military science, although this occupation must have been very popular with most mathematicians of the 16th and 17th centuries. Apart from the fact that in times of war the scientific world takes a great interest in the conduct of war¹⁰⁾, we may well conclude that Stevin, by virtue of his bent for practical science, was the appropriate man for the study of military science and its improvement. It stands to reason that Stevin's close relation to Maurice has been highly conducive to the origin of Stevin's military publications. For the matter did not end with *the Art of Fortification* of 1594 (however important this work has been in those days), Stevin unfolded varied talents in the domain of military science as well as in the various other domains of science he occupied himself with. Alas he has not had the time to have all his writings printed; the latter has only been the case with his *Castrametatio* and his *Fortification by means of Pivotted Sluice Locks*, both dating from 1617. Also the last two works contain a wealth of military data, both of a technical as well as a tactical nature.

The more one becomes engrossed in these military works, being a regular soldier or layman, the more one admires the author's ingenuity and it is only to be regretted that all that his diligent pen has at one time written has not been completely preserved for us. In addition there are his undoubtedly extensive activities as a military engineer (with regard to the latter little has been traced so far to form a proper opinion, but also this work will certainly have been very important).

⁶⁾ Dijksterhuis, loc. cit. p. 10.

⁷⁾ Ibidem, p. 9 and note 4; *Jaarboekje voor geschiedenis en oudheidkunde van Leiden en omstreken*, 1918, p. 10, containing however some wrong dates.

⁸⁾ de Cock, *Simon Stevin*, Gent 1888, p. 40.

⁹⁾ J. W. Wijn, *Het krijgswezen in den tijd van Prins Maurits*, Utrecht, 1934, p. 535.

¹⁰⁾ Ibidem, idem p. 319; cf. also J. P. van Capelle, *Bijdragen Gesch. Wetensch.*, 1821, p. 5.

It is true, that Stevin's son Hendrik has published his father's posthumous papers to the best of his knowledge, but we are in doubt whether — at least where military science is concerned — he has been very successful, which may be discussed later on.

2. STEVIN'S WRITINGS ON THE ART OF WAR.

As has already been stated Stevin's military works were not all published in his lifetime. The works published after his death by Hendrik Stevin in his *Materiae Politicae, Burgerlicke Stoffen* (Civic Matters)¹¹⁾ should, in our opinion, be compared with the MSS kept in the Royal Library in the Hague, viz. three copies edited by Hendrik Stevin about the year 1635¹²⁾. Such a comparison, serving at the same time as a verification, has been surveyably arranged by C. de Waard from the excerpts made from Stevin's posthumous works by the learned mathematician and physicist Isaac Beeckman in 1624 (C. de Waard, *Journal tenu par Isaac Beeckman de 1604 à 1634*, Vol. II, edition in four volumes, The Hague, 1939-1953).

The first mentioned copies of these MSS are in their completeness exceptionally valuable since their originals have almost all been lost; both in the Royal Library as well as in some military archives and libraries there are still a few MSS dating from Stevin's time and therefore apparently attributed to him (Cf. hereafter sub B).

Up to now, except for the work done by de Waard and Hahlweg¹³⁾, the MSS in the Royal Library have not been much studied; Dijksterhuis in his book published in 1942 (p. 60, note 1) gives as a reason viz. the prevailing circumstances of the times; no more did former writers about Stevin such as Van Cappelle (1821), Goethals (1841) and Brialmont (1846) know their contents. All of them have only been able to consult the *Materiae Politicae*, consequently at second-hand! In this respect one exception should be made for the paper: *About Reprisal (Van de Verdrucking)*, which might be called a treatise of a strategical nature, known to Van Capelle, *Bijdragen tot de geschiedenis der Nederlanden*, 1827, p. 283-300: *Maurice and Stevin*.

For the rest, as for a general discussion on Stevin's military works, we find a good starting-point with the study of Alexis Brialmont, entitled: *Oeuvres militaires de Simon Stevin*. This study bears evidence of a great professional knowledge and critical sense, qualities, which, as they are attended by a fine style, affirm already in the lieutenant of the Belgian military engineers (then only 25 years of age), the great author on modern fortification and defence, who, also as a designer and builder of Belgian and other European fortifications, was to become famous. It was self-evident that this very military engineer was to devote such an

¹¹⁾ First impression 1649, second impression 1686, exactly identical to the first impression and published after Hendrik's death.

¹²⁾ As to the date of 1635 (or a little later) we refer to the statement sub 3 on p. 11 hereafter; cf. Dijksterhuis, p. 22.

¹³⁾ Dr. Werner Hahlweg has consulted the MSS in behalf of his book: *Die Heeresreform der Oranier und die Antike* (Berlin, 1941). He mentions this on page 9 and points out the contents of the parts he used on p. 51 and in note 74, while a fragment from MS 128A-9II, fol. 88 etc. has been reproduced on pp. 248-250 as: *Studien aus der Taktik des Ailianos* (Urkunden 3).

eminent treatise to Stevin, his countryman. And the more so as this study formed part of Dr. Michel Steichen's *Mémoire sur la vie et les travaux de Simon Stevin* and its author, since 1837 professor of theoretical and applied mechanics at the Brussels "Ecole Militaire", was apparently quite willing to give full scope to his old pupil: "Quant à ses (i.e. Stevin's) oeuvres militaires nous n'avons pas hésité à recourir aux lumières de notre ami A.B.; c'est à lui que nous devons tout ce que l'on peut dire sur ce sujet" ¹⁴).

It is indeed an elaborate study comprising not only 48 pages of text, but in addition 38 annotated pages (a total number of 124 notes).

Its subject-matter has been subdivided into the following eight chapters viz. with regard to the books:

- I. De la construction des forteresses (with two figures);
- II. De la castramétation (with figures of army camps);
- III. Nouvelle fortification par écluses;
and further, concerning his posthumous writings;
- IV. De l'ordonnance des villes (*Oirdering der Steden*);
- V. De l'ordonnance des maisons (*Huys oirderingh*);
- VI. Du choix des employés (tant civils que militaires) (*Amptlien kiesing*);
- VII. Du déplacement continuél des troupes
(*Geduerige verlegging des crychsvolcks*);
- VIII. Théorie de l'art de la guerre (*Crychspiegeling*)
(with a figure of the Spabijlhou) ¹⁵).

With regard to Stevin's posthumous military works Brialmont has been greatly influenced by the rather arbitrary classification found in the *Materiae Politicae*. This is shown inter alia by the summary sub VIII of the *Crychspiegeling*, for which Hendrik Stevin has used no less than 17 chapters of a varied subject-matter! Of this difficult task of subdividing the matter — especially difficult for a non-soldier — Dijksterhuis has acquitted himself better than Brialmont in his standard work on Stevin of 1943. The pure military works have practically all been inserted into the chapter X, *Military Science* (p. 222-247 in his book), subdivided into A. *The Art of Fortification*; B. *The Art of measuring Army Camps*; C. *Various Subjects*; the last part referring to the *Materiae Politicae* as follows:

- Section 1. *Van de geduerighe verlegghing des Crychsvolcx*
(About the Continual Displacement of Troops)
(Part VII).
- Section 2. *Ampten en Amptlien* (Army-Duties and Officers)
(Part VIII, Chapters 1, 2, 4, 5).
- Section 3. *Tactiek* (Tactics) (Ibidem, Chapters 3, 6, 11, 13).
- Section 4. *De Spabijlhou* (Ibidem, Chapter 8).
- Section 5. *Belegering* (The Siege) (Ibidem, Chapter 12).
- Section 6. *Gewenste Hervormingen* (Desired Reforms)
(Ibidem, Chapters 7, 9, 10, 14, 15).
- Section 7. *Elianus' commando's* (Aelian's Commands) etc.
(Ibidem, Chapters 16, 17).

¹⁴ Steichen, *Mémoire*, 1846, p. 3.

¹⁵ Spabijlhou = Spade-axe-pick-axe. One of Stevin's inventions. Cf. Introduction to Part 4 of this Volume.

A. BOOKS.

The three treatises on military science, published by Simon Stevin himself in book-form viz.:

1. *De Stercktenbouwing* (The Art of Fortification), of 1594;
2. *Castrametatio, Dat is Legermeting* (Castrametatio, That is Camp-measurement) of 1617; and
3. *Nieuwe Maniere van Sterctebou door Spilsluysen* (A New Manner of Fortification by means of Pivotted Sluice-locks), just like the former of 1617, and always found bound together¹⁶⁾, do not form a coherent whole. Apparently the period of time elapsed between these three publications is too great.

The first mentioned work, which has been printed and elaborately discussed in this volume of Stevin's *Principal Works*, is found to be most excellent and in itself most complete as to the preparation of its subject-matter¹⁷⁾. The third one however does by no means reveal a new system of fortification but only the application of sluice-locks, at least of a special kind of lock, used to obtain a better control of the water-level in the ditch and to establish a protected approach by water to the ditch of a fortification. As a description of their military application is preceded by an explanation of the construction of these locks, which takes up 2 out of the 4 chapters of the book, this work actually contains more technical information than military science, the reason why it has been reproduced and discussed as a whole in Vol. V, whereas hereafter in Vol. IV its pure military tenor and the significance of the practical use are being explained.

Finally *the Castrametatio*, which has been treated in this volume, does form a compact whole and as such a treatise eminently composed, describing the construction and arrangement of army camps in the days of Prince Maurice. Yet, as Dijksterhuis so rightly demonstrates¹⁸⁾, this work does not give any new directions but for the rules and regulations as they had come into existence during the course of the years before 1617. Nevertheless this book has as its merit that it has adapted the encampment to the army-organisation and that it passes criticism on the Roman army camps as to their application in 17th century warfare. Stevin fully enters here into the history of the army-organisation of the Ancients, which he follows more or less as an example.

From the following statement sub *B* of the posthumous manuscripts it will appear that there is every probability that a part of them might have been published in the *Castrametatio* of 1617, be it only fragmentary. But at the same time we should consider this remarkable book as the only printed evidence of Stevin's studies on army reform, of the same nature and according to the same principles

¹⁶⁾ Dijksterhuis, p. 53. The sometimes separate publication of these works and their translations can be seen from the catalogue of the library of the House of Orange, listed in 1686 by Constantijn Huygens and present in the Royal Library (MS 78-D-14); viz. they are classified therein under various numbers (see pp. 187, 206 and 207).

¹⁷⁾ Dijksterhuis, pp. 234, 338.

¹⁸⁾ Ibidem, p. 238.

as it had been carried into effect by Count William Louis of Nassau and Prince Maurice about the year 1590¹⁹).

B. MANUSCRIPTS.

On June 15, 1624 Isaac Beeckman, who must have known Stevin in person²⁰), found among Stevin's posthumous „papers" the following writings on military science²¹):

- [2] *Van de Spabijlhouw.* (About the Spabijlhou, see note¹⁵)
 - [3] *Van de geduerighe verlegginghe des crychsvolckx.*
(About the Continual Displacement of Troops)
 - [4] *Van de weerdicheden der cryghsampien.*
(About the Worthiness of the Army-Duties)
 - [5] *Oorden der verkiesinge.* (Order of Selection)
 - [7] *Chryghssaken.* (Military Matters)
 - [8] *Teghen verdruckingen.* (Against Reprisals)
 - [9] *Veltslachoordeningh.* (Battle-array)
 - [10] *Pyckschansinghe.* (Pike Redoubts)
 - [14] *Chryghskonst, seer veel daarvan.*
(The Art of War, very much of it)
 - [15] *Verscheyden Chryghstochten, dadelick van hem gesien ende geordineert.*
(Various Campaigns, observed on the spot and controlled as to their order)
 - [17] *Syn Excellenties teyckeningen ende schrift.*
(His Excellency's Drawings and Script)
 - [23] *Orderingh der steden.* (Town-planning)
- and pro
memoria
- [26] *Huysbouw.* (Building of Houses)
(classified by Brialmont under military science)

¹⁹ Although we do not know anything about Stevin being personally acquainted with Count William Louis, or his secretary van Reynd, the first mentioned might have been drawn by Prince Maurice into his cousin's studies as well as into their mutual exercises (cf. de Waard, II, 425, note 2 and Wijn, pp. 470-471, who is of the opinion that it is quite possible that Maurice and William Louis had started their military exercises at the same time).

Motley writes (*History of the United Netherlands* Vol. III, pp. 3, 4):

“*Organization of the republican army:* But a Dutch army there was none and Maurice had determined that at last a national force should be created. In this enterprise he was aided and guided by his cousin Lewis William, Stadtholder of Friesland. . . (who) had revived the old manoeuvres by which the ancient Romans had performed so much excellent work in their days The two cousins understood each other thoroughly and proceeded their new system, to be adopted at a later period by all civilized nations” (Reynd, *Historie der Nederlandsche Oorlogen*, 3rd edition, 1650. VIII, 162).

Cf. also Hahlweg l.c. pp. 14, 15 and 255 on the mutual studies of Maurice, William Louis and Johann v. Nassau (1561-1623), with reference to Stevin and his pronouncement about Maurice's erudition (cf. Cappelle, pp. 135-137). Yet Hahlweg does not mention Stevin's *Castrametatio* in his bibliography.

²⁰ Stevin's eldest son Frederik, born in 1612 or 1613, went to the grammar-school of the Rotterdam headmaster Jacob Beeckman, brother of Isaac (cf. Dijksterhuis, p. 22 and note 7).

²¹ C. de Waard, *Journal tenu par Isaac Beeckman*, II, p. 291.

All these subjects and various other items, probably inserted in [7] and [14], have been more or less completely included by Beeckman in his journal under the title or collective name: *Vijfde deel der ghemeynghe stoffen. Van de Crijchconst.*

The Manuscript in the Royal Library 128-A-10, marked by de Waard with I, bears a similar title²²⁾. Both names are apparently derived from Part V: *Van de Ghemengde Stoffen* (About Various Subjects); from Stevin's voluminous work *Wisconstighe Ghedachtenissen* (Mathematical Memoirs) (1605 and 1608), of which it is beyond doubt that it must have been known to Beeckman; and from its treatise no. 5 *Van den Crijchshandel* (About the Conduct of War)²³⁾, which has not been inserted, but which according to its Argument had been originally intended for it.

So we may rightly assume that Beeckman must have studied this treatise in manuscript. According to Stevin's own statement²⁴⁾ it had not been entirely finished in the year 1608, but that it was to have developed into an extensive work is shown by its large number of subjects and the space they occupy. This is evident from that which has been treated both in the *Materiae Politicae*, (compiled by Stevin's son Hendrik) as well as in the three MSS in the K.B. (Royal Library), described hereafter. According to their contents they are indicated by the manuscripts: I, II and III. The already mentioned MS-I and MS-II follow each other closely, and MS-III might be considered to be a supplement from a somewhat later period.

MS I in the Royal Library (K.B. 128-A-10) comprises of the above-mentioned Volume V (first book: *Van de Landtcrijgh*):

- Chapter 1: *Van der Raden Oirden* (p. 4-20); *Mat. Pol.* 51-86.
(About Governmental Administration)
- Chapter 2: *Van de Amptlienkiezingh en ghemeene aenclevinghen der ampten* (p. 21-39); *Mat. Pol.* 91-121.
(About the Selection of Officers and all that belongs to the Offices)

MS II in the Royal Library (K.B. 128A-9 I) comprises as follows:

- Chapter 3: *Van de oirden der Amptlien eens Legers met haer en ander eyghen crychwoordens bepalinghen.* (p. 4-22); *Mat. Pol.* 185-202 and 209-225.
(About the Order of Army-Officers and its Respective and Other Regulations in their proper Military Terms)
- Chapter 4: *Vant gebruijck des Hantgeweers, vant graven en rijshouwen, etc.* (p. 24-30); *Mat. Pol.* 238-249.
(About the Use of the Musket (rifle), about the Entrenchment and the Cutting of Fascines, etc.)

²²⁾ Idem, idem, II, pp. II and XVI-XXI.

²³⁾ Beeckman summarizes his annotations into: *Chryghshandelinge van Stevyn in 16 ½ bladen gecompenderd.* (Stevin's War Activities compiled into 16 ½ Sheets (i.e. 31 pages).

²⁴⁾ "The cause why they have not been inserted according to the contents of the afore-mentioned Arguments, is that they had not been entirely perfected, when the printer did not want to keep any longer what had already been printed for such a length of time and kept by him at his detriment; so that I now have the intention to have the above-mentioned remaining part published in due time" (p. 107 at the end of the *Vijfde Stuck der Wisconstighe Ghedachtenissen*) cf. Vol. I p. 30 Part V. *Van de ghemengde stoffen.* V, 5 *Van den Crijchshandel* (lacking).

- Chapter 5: *Vande veltslachoirdening met navolginge der Romeinsche wijze en dat met gheschut en Crijchslien gewapent na de gemeene manier deses tijts.*
(p. 32-62); *Mat. Pol.* 202-209 and 258-261 25).
(About the Battle-array following the Example set by the Romans with Ordnance and Soldiers armed according to the General Custom of the Times)
- ibidem: *Vande oirdentlicke buytdeelingh*
(p. 63); *Mat. Pol.* 261-263.
(About the Orderly Distribution of the Loot)
- ibidem: *Vande ghemeene reghel der vervulling*
(p. 65); *Mat. Pol.* 233-237.
(About the General Rule of Replacement)
- ibidem: *Vershil tusschen Elianus' beschrijving en dese angaende de sake der roersels*
(p. 67); *Mat. Pol.* 264-267.
(Difference between Aelian's Description and the Present Instance, with Regard to the Exercises)
- Chapter 6: *Vande pyckschansen* (p. 71-86); *Mat. Pol.* 142-143
(at the end of this book).
(About Pike Redoubts)

MS III. The third important MS in the Royal Library (K.B. 128-A-9-II) bears the title: *Eenighe stucken der Crychconst, beschreven deur Simon Stevin* (Various Parts of the Art of War, described by Simon Stevin) and has been indicated by de Waard by III. Its contents are as follows:

- Vande oirdening der Steden* (p. 1-21); *Mat. Pol.* 1-38 26).
(About Town-planning)
- Vant belegeren der Steden en Sterckten* (p. 22-57); *Mat. Pol.* 252-258.
(About the Besieging of Towns and Fortresses)
- Verscheyden Crychs-saecken, viz.:*
(Various Matters of War)
- Van de ghedurighe verlegging des Crychsvolcx*
(p. 59-71); *Mat. Pol.* 153-173.
(About the Continual Displacement of Troops)
- Van de verdruckingh (repressalie);* (p. 72-77); *Mat. Pol.* 143-152.
(About Reprisal)
- Van de weerdicheijt der Crychslie* (p. 79-85); *Mat. Pol.* 225-233.
(About the Worth of the Soldiers)
- Verduytsing van Elianus Griekse woorden* (p. 86-91); *Mat. Pol.* 267-273.
(Dutch Translation of Aelian's Greek Words)

²⁵) The following 3 sections of chapter 5 have been wrongly inserted in the MS together with the 17 other sections; they do not belong to them and are therefore mentioned by Beeckman at a later period.

²⁶) In this MS we do not find the Byvough: *Van de Huysbou* (the supplement: About the Building of Houses), yet on pp. 18-21 we come across a chapter of a pure military tenor, entitled: *Verstercking der vierboecken van kleinder tot grooter (met 7 figuren)* (Fortification of the quadrangles from small upwards (with 7 figures).

Verclaring der manier van reijzen eens Legers

(p. 92-93); *Mat. Pol.* 250-252.

(Explanation of the System of Marching of an Army)

Vande Ruijters die dienst souden connen doen in plaats van jonghers der cuirassiers

(p. 94); *Mat. Pol.* 249-250.

(About the Cavalry who could join the Army instead of the "Batmen" of the Cuirassiers)

Compagnie Colonelle een quade wijze te wesen

(p. 95); *Mat. Pol.* 263.

(Staff Company a difficult Army-Duty)

A comparison of this survey of contents with the Table shown by de Waard on p. XVI-XXI in his Vol. II, proves that in Beeckman's journal the military subjects practically all tally with the MSS in the Royal Library and occur in about the same sequence. On the other hand this is not the case with the military subject-matter dealt with in the *Materiae Politicae*. Therefore we agree with the disapproval expressed by de Waard about the way in which Hendrik Stevin has published his father's valuable military treatises ²⁷). We even deem it necessary — that the reader of the *Burgherlicke Stoffen* be warned — to amplify his criticism as follows:

- 1) Hendrik Stevin wanted to render his book more readable by merely inserting from the *Conduct of War* matters that could be understood without the practice of mathematics; yet he went too far in this, omitting not only all the drawings, but even very often the calculations as well!
- 2) He has been deliberately incomplete in his description of the arrays of battles, as in this instance he referred ²⁸) to his father's *Crychconst*, at the time still to be published, which however never appeared in print; thus we find with him a great lack of detail in this very important part of army tactics, which consequently has been more amply recorded by Beeckman in his annotations.
- 3) Hendrik has very often inserted in his father's texts personal remarks (it is true under the heading *H.S.*); we find them both in the MSS in the Royal Library as well as in the *Materiae Politicae*. In the MS in the Royal Library no. II, p. 58 we even come across a whole chapter dealing with a battle-array dating from the year 1635: "ordered by His Highness and given to me by His Excellency the Count of Brederode for the purpose of drawing".
- 4) In the very arbitrary classification of chapter VIII: *About the Theory of War* of his book, into 17 chapters, he has unnecessarily deviated from the original framework and has caused much trouble to an expert compiler such as Brialmont, who erroneously thought to have discovered Stevin's complete *Théorie de l'Art de la Guerre*.

Apart from the shortcomings as mentioned above, the military chapters from the *Materiae Politicae*, which have little or nothing to do with mathematics in Stevin's days and which do not particularly deal with the tactics of battle-arrays etc., do give a good notion of the military science such as Stevin visualized it in

²⁷) de Waard, II, p. II, XV and XVI.

²⁸) *Materiae Politicae*, pp. 261, 266.

an improved sense and described it. This chiefly concerns the chapters, bearing the following titles:

<i>Vande Oirdeningh der Steden</i>	(without the supplement: The Building of Houses)
(About Town-planning)	
<i>Vander Raden Oirden</i>	(as far as it is related to the organization of the army)
(About Governmental Administration)	
<i>Vande Amptlienkiesing en gbemeene aenclavingen der Ampten</i>	(the 11th chapter of which giving a description of the special duties appertaining to the "Crijchhandel" (the conduct of war)
(About the Selection of Officers and all that belongs to the Offices)	
<i>Vande Verdrucking</i>	(About Reprisal in Times of Peace)
<i>Vande Geduerige verlegghing des Crychsvolcx</i>	
(About the Continual Displacement of Troops)	

And finally the greater part of the sections from the chapter: *Vande Crychspiegelingh* (About the Theory of War), as mentioned on p. 6 before (classified according to Dijksterhuis).

Hendrik Stevin has really endeavoured to the best of his knowledge to do useful work with his *Crychspiegelingh* and as he says himself ²⁹⁾ "to give a brief explanation of nearly all that properly belongs to an orderly army"; he describes it all in 17 chapters as "various general rules and necessary practice required in warfare", yet follows it up by: "of which the greater part has gone out of use these days" ³⁰⁾.

Isaac Beeckman however has acquitted himself of this task in a much more detached manner and in many respects his adaptation of Stevin's works is much more complete, even when also "sommierlick" (of a concise conception), which is proved by the important work done by de Waard, who has been so kind to give us the copies of Beeckman's excerpts, the greater part of which has been lost unfortunately. In this respect we might refer to the second volume of his work and in particular to pages XV-XXI of the "Avertissement" (preface) and to the corresponding pages 420-428 (Appendices, I-G: *Van den Cryghconst*). When reading these pages we shall find that de Waard does give a complete survey of Beeckman's excerpts and notes, but that he has had only a part of the fragments printed in the appendix, that was not published by Hendrik Stevin; but naturally it was not for him to issue a complete and verbatim reproduction. For us this has been all the more reason to further discuss in detail two, in our opinion, important subjects from the MSS in the Royal Library, which both do not get full justice in the *Materiae Politicae* and which, in as far as they have been copied by Beeckman, have not been reproduced by de Waard, viz. *Over het belegeren van steden en sterkten* (About the Besieging of Towns and Fortresses) and *Over de pykschansen* (About Pike Redoubts). (See Parts 3 and 4).

²⁹⁾ *Materiae Politicae*, from the dedication of Chapter VIII to Lewis of Nassau, Lord of the Leek and Beverweert.

³⁰⁾ *Ibidem*, from the title of Chapter VIII: *Van de Crijchspiegelingh*. (pp. 175-273).

Finally the question arises whether there might be more MSS known in the military domain of which Stevin could have been the author. It seems very likely³¹⁾ that there should have been more, at least until 1750 and thereabouts. In any case there are still some known to us in Dutch libraries, of which it is not quite certain for all of them that they are by his hand, yet there is every probability that they could have been wholly or partly compiled by Stevin himself or in collaboration with him. This may be concluded either from his characteristic style and choice of words, or from annotations, which seem to have originated from him, as well as from full fragments equally occurring in his *Castrametatio* almost in the same wording.

These MSS, which have practically all been mentioned by de Waard and partly by Hahlweg, comprise the following³²⁾:

a. In the Royal Library, The Hague, the numbers:

- 128 A-14. *Formen van Logeeringen (soo wel ten deel als int geheel) vant leger, met zijn verclaringen*
(Figures of Encampments (in detail as well as in general) of the Army, and its Explanations).
- 128 A-18. *Formen van Slag-orders (soo wel ten deel als int geheel) vant leger*
(Figures of Battle-arrays (in parts as well as in general) of the Army).
- 128 A-19. *Diverse slagorders (1605-1622)*
(Various Battle-arrays)
- 128 A-20. *Verschyde Legerquartieren*
(Various Army-quarters; for the greater part similar to MS 128 A-14).

b. In the library of the War Ministry, The Hague, the numbers:

- 1 A-750. *Militaire Afbeeldingen, aanwijzende de Legertogten, Campementen, Logeringen, Slag-ordres, Batalien, Fortressen, Attacques, Defensien, en andere schikkingen der troupes te Velde zoo te paarde als te voet. Onder de Princen van Orange, en de Legers van den Staat gebruykelijk.*
(Military Illustrations, indicating the Campaigns, Encampments, Quarters, Battle-arrays, Battles, Fortifications, Attacks, Defences and other Formations of Troops in the Field both Cavalry and Infantry).

³¹⁾ Here we have in view the MS: *Manière de faire la Guerre selon le Génie des Romains, par Simon Stevin*. Parch. 2 vols., as stated on p. 230 under no. 15 of the printed catalogue of sales from the library of Prince Frederick Henry (A la Haie, 1749), Royal Library 345-H-23. In the Index to the works purchased from the above-mentioned library by Prince William IV (MS Royal Library 76-B-2) the same MS figures under no. 15, bearing as a mere title: *Manière de faire la Guerre*. Perhaps this was the MS figuring in Huygens' catalogue (MS Royal Library 78-D-14), p. 190 under no. 1115: *Manuscrit sur les Ordonnances des batailles des Romains*. This follows upon the French edition of Stevin's *Castrametatio* and *Pivotted Locks* of 1618 and precedes two books by Marolois: *La Perspective* of 1611 and *La Fortification*, augmenté par Albert Girard, of 1627.

³²⁾ de Waard, II, pp. XVI and XXI.
Hahlweg mentions in his "Aktenverzeichnis" (Sources) on p. 308 only the "*Ruich ontwerp van krijchs-saken*" and furthermore no MSS concerning army camps, but principally about drill.

According to the general custom adopted by the Princes of Orange and the States Armies).

The third part is entitled: *Cort ende eenvoudigh onderwijs vant maken ende stellen der huijdendaechsche ghebruyckelycke slachordens ofte Battallions mitsgaders eenighe vermakelijke formen ende curieuse questien der selver materie.*

(Brief and Simple Instruction of the Formation and Lining up of Contemporary most Common Battle-arrays or Battalions including some Amusing Representations and Odd Questions of this Subject-matter).

- 1 A-751. French adaptation of a part of MS 1 A-750.

- c. In the Archives of the General Staff, History of War Department:

III-I G-79. *Ruich Ontwerp van Krychs-saken ende t'gevolch van dien. Gelyck het bedensdaeges by Haere Excellentie Prins Mauritijs van Orangien Grave van Nassau, in die vereenichde Nederlandtsche Provintien gebruickt wort.*

(Rough Outline of Military Matters and their Results. According to the General Methods adopted nowadays in the United Dutch Provinces by his Excellency Prince Maurice of Orange, Count of Nassau).

The authors of *Het Staatsche Leger* (The States Army), vol. II and vol. III³³), merely refer to the MSS mentioned sub *b* and sub *c*. They consider the one mentioned sub *b* to have been probably compiled by Stevin himself, inter alia on account of the great similarity in various parts of this MS and the *Castrametatio*. This is also found to be the case with the MS, mentioned sub *c*, which MS according to Wijn³⁴) has been ascribed to Stevin by some people. We are of the opinion that both statements, when comparing the MSS mentioned sub *a*, prove to be a confirmation of this conclusion; moreover it has also been ascertained that certain parts in the respective MSS dealing with battle-array and the "tochten" (guards) show a mutual agreement and perfectly tally with places mentioned in Beeckman's journal. We are giving a few instances of it:

1. The 5th volume of the *Ruich Ontwerp van Krychssaken*, the name of which reminding us of Beeckman's inventory sub 7 (de Waard, II, 291 and p. 8 hereinbefore), is entitled: *Formen van Schlachoordens soo wel ten deele als int geheel vant leger* (Figures of Battle-arrays given in Parts as well as in General of the Army). Not only is the latter the actual title of MS 128 A-18 in the Royal Library, but also the contents of these two MSS, except for their orthography of the words, are exactly the same.

The opening lines of the above-mentioned MS run as follows:

"The entire army or multitude of troops are generally divided into three bodies ("tochten"), each under the special command of a field-officer, although the supreme command is everywhere in the hands of an army general. These bodies have each their separate names, such as Advance-guard, Main-

³³) F. J. G. ten Raai and F. de Bas, *Het Staatsche Leger* vol. II Breda 1913, (1588-1609), p. 38; Vol. III Breda 1915, (1609-1625), pp. 14 and 18.

³⁴) Wijn, loc. cit. 475.

guard and Rear-guard, not with regard to their actions in the arrays, but with regard to their marches, because he, who is marching ahead is said to lead the advance-guard, and he who is marching with his troops in the rear-guard is said to lead the rear; but he who is marching with his troops in the middle is said to lead the main-guard. That is why these bodies of soldiers as such change their names every day according to a change in their marching in advance or in the rear" ³⁵).

Stevin's authorship of the MS, identical of text, in the Royal Library, seems very plausible to us, if we turn our attention to the preceding lines of the above quoted fragment. Viz. when at first there is a description of two "Formen van Slagorders" (two figures of battle-arrays) (being represented and described later in the "*Ruich Ontwerp*") the author says:

"Dit verstaen sijnde soo laet ons commen tottet beschrijven *Vande oirden der slachboirden*". (Now that we have formed an understanding of this let us now come to the description of the *Order of the battle-arrays*).

2. In the "*Ruich Ontwerp*", repeatedly mentioned we find in chapter 5 (the end) likewise:

"The main-guard ("Bataillie") consisting of 11 troops or 37 Cavalry squadrons as they have stood before the town of Rees on September 25/15, 1614."

This same array is also found in Beeckman's journal on page 224-verso and has been printed in detail by de Waard, Vol. II, p. 428.

3. The following preliminary passage is found in MS 1 A-750: *Militaire Afbeeldingen* (Military Illustrations) in the part entitled *Cort en eenvoudigh onderwijs* (Brief and Elementary Instruction) in the library of the War Ministry:

"How to form a square Battalion of men.

For this it is necessary that one is an expert in extracting the square root, which is such common knowledge that it is needless to dwell upon it here, as in our *Arithmetic* ³⁶) we have given ample constructions and when proceeding we shall come to several examples of battalions" ³⁷).

The preceding statement has strengthened the supposition of the war-historian Lodewijk Mulder, editor of the well-known *Journal by Anthonis Duyck* (publ. 1862) as he writes ³⁸) that this MS must have been written by Stevin.

³⁵) "Het gantse Leger ofte mennichte des volcks worden gemeenlick gedeelt in 3 Tochten, welke elcks besonder onder t' gebied van eenen krychsoversten staen hoewel t' opperste gebied overall staet onder den Generael vant Leger.

Dese Tochten krijgen yder haere Naemen van Avantgarde, Bataille ende Arrierguarde, niet ten aensien haers doens, int stuck van Schlachtoordens, maer ten aensien des Treckens, want welke met sijn troupe den voortocht heeft, die noemt men die Avantgarde te voeren, ende welke die hindertocht heeft, die segt men d'Arrierguarde te voeren; Maer welck in die midden met sijn Troupen treckt, segt men die Bataille te voeren. Daerom die Tochten ooc alle daegen in die selve haere naemen veranderen; naer t' veranderen des voor ofte aerttreckens".

³⁶) Cf. Vol. II B, p. 580: extraction of roots. *Arithmetic* (pp. 459-745).

³⁷) "Om een vierkant Battaillon van mannen te maken. Hiertoet ist' noodich datmen wel expert is int' extraheeren vanden quadraat wortel, twelck soo gemeen is dat wij niet noodich vinden t'selve alhier te verhalen, alsoo wij daervan genoechsaem constructie gegeven hebben in onse *Arithmetica*, ende sullen voortvarende comen tot eenighe exempelen van Battaillons".

³⁸) MS 1-A-750, library of the War Ministry, the Hague, annotations at the beginning of the MS; cf. also *Journal by Anthonis Duyck* Vol. I, p. 717.

So when summing up the general views on Stevin's posthumous MSS we come to the following conclusion:

Apart from the three works by his hand the MSS are a source of extreme value in judging Stevin's knowledge in the domain of military science, as only a part of it — as far as we could ascertain — is found in his books, and particularly so in his *Castrametatio*.

One should be grateful for the work done by Isaac Beeckman and his interpreter C. de Waard to undertake the arrangement of this posthumous work and to publish a great many important items from them, because this has greatly contributed to the fact that the publication by Hendrik Stevin, equally meritorious but less professional, could be judged to better advantage. Above all, the MSS I, II and III in the Royal Library form a collection of extremely important documents of a very pronounced and original character.

As to the knowledge of the history of war in the days of Prince Maurice not all the MSS mentioned before are equally important. Both Brialmont as well as Dijksterhuis bear witness to this, where the first talks about Stevin's "propositions" and the other mentions "plans, designs and desired reforms", as found in a number of these MSS. In part both authors are treating the same subjects of which, for the sake of completeness, we merely mention the names below, leaving it to the readers to enter into their details.

BRIALMONT: "propositions"	DIJKSTERHUIS: "reforms, etc."
1. Military train (as a separate army unit)	
2. Modification of Infantry-drill	p. 247, 7 (Mat. Pol. VIII, 16, 17)
3. Improved regulations against looting	p. 246, 6 (" " " , 14)
4. Cavalry practice in fighting on foot	p. 246, 6 (" " " , 7)
5. Separate military stores	
6. Encampment of soldiers in tents carried by them	(Mat. Pol. 222)
7. Civil workmen in military service with the army	p. 246, 6 (Mat. Pol. VIII, 9)
8. Portable tools for soldiers	p. 245, 4 (" " " , 8)
9. Reorganization of the Cavalry (heavy and light)	p. 246, 6 (" " " , 10)

3. STEVIN, AS A MILITARY ADVISER TO PRINCE MAURICE AND THE STATES GENERAL, AS AN ENGINEER AND IN OTHER MILITARY FUNCTIONS ³⁹⁾

Already in 1584 the States of Holland, by resolution of February 17th, granted Stevin a patent for the first fifteen years to be allowed to use "his inventions and

³⁹⁾ Cf. also Dijksterhuis, pp. 14-17.

instruments" in the land of Holland ⁴⁰). By this resolution he is not yet entitled Engineer; yet it does show that the States wanted his "inventions, arts and instruments to be put into practice in the service of these Countries", thus also for the benefit of national defence.

From a notification by Prince Maurice to the Council of State in 1603 ⁴¹) it is known that Stevin, since 1593 and thereabouts, has been employed in the army as an "affteeckener der Quartieren" (a surveyor of the Quarters), but it was only in January 1604 that he received an official appointment as a "Quartiermaster to mark out the quarters", and on the 31st of this month he was sworn-in as such together with Claude van Senerpont, Lord of La Vacquerie, who had been appointed "Quartiermeester absolut" (Quartiermaster-general) of the army (in 1606 he was succeeded by Antoine de Solempne, who occupied this post until 1616) ⁴²). In these days Stevin is also called "engineer" and in later years his name is repeatedly found with this addition in the "Staten van Oorlog" (States of War). But already much earlier he must have had relations with highly placed military men and members of the States General, as is to be concluded from the dedications in his works: *Problemata Geometrica* (presumably published already in 1583) to the artillery-general Maximiliaan van Cruyningen ⁴³) and the *Sterckenbouwing* (Art of Fortification) (of 1594) to the Honourable Hendrick van Bienen, deputy for Guelders at the meeting of the States General.

Little is known however of Stevin's activities in the field as a "leghermeter" (surveyor of army-camps) and as a military engineer during the period 1593-1604. His name does not occur anywhere in the works on Prince Maurice's famous sieges, although, as we have seen, he himself states Stevin's presence at them. Only in Stevin's own writings we can read that he knew details of the sieges of *Hulst* (1591), *Grol* (1597), *St. Andries* (1600) and *Ostend* (1601-1604) ⁴⁴).

More clearly his part in the projects for the improvement of the fortifications at *Harderwijk* has been ascertained.

During the 80 Years' War this town was particularly important, because it could make it difficult for the enemy, when invading the Veluwe, to cross the Zuyder Zee and to land in North Holland ⁴⁵). For that purpose however, apart from a garrison, its fortifications needed also considerable improvement. In what manner this improvement had been carried out with great labour, yet in its

⁴⁰) F. J. G. ten Raai and F. de Bas, *Het Staatse Leger*, vol. I, Breda 1911, p. 272, sub b: "Engineers".

⁴¹) Cf. detailed exposition by Dijksterhuis, p. 10 and *Resolutions of the States General*, inter alia of December 24th, 1603 (*Rijks Geschiedkundige Publicatiën* 92, p. 520), in which "Johan Stevin" is found by mistake.

⁴²) F. J. G. ten Raai and F. de Bas, *Het Staatse Leger*, Vol. II, Breda 1913, p. 267 and Dijksterhuis, p. 11. In MS 1A-750 (Library of the War Ministry) and in the *Leghermeting*, p. 16 he is called *Solem*.

⁴³) About Maximiliaan van Cruyningen, squire of Heenvliet, Hazerswoude etc. artillery-general since 1579 and later a member of the Council of State, cf. *Het Staatse Leger*, Vol. I, pp. 151, 240.

⁴⁴) With regard to Hulst, Grol and Ostend see Dijksterhuis, (p. 12, note 2); concerning St. Andries see MS "*Belegeren van Steden en Stercken*" (Besieging Towns and Fortresses), p. 467.

⁴⁵) Resolution of the States of Holland November 21, 1598: "... in voortyden verscheyde assistentie tot de Fortificatiewercken der selver Stede, soo ten opsien van de Nabuyschap, als dat de selve op de Zuyderzee ghelegen is, ghedaen".
(... in former times assistance has been rendered on various occasions in the Fortification-works of this town, this in respect of its neighbourhood and with a view to its being situated on the Zuyder Zee).

execution far from perfect, has been fully described and illustrated by a ground-plan of the fortress with an explanation by F. A. Hoefer in Vol. XXVII (1924) of the *Bijdragen en mededeelingen der Vereniging Gelre* (Contributions and Informations of the Gelre Society). For this purpose he consulted the old Harderwijk archives, the inventory of which was only to be placed on record in the year 1935 by the keeper of the archives P. Berends ⁴⁶⁾.

The following papers, kept in these archives and partly in extenso mentioned by Hoefer, are documentary evidence of Stevin's share in the various projects.

1. Letter of instruction by Prince Maurice dated December 16, 1598 (Record no. 592):
 "His Excellency orders Symon Stevin to travel to Harderwyck and to inspect the fortifications in order to deliver a report to His Excellency after inspection, therefore Requests the Magistrate of this town of Harderwyck, to render him every assistance, so that he may return soonest possible, Actum Arnhem Dec. 16, 1598".

(was signed) Maurice de Nassau ⁴⁷⁾.

2. From the accounts of the Bailiff of Harderwijk, 1598/'99 (record no. 276):
 "Paid on December 16th to Mr. Stevijn and Mr. Davidt (van Orliens) engineers for the marking off and portrayal of the fortifications of the town according to the resolution of the Aldermen 82 guilders and 2 pennies.
 For the consumption taken at the house of Henrick Boon by the councillor Brien en Mr. Symon and Mr. David engineers of His Excellency during the time of eight days including the banquet of honour given to them in the full presence of the Collegium paid according to the statement of account of the burgomasters totalling 1 hundred 72 guilders 17 pennies and all this for the portrayal and measurements of the situation of the town."
 "Paid on December 23rd to "broenis Gerritszn." on account of the fact that he has taken to Amersfoort the councillor Brien en together with the engineers . . . 8 guilders ⁴⁸⁾."

⁴⁶⁾ The old archives of Harderwijk are now in the General State Archives, The Hague.

⁴⁷⁾ "Zijne Ex.tie lastgevende Symon Stevin, hem te transporteren naer Harderwyck, ende aldaer de fortificatien te besichtighen omme Zijne Ex.tie daernaer daervan rapport te doen, Versouckt daeromme den Magistraet der selve Stede van Harderwyck, hem daerinne alle behoorlicke assistentie te verthoonen, ten eynde hy zoo haest mogelick mach wedercommen, Actum Arnhem den 16en December 1598"

(get.) Maurice de Nassau.

⁴⁸⁾ "Den 16en Decembris betaelt aen Mr. Stevijn vund Mr. Davidt (van Orliens) ingenieurs vant afsteecken vund pourtraictheren vander Stadt wercken volgende de resolutie vande Schepen 82 gulden 2 stuvers.

Voor die Verterunge die der Raetsheer Brien en Mr. Symon ende Mr. David ingenieurs van Syne Excellentie gedaen hebben ten huise van Henrick Boon geduerende den tyt van acht daegen ende daer mit inne gerekent synde die eermaeltijt die hun bij t Volle Collegium gedaen worde betaelt volgende die affreeckening mitten burgemeesteren gehouden in alles 1c 72 gl. 17 st. vund dat alles over die pourtraicture ende affmetinghe van die Situatie vande Stadt."

"Den 23en Decembris betaelt aen broenis gerritszn. ter cause hy de raetsheer Brien en mitte ingenieurs op Amersfoort geveurt heeft . . . 8 gulden."

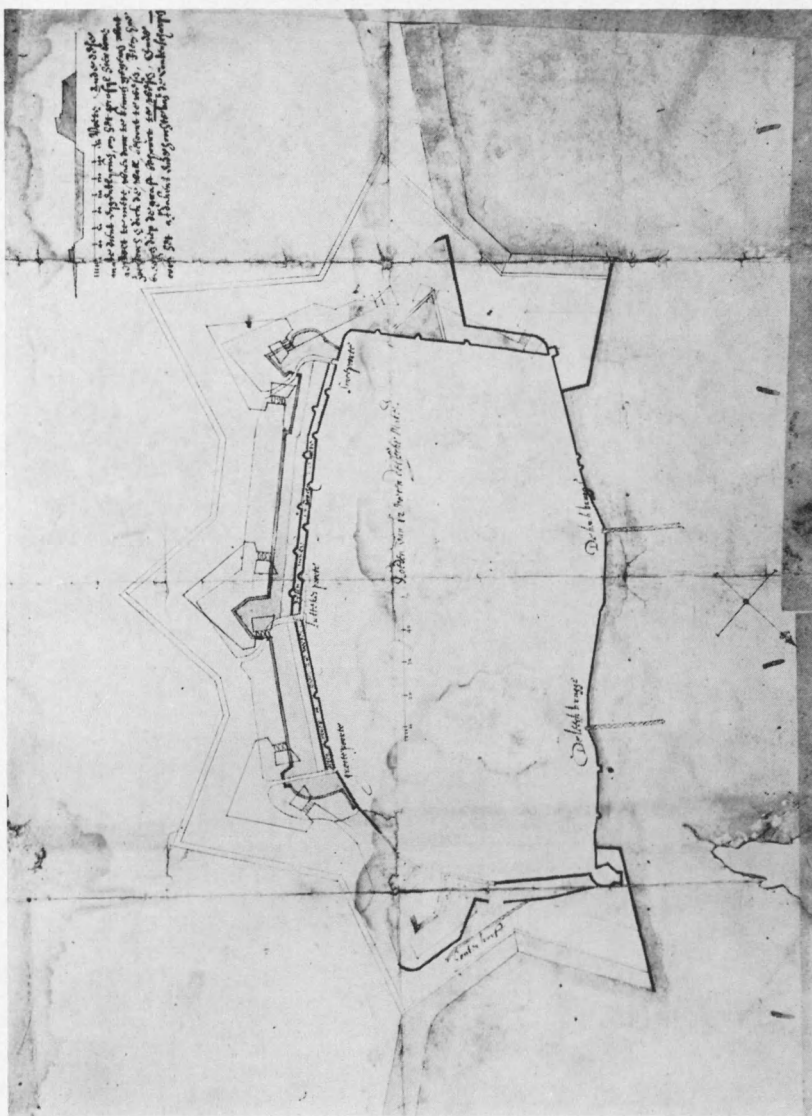


Plate 1. Design for the improvement of the fortifications of Hardevijck by Simon Stevin and David van Orlens in 1598. (General State Archives, The Hague)
The projected outer bastions are delineated in fainter lines

1

2

3. Resolution of the Prince on January 10, 1599 (record no. 592 and Hoefer, suppl. VI):

"Upon a written request by the Delegate Councils of the members of the States of Holland His Excellency has delegated his mathematician Stevyn and Davidt van Orliens, engineers of state, to travel to the town of Harderwyck, in order to inspect its fortifications and to mark off their exact angles, lengths, widths, heights and depths, to draw up a ground-plan according to these exact measurements and then to give advice whether sufficient provisions have been made for the protection of the Zuyder Zee. And after the report had been delivered ⁴⁹⁾, His Excellency, after mature deliberation, considered the afore-mentioned fortification of Harderwyck to be appropriate and necessary and that upon the indications of the present design, following the red and yellow lines, by which the new fortification is marked. Issued at The Hague, January 10, 1599."

(was signed) Maurice de Nassau ⁵⁰⁾."

4. Estimate for the construction of the Western bastion on sea (record no. 597 and Hoefer, suppl. VII):

"Device of the town, made by Mr. Stevin and Mr. David, engineers. Terms and specifications, according to which the Lords of the States General by special order and command of His Excellency to the town of Harderwyck invite tenders for the erection of a wall on the West-side of the bastion, to be erected before the old blockhouse in the following manner ⁵¹⁾": then follows a description of the wall to be erected, which should have a length of 40 rods and would cost fl. 10,290.—.

However, from the Resolutions of the States General over the years 1598-1599 it becomes evident that this College on April 5, 1599 passed the resolution to adopt the project for a partial improvement by Adriaan Anthonisz, who had already surveyed the fortifications during the years 1586-'88, 1590 and 1597 and who had designed various improvements ⁵²⁾.

Nevertheless the project by Stevin and van Orliens for a renovation of the entire fortress is much more important, because it comprised Stevin's system, which was found to be far superior (see Plate I and Stevin's *Art of Fortification*).

⁴⁹⁾ Viz. the report by David van Orliens of December 1598 printed by Hoefer, appendix VI.

⁵⁰⁾ "Syn Excellentie heeft opt schriftelyck versoeck van de Gecommitteerde Raden der Heren Staten van Holland gecommittiert sijn matematicum Stevyn ende Davidt van Orliens, ingenieurs van den lande, om henluden te transportiren naer de stadt van Harderwyck, deselve in hare fortessen te besichtigen ende in hare hoeckken, lengden, breedten, hoechden ende diepten pertinenteliken aff te trekken, maeckende daervan caerte naer de juiste mate, ende vervolgens t'avisieren op de forsieninghe, genoechsam sijnde tot versekerynghe van de Zuylzee. Ende naer gehoerden rapporte heeft deselve Siin Excellentie by rype deliberaty de vornoembde fortificaty van Harderwyck bevonden oerbaer ende nodich ende dat naer uyt wysen van dyt tegenwoerdig plan volgende de rhode ende geele linien, waarmede de nieuwe fortificatie beteekent wort. Gegeven in 's-Gravenhage den 10 Januarii 1599".

(get.) Maurice de Nassau.

⁵¹⁾ "Besteck van de stadt, gedain by Mr. Stevyn und Mr. David, ingenieurs. Conditien ende besteck, waernaen miin Heeren de Staten-Generael ende door den expressen last unnd bevel van Siin Excellentie aen de stadt van Harderwyck besteden willen te maecken eenen muyr op westzyde van het bollewerck, datt men leggen will voor het oude blockhuis in manieren als volgt."

⁵²⁾ Cf. Map no. 3229. Gen. State Archives (plan by Adriaan Anthonisz, October 24, 1590) and *State Historic Publications* (R.G.P.) 71, p. 613.

Yet Samuel Marolois⁵³) considered the fortress, improved by Anthonisz., to be of sufficient importance to give a detailed description of it in his book on the art of fortification of 1615 as an example of the fortification of an "irregular place situated on a riverside" (sic).

Within the period 1593-1604 falls further Stevin's project for an *Instructie voor de Ingenieursschool te Leiden* (Instruction for the Leyden School for Engineers), dated January 9th 1600. The text of this instruction, which has been printed both in *Bouwstoffen voor de Geschiedenis der Wis- en Natuurkundige Wetenschappen in de Nederlanden*, by D. Bierens de Haan (1878); as well as in *Bronnen tot de Geschiedenis der Leidsche Universiteit*, compiled by P. C. Molhuysen, Vol. 1, 1913 (*Rijks Geschiedkundige Publicatiën* 20); and which, as such, clearly betrays Stevin's style and choice of words, does not exist anymore in the original.

In the resolutions of the Governors of the University of January 10th, 1600 it is recorded that Prince Maurice had approved "that at the University lectures on arithmetic and surveying were to be held in good Dutch language, chiefly with a view to benefit those, who intend to become engineers", where by "engineers" are only meant the fortification-engineers, whose study and training had been fully regulated in the aforementioned instruction⁵⁴).

About Stevin's military activities and advice during the period 1604-1620, starting from his appointment as a quartermaster, we are better informed than about the period dealt with before.

Up to now the following items are practically common knowledge:

1. his activities in relation to the new fortifications at *Flushing* in 1607/08.
2. his joining the expedition to *Gulik* (Juliers) in 1610.
3. his advice concerning the castle (and the town) of *Batavia* (Djakarta).
4. his project for the fortification of *The Hague*.

We are giving below a further explanation.

Ad 1. FLUSHING.

From 1609-1614, by order of Prince Maurice, the Eastern- or Dockharbour was being dug by using the former ditch of the fortress. For this purpose the land-side of the town was first extended and surrounded by a regular new enceinte, provided with six bastions at distances of 80 rods from each other, from the Middelburg gate eastwards round about to the sea-dike. From the map suppl. no. 1 occurring in H. P. Winkelman's *Geschiedkundige plaatsbeschrijving van Vlissingen* (1873) it appears that tenders had been invited for this extension on June 19, 1609. This new enceinte or "the new works of walls and ditches, that have been made at Flushing", as mentioned in Stevin's *New Manner of Fortification*, p. 52, have undoubtedly been designed by Stevin himself.

As appears from the municipal account of May 1, 1607 until the end of April 1608 expenses were paid viz.:

⁵³) About the co-operation of Stevin and Marolois, "hun de Mathematische conste ten besten verstaende" (who have an excellent knowledge of the art of mathematics), cf. the article by de Waard about Marolois in *Nieuw Nederl. Biografisch Woordenboek*, taken from the *Resolutions of the States General* over the years 1612-1619.

⁵⁴) Dijksterhuis p. 14; Hoefler: *Mededeelingen omtrent het onderwijs in de versterkingskunst aan onze hooge en illustre scholen* (Bijdr. *Vad. Geschiedenis en Oudheidkunde* 1928) and *De Ingenieur*, 14 Dec. 1934, A-437: *Iets over de oudste ingenieursopleiding in ons land*.

"to William van de Wege, landlord in the Arms of Brittany, about the amount spent at his house by Bailliu, BBr.s. and S. and Mr. Sijmon Stevin since May 15, 1607 until the last day of April 1608 111-5-4 Flemish pounds" ⁵⁵⁾ and according to the account dated May 1, 1609 until the end of April 1610:

"to Joos Janssen en Jasper de Souter, stewards, about the amount to be paid for the banquet, reception in state and the festivities in honour of His Excellency, when he came to this town for the inspection of the new works, 288-6-5 Flemish pounds" ⁵⁶⁾

The last mentioned item apparently refers to Prince Maurice's visit after the fortifications had been completed. Also in later days Stevin has interested himself in these fortifications, viz. when, in his *New Manner* of 1617, he had published a project about them for the improvement of the hydraulic engineering. This project was never carried out and his sceptical words in the text: "t mocht zijn dat icker verloren arbeit in dede" (it may be that it was labour lost) could point to the fact, that Stevin himself doubted its possible realization ⁵⁷⁾.

Ad 2. JULIERS (Gulik).

The Dutch war-historians have not written much about the particulars concerning the military expedition round about Juliers (brought about by a cause of hereditary succession) which might be attributed to the fact, that here there was an active army of international constitution (French, English, Scottish, German and Dutch troops) and that its most important feat of arms, the siege of the principal town of *Juliers*, took place outside our frontiers.

Nevertheless Prince Maurice, who was commander-in-chief of a military force about 20,000 strong, earned new fame by the quick manner in which he managed to capture this strong fortress ⁵⁸⁾.

After the army on July 14, 1610 had been inspected at Schenkenschans, it appeared before Juliers on July 30th; on August 15th all the outworks were in the hands of the Prince and already on August 31st, when the besiegers had crossed the ditch with their galleries and the breach-batteries, consisting of 30 guns, held themselves ready for action, negotiations were opened for the surrender of the town and the castle, which took place on September 2nd.

We find a ground-plan of this siege in *Korte beschrijvinge en afbeeldinge van de generale regelen der Fortificatie* (1624) by Hendrick Hondius and already Marolois in his book of 1615 gives not only representations of the fortress and its outworks, but also illustrates the army camp together with details of its various camp-sections such as the Prince's quarters and those of the officers, troops etc.

In his *Castrametatio* of 1617 Stevin also gives representations of the lay-out of the army camp, showing only slight differences from those by Marolois. Yet

⁵⁵⁾ "Aen guillame van de Wege waert in 't wapen van bretagne over Soo veele ten sijnen huijse bij Bailliu, BBr.s. ende S. en monsieur Sijmon Steven tsedert den 15 meij 1607 tot den lesten april 1608 is verteert 111-5-4. Pond Vlaems."

⁵⁶⁾ "Aen Joos Janssen en Jasper de Souter, hoffmrs. over zoo veele het bancquet gecost heeft in 't inhaelen ende festieren van zijne Exctie doen hij binnen deeser stad quam omme de nieuwe werken te visiteeren, 288-6-5.P.Vls."

⁵⁷⁾ Cf. *Oudheidkundig Jaarboek*, 6th issue, March 1937, p. 14; on p. 13, sixth line from the bottom one should read: 1607 and 1609 instead of 1609 and 1613.

⁵⁸⁾ Cf. inter alia J. Bosscha, *Neerland's Heldendaden te land* (Revised edition) Vol. I, p. 319; F. J. G. ten Raa and F. de Bas, *Het Staatse Leger*, Vol. III, Breda 1915, pp. 9-19.

in his book he has more fullness of detail and is also more accurate as to the distribution and strength of the troops ⁵⁹). We shall further revert to this subject in Part 2, but we should like to point out already what Stevin has written on p. 34/35 about the mapping out of the army-quarters on paper, by way of a jig-saw puzzle:

"I shall now come to the drawing on paper, taking as an example the drawing made of the army camp before Juliers, where after having inspected the camp-site, His Princely Grace decided to lodge the Cavalry and their waggons, and also the English and Scotch in the command of General Cecil, outside this camp, causing the paper quadrangles of these quarters to be omitted, the rest is then orderly arranged on the ruled paper as described above, and shown to His Princely Grace, who, after shifting them a little at his will, finally they were situated in the order as shown below" ⁶⁰).

Anyone, who proves to be so fully informed, must, in our opinion, have been present at this consultation. This is confirmed by the MS 1-A-750 in the library of the War Ministry, which has often been quoted, in which the battle-array at Schenkenschans is stated and in which Stevin figures as one of the three "Quartermasters-General" ⁶¹). Stevin himself does not mention his attendance, but in other of his writings it clearly comes to light, that he must have had full knowledge about the state of affairs at the fortress of Juliers during the siege ⁶²).

Ad 3. BATAVIA (Djakarta).

Stevin's part in the general conception of the new castle of Batavia, the building of which the Governor General Jan Pietersz. Coen decided on July 2, 1619, is shown from Coen's correspondence (published by H. T. Colenbrander) with the "Heeren XVII", the Trustees of the United East India Company ⁶³). By a letter dated April 10, 1618, the Board of Trustees, in consultation with Prince Maurice, instructed Coen to build a square bastioned fortress, where the provisional fortifications had been carried out, leaving it up to him to decide its dimensions. The instruction ran as follows:

"Upon further consult with his princely Excellence it has been considered best that only one square is to be built, like the one of the castle of Juliers, its dimensions to be determined by Your Honours and the Board of Trustees as will be required to provide accommodation (apart from the necessary ware-houses and

⁵⁹) Marolois always mentions the siege of 1611, which error has been adopted by Wijn on p. 410.

⁶⁰) "... ic zal nu komen totte teyckening op pampier, nemende tot voorbeeld de teyckening dieder ghedaen wiert om het Legher voor Gulich, alwaer de plaets int veldt bezichtigt wesende, Syn Vorstelicke Ghenade nam besluyt vande Ruyterie, mette waghens, ooc mette Enghelschen en Schotten, onder den Generael Cecil, buyten dit Legher te logieren, zulcx dat de pampiere vierhoeckkens van die quartieren daer uyt gelaten zijnde, zoo wiert de rest op 't bovenschreven gheregelt pampier in oorden gheleyt, en aen Syn Vorstelicke Ghenade vertoont, welcke die wat verlegghende na syn goetduncken, sy laghen voor besluyt in oorden als hier onder."

⁶¹) In MS. 1 A-750 in the Library of the War Ministry we find in the first part on p. 5 under "Officiers van't Legher": Quartermasters General Monss.: Stevin, Thijs (Livinus Chijs), Solem. Cf. also *Het Staatliche Leger* Vol. III, p. 14.

⁶²) MS Royal Library 128A-9-II, pp. 41, 44, 45 (*Belegeren van steden en stercken*).

⁶³) H. T. Colenbrander, *Jan Pietersz. Coen, Bescheiden omtrent zijn bedrijf in Indië*, 7 volumes (The Hague, 1919-1953). The letters quoted occur in Vol. I, pp. 491, 503 and in Vol. IV, p. 402: *Ontwerp van Simon Stevin* (project by Simon Stevin). Dijksterhuis' quotation on p. 16, note 8 is taken from Vol. VI, p. 171.

stores) for 6 or 800 men, according to the project made by his Excellency's engineer Simon Stevinj. Together with this project he has also made a plan for a town but we are of the opinion that for the time being this need not be considered and that the castle as it is will suffice⁶⁴⁾.

Unfortunately Stevin's drawing, which had been enclosed, is not known anymore, yet we do believe that there is every possibility that Coen may have used it⁶⁵⁾. For, together with his letter of October 7, 1619, he has sent an outline of the new square bastioned fortress, the building of which had already begun as is shown by the following excerpt:

"After ample thought and deliberation what fortification was to be constructed, it has been actually decided to erect a new fortress measuring 50 square rods round about the old fortress The foundations of the land-bastion have just been marked out We enclose a project showing in what manner the work has been planned"⁶⁶⁾. This ground-plan has been preserved in the General State Archives, Inv. Leupe No. 1176; in which it has been clearly shown why the new fortress, later the Castle of Batavia, has been projected much larger than the old fortress of Jacatra; a part of it has been copied in *Oud Batavia*, Vol. I, pp. 44/45 (Batavia, 1922).

Indeed its actual dimensions were: 65 rods exterior- and 50 rods interior polygon (the last-mentioned measure was meant in Coen's letter)⁶⁷⁾ being not much smaller than that of the castle of Juliers, which Stevin had chosen as an example and which, as may be concluded from the above *ad 2.*, will have been familiar to him. According to the representation in Speckle's *Architectura*, the exterior polygon amounted to 1,080 "Schuh", corresponding to about 90 Rhineland rods⁶⁸⁾.

⁶⁴⁾ "By naerder conferentie met syne princelijcke Excellentie soo is voor best gevonden datter maer één quarré, gelijck als hetgene van het casteel van Gulick, soude gemaectt werden, soo groot als uwelieden ende de raden sullen noodich achten, omme daerinne, behalven de noodige packhuysen ende magasynen, 6 ofte 800 man te mogen logeren, volgens het project by den ingenieur van sijn Excelentie Simon Stevinj gestelt. Hij heeft daarby oock een ontwerp van eene stadt gemaectt doch wij achten dat het vooreerst niet en sal van nooden wesen daeraen noch te komen, maer dat het casteel alleene suffisant sal wesen"

About Stevin's general project for a fortified town, cf. *inter alia* Dijksterhuis, pp. 262, 263 (Town-planning).

⁶⁵⁾ That Coen is said to have returned Stevin's project for the castle at Batavia, as assumed by Mrs. J. van Leur-de Loos in *Tijdschrift voor Indische Taal-, Land- en Volkenkunde*, 1949, p. 195, does not, in our opinion, furnish adequate evidence; in this respect one should read very accurately Coen's letter of August 5, 1619 (Colenbrander Vol. I, p. 491) about the small fortress Jacatra and the new, larger fortress still to be built.

⁶⁶⁾ "Nadat ons lange bedocht en lange gedelibereert hadden wat versterckinge hier maecten soudon, is eygentlijcken goet gevonden een nieuw fort te beginnen groot 50 quadraet roeden buyten om het oude fort De fondamenten vande landtpunt hebben nu begost Bij deze gaat project hoe het werck gedissegniërt wort."

⁶⁷⁾ This is shown by the Resolution of the Governor General and Counsellors of August 14, 1619 (Colenbrander III, 530), in which it is "goet gevonden, datmen het voorgenomen nieuwe fort, sal voltrecken tot een quadraet fort, groot omtrent 50 roeden in 't viercant, mits dat vooreerst niet meer sullen beginnen dan de twee bolwercken en de gardijn aen de lantsyde." (approved that the new fortress, as projected will be erected as a square fortress measuring 50 square rods, lest for the time being the work should be restricted to the two bastions and the curtain on the landside).

⁶⁸⁾ In his *Art of Fortification*, p. 42, Stevin gives five measures for 1/4 foot: "ghetrocken uyt *Daniel Speckle*" (adopted from Daniel Speckle), ranging from 7 to 8 cm. Thus the "Schuh" varied from 0.28 to 0.32 m, the rod from 3.36 to 3.84 m.

Ad 4. THE HAGUE.

The project for a bastioned fortification of The Hague, which has never been carried out, is found in the municipal Record-Office as print no. 657 and owing to its regularity of design is said to date back to the beginning of the 17th century. Yet there is still a difference of opinion about its probable exact year of origin. However, as a much later copy mentions the year 1603, the former municipal keeper of the records, Dr. W. Moll, is of the opinion that the map can only date from the year 1614 or 1615, but he cannot explain why in those very days, right in the thick of the truce, they should have drafted this project ⁶⁹).

In our opinion we should consider the year 1603 more likely, because shortly before, in 1600, Prince Maurice must have had the intention "den Hage te beschantsen ende te retrancheren" (to fortify and entrench The Hague) ⁷⁰). It is also known that he had ordered some engineers to draft projects for that purpose ⁷¹). Vermeulen ⁷²) has been so much impressed by the regularity shown in the Hague project that it seems to him "that we have good grounds to consider this drawing to be one of Stevin's projects, who apparently had made it by order of Maurice". It is true, that when we compare the ground-plan of the new fortifications at *Flushing*, as discussed *ad 1.*, there is a marked similarity, yet this is no proof as long as we do not know of any instruction to Stevin by the Prince.

Apart from the four above-mentioned projects, however striking they are, yet not all of them equally important, further particulars on Stevin's activities were found up to now in the *Resolutions of the States General and the Council of State* during the period 1604-1620, apparently of a less conspicuous nature, but worth mentioning here. For the greater part we owe them to the compilation of the above-mentioned Resolutions of the States General in behalf of the R.G.P.: *Rijks Geschiedkundige Publicatiën* over the years 1602-1606 by Miss H. H. P. Rijperman, who has been so kind as to draw our attention to them. In chronological order we state as follows:

Resolution of the Council of State, February 14, 1604
(Determination of the standard rod)

Prince Maurice's proposal, that a certain standard measure should be set up and determined after which all fortification works, masonry, dikes etc. had to be "gemaect, gemeten ende geëstimeert" (set up, measured and estimated) had been adopted by the Council. As appears from the resolution the "mathematician Symon Stevin" was summoned to the meeting and charged to determine a rod according to the exact measure indicated by His Excellency, upon which Stevin produced this measure, being the Rhineland rod.

⁶⁹) *Jaarboek Ver. "Die Haghe"* of 1932, p. 32. Ibidem 1935, p. 39, where J.K. v. d. Haagen refers to the fact that in 1603 a sum of 30 pounds was paid to Hans van Groll, an engineer not mentioned elsewhere, for a project as meant above, made by order of the town-mayors (cf. *Oud-Holland* XXX, 1912, p. 108).

⁷⁰) *Journal by Anthonis Deyck*, Vol. II, 558 and *Resolutions of the States General*, March 30, 1600 (R.G.P. 85, pp. 15, 180, 181).

⁷¹) *Jaarboek Ver. "Die Haghe"* of 1924, pp. 1-18 and its supplement (Prince Maurice's letter of May 4, 1600 from the army camp at *Alem* to the States of Holland); cf. also note 69.

⁷²) F. A. J. Vermeulen, *Handboek tot de Geschiedenis der Nederlandsche Bouwkunst*, Vol. II, p. 433.

From this we may conclude that Maurice gave preference to the Rhineland measure; this will have been the rod used by Willebrordus Snellius in his measurement of a degree of latitude in 1621 and which in 1807 was found to represent a length of $12 \times 0.3139456 \text{ m}$ or 3.77 m .

In his *Art of Fortification* of 1594 Stevin still based himself on the Delft measure (see p. 129), by which the rod proved to be about $2\frac{1}{2} \text{ cm}$ smaller ⁷³).

Resolution of the States General, Sept. 18, 1604

(Conquest of the Land of Cadzand by Prince Maurice) (R.G.P. 101, p. 72)

Maurice asked whether the States had already passed a resolution about the fortification of Aardenburg and about the fortresses, that had been constructed on the dike of Coxie; and about the dike before Kadzand and the huts constructed there; the answer was, that the States had not yet adopted any resolution because Stevin had not yet submitted the "planten" (plans or projects) of the works.

From a resolution dated September 20th it appears, that in this matter the advice of His Excellency, the honourable Count William, and the engineers was followed. At the time all these people were present at Sluis, including the States General and the Council of State.

Here an important campaign was concerned, which had ended with the conquest of the town of Sluis on August 19th, comprising the whole of Western State-Flanders; this has been preceded by the capture of IJzendijke and Aardenburg on May 9th, respectively May 12th. Between these three towns there were several minor fortifications, inter alia the fortresses of Coxie, St. Cathalyne and St. Philippe, the improvements of which have been designed by Stevin, or at least judged on site ⁷⁴) by order of the Prince.

Resolution of the States General of June 9 and June 25, 1605.

(New fortifications at IJzendijke) (R.G.P. 101, pp. 265, 266, 271)

As it had already been decided in September 1604, that the ramparts of the fortress at IJzendijke were to be reinforced and its ditches widened (R.G.P. 101, pp. 73 and 74), Prince Maurice, who on May 12, 1605 together with Count William Louis had departed again to the army in Zealand, writes on June 7th to the States General about the new fortification of Ysendijke giving advice as to in what manner improvements could be carried out.

On June 9th the States wrote about it to the Deputies in the field and they replied on June 21st by sending a project of a large entrenchment, that Maurice wanted to be built to the North of the place. As appears from the drawing in the General State Archives, Stevin must have considered this plan for advice and must have submitted a project, that had been slightly improved.

The considerable importance of this extension, estimated at fl. 12,000.—,

⁷³) According to the length indicated for $1\frac{1}{4}$ foot: 7.80 cm , i.e. $12 \times 4 \times 0.0780 \text{ m} = 3.744 \text{ m}$ for the rod.

⁷⁴) By these fortresses are apparently meant the "nine fortresses", which are also mentioned further on in the *Resolutions*, viz. on p. 74, note 1 of the R.G.P., the building of which was highly appreciated by Maurice; it is true that he does not mention their names, but in Orlers and Van Haestens, *Den Nassauschen Laurencrans* (Leyden, 1610), p. 205, we find that the States "resolueerden te verstercken ende te maken 9 schansen, ligghende omtrent de Coxie, Cathaline, Oostborgh ende het huys te Weelde" (passed the Resolution to fortify and to build 9 redoubts lying round about Coxie, Cathaline, Oostborgh and the manor-house at Weelde. . .).

which has actually been carried out, is explained in this letter of June 21st; its object was viz.:

"in order to be able to carry out on all occasions and occurrence a good invasion into Flanders, while the port of Sluis could not be considered to render at all times equal facilities" ⁷⁵).

IJzendijke could provide a better access by water to the territory of the enemy and had therefore to be extended and fortified into "an invincible place, as large as a town, or like another Ostend" ⁷⁶).

Resolution of the States General of March 25, 1605
(Appointment of an Engineer) (R.G.P. 101, p. 392)

On March 25th Anthonis Adriaensz., son of Mr. Adriaen Anthonisz., Engineer, was appointed engineer through Stevin's recommendation in the service of his country on the same terms and conditions as his late brother.

This resolution as such is of a different nature than the previous one, but nevertheless very remarkable. On March 23rd "Master Stevin" had been requested to investigate whether the applicant had "gront, wetenschap ende courage" (aptitude, knowledge and courage) to follow the profession according to the requirements. But why did not they follow the more regular procedure, viz. a training at the Training College for Engineers at *Leyden*, for which Stevin himself, as we have seen, had drafted the regulations? ⁷⁷) Probably because here it concerned the appointment of one of the sons of the well-known Adriaen Anthonisz., master of fortification of the Republic and undoubtedly known to Stevin in person. Of the four sons, who had all inherited from their father the love of mathematical science and called themselves Metius ⁷⁸), it was Adriaan Metius (1571-1635), professor of mathematics and astronomy at the Franeker university, who was best known.

SUMMARY.

It is difficult, with the scarce data that have become known till now, to follow a certain line or trend in Stevin's practical military activities in the Stadtholder's service and in that of the States. It may be that, concerning his activities, there is still more to come to light from the existing archives: for instance so far those of the Council of State have never been completely investigated. This chiefly

⁷⁵) "Om bij alle gelegentheyt ende occurrentie . . . een bequame descente in Vlaenderen te moegen doen, terwijl die haven van Sluys tot allen tijden daertoe zoo bequaem nyet en wordt geëstimeert."

⁷⁶) Orlers and Van Haestens, p. 205 (Continuation of the quotation in note 74).

⁷⁷) Dijksterhuis points out a few similar cases concerning surveyors, on p. 17, note 3.

⁷⁸) The name Metius has presumably been derived from "meta", the latin word for rick of hay; it is known that Anthonis Adriaensz. and his brother Dirck, deceased in 1599, had both occasionally adopted the name Schelven, probably after their mother (communicated by Dr. A. L. van Schelven).

Adriaan Metius writes at the end of his book *Fortificatie ofte Sterckten-Bouwinghe* (Franeker, 1626): "Wydcers wat forme van Puncten ofte Bolwercken de bequaemste zijn, can hier over lesen *partem quintam Geomet. nostrae de munitionibus*, ofte so indien den Leser het Latijn niet verstonde, mach over dese questien Simon Stevijn, Daniel Spekele ofte andere Ervaren Schryvers naersien." ("Further as to what form of Points or Bulwarks would be most suited to the purpose can be read in *partem quintam Geomet. nostrae de munitionibus*, or, if the Reader should not understand Latin he may look up about these questions Simon Stevijn, Daniel Spekele or other Experienced Authors").

concerns his work as a surveyor of army camps or quartermaster-general, the office he has actually held. Jan Frederik Helmers has not unjustly written the following lines in *De Hollandsche Natie* of 1812 (5th hymn, p. 151):

"Hier staat Stevin ter zij van Neêrlands grootste held,
Daar hij het Statenheir op zijnen hoefslag stelt"
(Here stands Stevin next to Holland's greatest hero,
As he puts the States Army on its track)

Stevin has become better known as a scientific adviser, in the first place to Prince Maurice and occasionally to the States General or the Council of State. Yet Maurice consulted him more for *mathematical advice* and in his mathematical studies than in his campaigns and sieges. Nevertheless he must often have been accompanied by Stevin, for this could only benefit their mutual scientific work.

The expeditions to Flanders in 1604 and to Juliers in 1610, and presumably also the one to Rees in 1614 ⁷⁹) are proof of this, although at Juliers Stevin acted also as a "legermeter" (surveyor of army camps).

The "mathematician" is sent to Harderwijk with a commission in fortress engineering, but the Prince, in the field in Guelders, insists upon his speedy return!

In the domain of town fortification however, he is not the first man; Adriaan Anthonisz., David van Orliens and several other engineers are more often consulted than Stevin by the States General and the Council of State. At Flushing he presumably excelled more as a hydraulic engineer than as an engineer in the art of fortification.

In matters of general advice and commissarial work he often finds Samuel Marolois or Marlo, the learned mathematician, at his side; the latter proved himself to be a writer on the art of war, but remains, in our opinion, far beneath Stevin, who — and this is provisionally our concluding judgement — has been of greater significance to the military science of his time by his military writings than by his activities in the theatre of war.

⁷⁹) Concerning Rees cf. sub 2 on p. 15 hereinbefore.

1

DE STERCTENBOUWING

THE ART OF FORTIFICATION



INTRODUCTION

1. NATURE, LAY-OUT AND ORIGIN OF THE WORK

In continuation of what was observed on Stevin's books in the General Introduction to this volume, it should first of all be pointed out that Stevin's *Art of Fortification* of 1594 is to be regarded as a text-book. In *The Argument* he already addresses "the pupil", but he teaches not only the theory, but also the practice of building fortresses, just as his contemporaries and followers do¹⁾. However, he surpasses them in clarity, even though his argumentation is long-winded, thus demanding the continuous attention of the modern reader, who is not accustomed to great verbosity. Stevin understood better than Speckle and Marolois that he wrote for simple people, and not for learned men. Therefore, not only did he use the vernacular²⁾, but he also did his best to give his book a methodical lay-out, which is even announced in the Dedication, *The Argument* and the associated table.

This lay-out appears to have been worked out as follows in 7 chapters:

1. Enumeration and explanation of 21 "definitions", viz. the principal technical terms for the art of fortification of his time.
- 2-4. Explanation of the construction and building, in theory and practice, of regular fortresses, with the bastioned hexagon as the easiest example and subsequently of other regular polygons, viz. the 5-, 7-, 8-, 9-, and 10-angle³⁾.
5. The main principles underlying the object of building fortresses; and finally:
- 6 and 7. A large number of considerations, called "differences", prevailing at the time among builders of fortresses on important problems in their art of building regular and irregular fortresses, respectively.

The instructive nature of the book comes to the fore particularly in Chapter 1, but also in Chapters 2 to 4, which together comprise 28 pages. Stevin discusses his system, both geometrically and architecturally in a lucid way, as if teaching in

¹⁾ Lazard (*Vauban*, pp. 11, 15, 23-26) mentions the works of Stevin's contemporaries: Jean Errard de Bar-le-Duc (1594) and Antoine de Ville (1617, 1628) and those of his followers Pagan (1645) and Mallet (1671) under the "ouvrages didactiques sur la fortification". Also Marolois, in his book (1st edition of 1615) teaches fortification, which for him mainly consists in teaching how to solve mathematical problems.

²⁾ See the opening words of the Dedication to Hendrick van Brienon, the remark at the end of the 9th Definition and the one at the end of Chapter 1, as well as the sharp reprimand of the "Dutch" on p. 215.

³⁾ To keep his argumentation simple, he avoids giving mathematical calculations, but mentions only the results (see p. 107, in connection with p. 95).

front of a class. Chapters 6 and 7, which together comprise more than 50 pages of the book, are destined rather for further study of the pupil⁴).

Between this first tuition and the opportunity for further development the brief 5th Chapter is somewhat out of the picture; however, it is in no way superfluous, giving, as Stevin says, "the scope of this treatise," to wit an explanation of the art of building fortresses under three main headings, viz. the mutual flanking of the parts, blunt angles of the bastions and application of the regular polygon with as many sides as possible⁵).

One would rather have this chapter 5 printed more towards the beginning of the book, but it is also very well understandable that the author first wanted to introduce the pupil to the subject-matter, in order that he might more easily grasp the aim of the art taught to him. Other authors do not work so systematically. It would carry us too far, however, to explain here the much less logical lay-out of the works of Speckle, Marolois, de Ville and others; only Freitag (1630) is an exception⁶).

Daniël Speckle's *Architectura von Vestungen* of 1589 in particular must have served as an example to Stevin as regards the system of fortification developed by him. Like Speckle himself, however, he has, according to his own quotations, also followed the systems of the Italian engineers.

With respect to the further aspects of Stevin's art of fortification (as a system), to learn more about the details, and of what he borrowed from his predecessors, to elucidate the original text of his book and to supplement the notes given by us, it is recommended that the studies of his compatriots Brialmont and Wauwermans be consulted: they are both styled by Henri Bosmans as "hommes de métier, dont personne ne niera la compétence"⁷). Both speak highly of Stevin's military work; Brialmont, whose excellent study of 1846 we cited already⁸), attributes to Stevin the decision to save with his book his compatriot engineers from their error, which

⁴) On p. 5 of his *Architectura militaris* of 1630 Adam Freitag mentions Stevin and "Barleduc" (Errard) as having extensively written on the sites for building fortresses, namely "zur Disputation". The English translator of the Art of Fortification speaks a few times of a "Controversy" (dispute or difference).

⁵) Here Stevin actually defines the main technical and military principles of building fortresses, whereas his contemporaries and followers in their "Maxims" or "Rules" sum up all kinds of details which relate rather to the mathematical aspect of the matter.

⁶) Also the—obviously—didactic manuscripts of Franciscus van Schooten, professor of fortification (and mathematics) at Leyden from 1612 till 1646 and of his sons Frans (professor from 1646 till 1660) and Petrus (professor from 1664 till 1679) (see F. A. Hoefer, in *Bijdragen voor Vaderlandse Geschiedenis & Oudheidkunde*, 1928, pp. 205-242) resemble, as regards lay-out, Stevin's book. According to Jähns (*Gesch. d. Kriegswissensch.* II, 1105) the former has been a pupil of Stevin, but in his description of the regular fortresses it appears that he follows the regulations of Marolois, of whose book he edited a French reprint in 1628 (published by "Guillaume Iansson Caesius" in Amsterdam). A drawback of Freitag's book is its many calculations and the large number of tables, as a result of which the art of building fortresses was completely schematized.

⁷) See *Biografie Nationale—de Belgique*, vol. 23, p. 909. In addition to Brialmont and Wauwermans one should consult: Allain Manesson Mallet (*Travaux de Mars*, 1671-2, vol. II, p. 113), Max Jähns (*Gesch. d. Kriegswissensch.*, 1889, vol. I, p. 839) and E. J. Dijksterhuis (*Simon Stevin*, 1943, pp. 222-234) for their summary of Stevin's system.

⁸) See pp. 5, 6 and 16 of the General Introduction.

in his opinion was that they wanted to make the primitive Dutch system with its temporary nature the only correct method of fortification⁹⁾.

The General of military engineers, H. Wauwermans, who wrote about Stevin in the years 1875-1885¹⁰⁾, gives a somewhat different view on the — in his opinion — mysterious origin of Stevin's *Art of Fortification*; he seeks the reason of the publication in the existence of a national Flemish school for the art of fortification, of which Stevin is said to have been the last representative and which is supposed to have been the transition from the Italian school with Tartaglia as the first author (1546) to the Dutch one, which began to flourish under Prince Maurice's Stadtholdership. Antwerp was, according to Wauwermans, the seat of this Flemish school, both as regards the architects (who seldom acted as authors because of the secrecy of the matter required during the war years) and the fortifications erected. Among the first he reckons for instance the Antwerp city-architect Peter Frans, his pupil Speckle (who twice visited the town) and Marcus Aurelius de Pasino, an architect from Ferrara, who in 1579 published with Plantijn's printing-office a book entitled: *Discours sur plusieurs points de l'Architecture de guerre, concernant la fortification tant ancienne que moderne, ensemble le moyen de bâtir et fortifier une place de laquelle les murailles ne pourront être aucunement endommagées de l'artillerie*.

Owing to the many points of agreement, all of which are mentioned by Wauwermans¹¹⁾, between this book and the *Art of Fortification* of 1594, he regards, and not unjustly, Pasino as Stevin's direct forerunner.

The proof that Stevin has consulted this as well as other authors on fortification and has also borrowed a few things from their works, is supplied by the *Art of Fortification* itself: one finds there quotations from the military writings of Tartaglia (1546), Macchiavelli (1521), de Pasino (1579), Castriotto-Maggi (1584), Theti (1589), Speckle (1589), Cataneo (1593) and some other less widely known authors. The fact that these and similar works were available to Stevin may also appear from the Catalogue of Prince Maurice's library. The

⁹⁾ This system of earthen, not revetted, bastions and walls dated back to the year 1531, when Count Henry III of Nassau started providing his town of Breda with such fortifications (see G. G. van der Hoeven, *Geschiedenis der Vesting Breda*, 1868, pp. 16 and 23, and Brialmont, *Oeuvres militaires de Simon Stevin*, p. 199, note 2, in which he erroneously mentions Frederic Henry, the later stadtholder). In this field there existed therefore already a tradition in the Netherlands.

¹⁰⁾ Wauwermans's articles important for Stevin's system and the building of fortresses in Flanders are:

La fortification de Nicolo Tartaglia (Revue belge d'art, de sciences & de technologie militaires, 1^{re} année 1876, tome IV, pp. 1-42);

L'architecture militaire flamande et italienne au XVI^e siècle (ibid. 3^e année, 1878, tome I, pp. 136-176, and also published already in the Bulletin de l'Académie d'Archéologie de Belgique of 1877);

De la démolition des fronts intérieurs des citadelles. Citadelles du Sud et du Nord d'Anvers, etc. (ibid., 4^e année, 1879, tome II, pp. 1-73);

Albert Dürer, son oeuvre militaire, son influence sur la fortification flamande (ibid., 5^e année, 1880, tome I, pp. 1-83);

Etude bibliographique sur la fortification de Jean van Schille (d'Anvers), Ingénieur et Géographe, 1573 (Bulletin van de Maatschappij der Antwerpsche bibliophilen, I, 1882);

Etude sur la bibliographie de l'Architecture militaire flamande au XVI^e siècle (ibid., III, 1885). (This study includes a discussion of de Pasino's work of 1579).

¹¹⁾ See note 10, the last-mentioned article.

manuscripts and books enumerated in it¹²⁾ include a manuscript and not Pasino's book, but unfortunately the manuscript is no longer present in the Royal Library at The Hague. A copy of the book is, however, available for instance in the University Library at Utrecht.

2. THE DEDICATION TO HENDRICK VAN BRIENEN

Stevin was well acquainted with this deputy of the States General¹³⁾ and was on friendly terms with him. It appears from the dedication, which is written in an intimate manner, that their friendship had grown up during their joint studies. It deals with the science and practice of building fortresses and defends the choice of the vernacular in the description of this matter.

This was done for the benefit, not only of soldiers, architects and other people interested not familiar with Italian and French, but also because in his opinion Dutch is so much better suitable for description. In this plea Stevin appeals to the authority of the Louvain professor Adrianus Romanus¹⁴⁾ and the Milanese mathematician Cardano¹⁵⁾.

He explains the dedication of his book to Van Brien en by an appeal to their joint study of mathematics¹⁶⁾, from which he kept his preference for the methodical lay-out of Euclid, while he has also learned not to confine himself to the former's *Elements* alone, but — at the example of Van Brien en — also to include the practical development of the mathematical theory in his writings. This standpoint, the combination of theory and practice, or, as Stevin calls it, of *spiegel en* and *daet*, occurs — as is known — in many of his works: such as *Problemata Geometrica* (ca. 1583) and *Practice of Measuring* (1605); *Arithmetic* and *Practice of Arithmetic* (1585)¹⁷⁾; *Art and Practice of Weighing* (1586).

In this respect the influence of the Guelders statesman has in our opinion therefore been certainly important.

3. THE ENGLISH TRANSLATION

The English translation of 1604, in manuscript form at the library of Trinity College at Cambridge¹⁸⁾ has, to the best of our knowledge, never been printed.

¹²⁾ The manuscripts and books from Prince Maurice's library which may have been consulted by Stevin for his book, are, according to the catalogue of this library composed by Abraham von Dohna in 1608: manuscripts of Adr. van Conflans (1593), M. Aurelio de Pasino and Winckelmans and books of Carlo Theti (1589), Daniel Speckle (1589) and Girolamo Cataneo (1593). See W.G.C. Byvanck, *De Oranje Nassau-boekerij*, etc., The Hague, 1898, p. 57.

¹³⁾ For Joncker Hendrick van Brien en, born ca. 1540, deceased 1620 and — to distinguish him from his namesake and compatriot — called "the eldest", see *Nw. Ned. Biogr. Wbk.* VII, 208. Besides being burgomaster of Harderwijk, where he lived already in 1563, he was a member of the nobility of the Veluwe, councillor of the Court of Gelderland and for many years deputy for Gelderland in the States General and in the Council of State; see also General Introduction, p. 17.

¹⁴⁾ For Adrianus Romanus or Adriaen van Roomen, see Dijksterhuis, *Simon Stevin*, p. 13.

¹⁵⁾ For Cardano, see inter alia D. J. Struik, *A concise History of Mathematics* (New York, 1948), p. 112.

¹⁶⁾ We do not have any further data on this joint study; thus, for example, we have no proof that van Brien en has studied at Leyden.

¹⁷⁾ See Dijksterhuis, *Simon Stevin*, p. 89.

¹⁸⁾ The existence of this manuscript came to our notice through Dijksterhuis's reference, l.c., p. 43.

This rare 106-page document, most of which in old writing¹⁹), has been found not to be serviceable for the interpretation of Stevin's original text for the non-Dutchmen. Except for our remarks on the qualities of the manuscript on the following page 36, we have made no use of it for the translation of the book.

The book has been translated not only into English, but also into French and German. The French translation of 1634 by Albert Girard, occurring in the *Oeuvres Mathématiques* (Work XIII) is presumably the only one, but is in any case the best known. It was used for instance by Mallet for the extract in his *Travaux de Mars* of 1671 (and was translated back into Dutch again by Smallegange in *Den arbeid van Mars* of 1672, 2nd part, pp. 113-122); afterwards also by Brialmont. Wauwermans, however, has consulted the original Dutch text²⁰). The German translator anticipated the French: as early as 1608 the first edition by Gothard Arthus of Danzig was published at Frankfort-on-the-Main; an "improved", but probably identical reprint, also as regards the dedication, appeared in 1623. Perhaps this early translation can be regarded as a result of the respect for the compatriot Speckle, who for Stevin was such an important predecessor and example? The French, it must be admitted, were not so much in need of Stevin's book: since 1594 or 1600 they possessed Errard's *Fortification*²¹).

The question why an English translation was so soon made, is not difficult to answer. For in 1604, the year which the manuscript bears, there were still a fair number of English troops in the service of the Republic²²); the siege of Ostend, in which also English commanders and engineers were involved, had just come to an end and until 1609 Britain was to keep the fortresses of Flushing and Brielle occupied as pawn towns²³). Likewise, it may appear from the *History of The Royal Engineers* that in those years and even earlier, the English themselves must have been acquainted with the art of fortification in

¹⁹) With the exception of the title page, the tabulated classification of the contents, the notes in the margin and the captions and legends of most of the figures, the entire manuscript has been written in old "Gothic" script.

²⁰) This appears from the quotations of fol. 71 and 83 of the *Art of Fortification* in Wauwerman's article: *Etude sur la bibliographie de l'Architecture militaire flamande* (see note 10). Merkes (*Inleiding beoef. vestingbouw*, 1825) did know Mallet's extract of the *Art of Fortification*, but not the original work. Neither has this been mentioned in the—in other respects excellent—work of M. J. D. Cockle, *A Bibliography of Military Books up to 1642* (London, 1900), which does refer to *de Nieuwe Maniere* and *Castrametatio*. This omission had not been necessary, for in H. F. Rumpf's *Allgemeine Literatur der Kriegswissenschaften* (Berlin, 1824), called by the author in the Preface to his work, p. xi, "the best known of the German bibliographies" and therefore presumably used by him as source material, one does find the *Art of Fortification*, not, it is true, the first edition of 1594, but the Dutch edition of 1624, in addition to the German quarto editions of 1608 and 1623, as well as the folio edition of 1623, unknown to us so far.

²¹) Although the privilege of the first edition dates from 1594, it seems that Errard's work was not printed before 1600. In 1604 two new editions were published, one in Paris and one at Frankfort-on-Main, as well as a German translation. Neither Jähns (*Gesch. d. Kriegswissensch.* p. 833), nor Lazard (*Vauban*, p. 11), from which authors the above has been derived, mention the French folio edition at Frankfort-on-Main of 1617, a copy of which is present in the Thysius library at Leyden. For Errard's book see also Cockle's *Bibliography*, pp. 207-8.

²²) For the regiments of Englishmen (and Scots) who served in the Republic until 1609, see *Het Staatse Leger*, I, pp. 263-267 and II, pp. 158-163. For the Scots see especially also: James Ferguson, *Papers illustrating the history of the Scots Brigade in the service of the United Netherlands* 1572-1782. Vol. I (1572-1697), Edinburgh, 1899.

²³) For the pawn towns, see *Het Staatse Leger*, II, p. 281.

the style of the Italians and their followers Stevin and Speckle²⁴). To this testifies not only the old town plan of Berwick, possibly the only town in England which has kept its bastioned fortifications, but also the above-mentioned *History*, which in addition to important data on the construction of these fortresses in the years 1559 to 1563 contains the names of English engineers who were contemporaries of Stevin. Among them is captain John Paperill, who served as an engineer in the siege of Ostend in 1601-3 and in that of Juliers in 1610²⁵). In addition to this engineer, his compatriot Raeff Dexter is especially known, and is praised by the authors of the former siege as "the best and most daring of all among the engineers"²⁶). Could not either of these two, after returning home, influenced by what they had experienced in the besieged fortress, have taken the initiative for the translation which has all the features of having been made by an expert?²⁷

Not only has this engineer translated the Dutch text which was clear to him into English, but — apart from minor licences in style and choice of words which, naturally, he could permit himself — he also made improvements, among other things by curtailing Stevin's argumentation. The principal of these is no doubt the extra picture of Stevin's bastion included as 9th figure²⁸), "added by the Translator for the better expressing of the authors meaning". It would seem to us that there was reason for this; in any case, it made for easier reading of the book.

The translation of 1604 does not include the aforementioned Dedication of the book to Hendrik van Brienen, the note at the end of Chapter 1, on folios 6 and 7, and the "Conclusion" on folio 91.

4. APPRECIATION OF STEVIN'S ART OF FORTIFICATION

To conclude this introduction we wish to emphasize two points.

1. For the time in which it was written *The Art of Fortification* was a model of a description of main principles and construction, as well as of the special requirements fortresses have to meet. Apart from the lengthy style, with which

²⁴) See Whitworth Porter, *History of the Corps of Royal Engineers*, Vol. I (London 1889), especially pp. 29-33 (Berwick) and pp. 41-61 (Engineers in the 17th century). For this matter and for Berwick see also: B. H. St. J. O'Neill, *Castles and Cannon, A study of Early Artillery Fortifications in England* (Oxford, 1960), which on page 69 mentions as first English author on bastioned fortifications Peter Whitehorne, whose book appeared in 1562. As appears even better from Cockle's *Bibliography* (p. 11, no. 13) Whitehorne has, besides other subjects, described and depicted in his book: "Figures of certaine new plattes for fortification of Townes", which, however, according to O'Neill, he is said to have "reproduced without acknowledgement, but with minute variations of detail" of those in the book of the Italian Zanchi of 1554. As argued by Cockle (under no. 767), Zanchi was "certainly the first Italian to write exclusively on the new system of fortifying cities" and O'Neill apparently agrees with him. However, we know already from the first publication of Wauermans mentioned in note 10 and from Max Jähns's before-mentioned work (pp. 597 and 797) that as early as 1546 Tartaglia devoted the 6th book of his *Quesiti et inventioni diverse* completely to the new style of fortification. Stevin quoted him when discussing the dimensions and measures of fortifications (Chapter 6, 1st Difference, of *The Art of Fortification*).

²⁵) cf. Porter, l.c., Vol. I, p. 44.

²⁶) cf. C. A. van Sypesteijn, *Het merkwaardige beleg van Ostende* (The Hague, 1887), p. 73 and *Het Staatse Leger*, II, pp. 276, 279, 414.

²⁷) For the engineer Robert Norton, who translated Stevin's work *De Thiende* in 1608, see Vol. IIA, p. 387 and Porter, l.c. Vol. I, p. 44.

²⁸) See p. 101. — The flanking embrasures in the orillions and the cavalier in this 9th figure are not all mentioned by Stevin and are therefore—at least in part—for account of the translator.

the reader first had to make himself familiar, but which for a patient and diligent pupil also had its advantages, there is not even at the present time a work so complete and clear as this book. The technical military subject matter is treated as it should be, systematically, mentioning the correct definitions, dimensions and principles first, and explaining the deviations from the most perfect form by appealing to the special conditions. It is therefore not surprising that the book attracted attention among Stevin's contemporaries abroad.

2. Of the great financial consequences which his system could not but involve, Stevin — when he wrote his book — had no idea; he restricted himself to giving the best that could technically be achieved in his time and that was to be considered scientifically necessary. We must therefore not blame Stevin for the fact that his art of building fortresses as such has not been put into practice, yea that a system much simpler and inferior, militarily and technically to his was introduced — or rather further developed²⁹⁾ — under the names of Marolois and Freitag. Indeed, the financial means of the Republic were only just sufficient to apply this very inferior system for the many fortresses that had to be built or improved in those years. Prince Maurice will certainly have realized that the design according to Stevin's system with its double walls, revetments, very large bastions and three-fold flanks would have made financially impossible demands. Only a century later this system, though of course in a somewhat modified form, was to find application, as appears from the fortresses built under the supervision of Vauban and Coehorn and their contemporaries. Those who argue that Stevin with his *Art of Fortification* has failed to exercise any influence, therefore go too far. As Brialmont rightly remarks against this opinion, one might as well say that great fortress-engineers such as Speckle, Coehorn, Montalembert and Carnot "ont manqué d'influence"³⁰⁾.

We can add that Stevin's many fortress-engineering recommendations to Prince Maurice and the States General will certainly not have failed to have their effect.

²⁹⁾ This development consisted particularly in the application of larger bastions—with better mutual flanking—than had been used before, which development started round about 1595. Neither were these bastions provided with retired flanks and casemates, nor were the intermediate curtains any longer made re-entering, but perfectly straight. Finally the land fronts of the fortresses came to be provided with a lower wall or *fausse-braye*. The Old-Dutch system thus developed was therefore better than the one applied before and this development may have been promoted by Stevin, although it certainly was not up to the norms laid down in his book. A noteworthy fact is in any case that many fortifications had already been built in accordance with this improved system, before Marolois and Freitag published their books in 1615 and 1630, respectively (Cf. also Dijksterhuis, *Simon Stevin*, p. 223, note 1, on the two periods in the Old-Dutch style, one before and one after Stevin).

³⁰⁾ See Brialmont, *Oeuvres militaires de Simon Stevin*, p. 119.

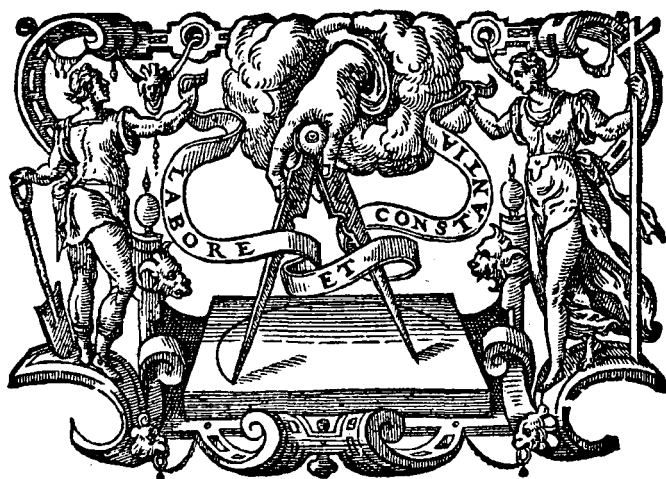
D E
STERCTENBOVWING,

Beschreuen

door

SIMON STEVIN

van Brugghe.



TOT LEYDEN,
By François van Ravelenghien.
c15. 15. xCIV.

SIMON STEVIN

wenscht

D E N E D E L E N

Erntfesten, Hoochgheleerden

Ioncker HENDRICK van BRIENEN,

ghedeputeerde van wegen des Vorstendoms van

Gelderlant, ter vergaderinge vande Heeren

Generale Staten, veel ghelucx.



E sterckten deses tijts, welckemen sterckten
noemen mach, te weten die door * *wisconsich* Mathematici-
cani Operatio-
nem iatus vi-
sualibus.
beleyt, met sichtsralen opt meeste voordeel
gheteykent worden, sijn inde Italiaensche
ende Françoische spraken soo overvloedelick
beschreven, dat ymant dencken mocht daer
af ghenouch ghedaen te wesen: Doch twee merckelicke redenen
hebben my beweeght derghelijcke oock in onse tael te doen. Ten
eersten, om daer mede te gherieven veel Nederduytschen in die
spraken onervaren, als Kriegsluyden, * Boumeesters, ende ander Architectis.
tot wetenschap van dien belusticht, waer uijt volghen can, niet
alleen vernomminghe van soodanighe besonder persoonen, maer
oock * daden streckende tot dienst des ghemeene Landts. Ten Effecta.
tweeden, om dat onse tael het selve (ghelijc oock alle * stof daer Materialem
swaricheyt in ghelegghen is) veel beter uijtbeelden, ende gront-
licker verclaren can als eenighe ander. Van welck ghevoelen

SIMON STEVIN WISHES THE NOBLE HONOURABLE
AND LEARNED LORD HENDRICK VAN BRIENEN,
DEPUTY OF THE PRINCIPALITY OF GELDERLANT AT
THE MEETING OF THE STATES GENERAL, MUCH
HAPPINESS

The fortresses of the present time that deserve to be called fortresses, to wit, those which are drawn most advantageously by mathematical methods, with auxiliary lines, have been described so amply in the Italian and French languages that one might think that enough has been done in this respect. But two notable reasons have induced me to do the same also in our language. In the first place in order to oblige therewith many Dutch people who are not conversant with those languages, such as soldiers, architects, and others desirous of knowledge of this science, which may result not only in the satisfaction of such special persons, but also in actions tending to serve the common country. Secondly, because our language is capable of expressing it (as well as any subject matter of a difficult kind) much better and explaining it more thoroughly than any other, a view which also seems to be held by the learned Mr. Adriaen van Roomen, Mathematician,

Mathemati-
cus, Medicus,
Rector Uni-
versitatis.
Mathematico
tractatu de
Quadratura
circuli

Autoritas.

Methodi.

Mathematicis.

Materia.

den hooghgeleerden H. Adriaen van Roomen, *Wisconsnaer,
Gheneser, ende Rector der Ghemeenschool tot Leuven, niet
en schijnt te verschillen, wijt seker *Wisconsfighen handel, die
hy vande *viercantinghe des rondts, onlanx in Duytsch heeft
laten wijtgaen, in Duytsch segh ick, datmen soo wel Duytsch
mach heeten, als men de stof Wisconsstich mach noemen: T welck
nadiert ettelicke gheleerden seer wel bevalt, ende dat daer be-
nevens Cardanus des Duytsch wonderlike gheluckighe t'saem-
voughinghe, onder de naturens vreemdicheden stelt, Libro
de subtilitate 11. (Wie soude van een Milanois verwacht
hebben?) soo schynt mijn meyning ghenouchsaem in reden ghe-
gront, ghemerckt de *achtbaerheyt van sulcke, billichlick voor
ghewichtigher te houden is, dan van duysent leecke schampers,
met noch duysent daer toe, die hun selven laten voorstaen meer
dan leecken te wesen.

Ick dan ant mi, verstant van soodanighe my niet stootende,
en heb mijn voornemen daerom niet achterghelaten maer de be-
scrijinghe deser stof by een vergaert, in sulcker form als die
V. E. hier toegeheeyghent wort: Totiet welcke my twee beson-
der redenen bewegen, d'eene, om voorbeeld te toonen des *Oir-
dens die ick van V. E. doen sy haer met my inde *Wiscon-
sten oeffende, gheleert heb, alwaer ick sach dat sy haer selven
een manier voorstelde, welcke niet teghenstaende de *stof diens
wetenschap ghy begheerdet u onbekent was, ick nochtans met-
ter daet merckte tot goede voortganck der leering te stree-
ken, ende in nateurlike redenen ghegront te wesen: V. E. hiel-
det daer voor, dat de Aristotelisten bestelick ghenouch vande
Oirden streden, maer metter daet weynich Oirdens ghebruyck-
ten: Dat Ramus meining van dies tot een goet einde streckte,
doch

Physician, and Rector of the University at Louvain, as appears from a mathematical treatise which he has recently published in Dutch on the squaring of the circle; I say in Dutch, which deserves to be called Dutch just as the subject matter may be called mathematical. And since this is very much to the liking of various scholars, while moreover Cardanus mentions the wonderfully felicitous composition of Dutch among the wonders of nature, *Libro de subtilitate* II (who would have expected it of a Milanese?), my opinion seems to be founded on sufficiently good grounds, since the respectability of such men is reasonably to be considered more weighty than that of a thousand unlearned scoffers, with a thousand others who pretend to be more than unlearned people.

Therefore, without taking offence at the lack of understanding of such people, I have not abandoned my intention on this account, but have collected the description of this subject matter in such a form as it is here dedicated to Your Honour. To this I was induced by two special reasons, the one being to give an example of the Method which I learned from Your Honour when you studied Mathematics along with me, when I saw that you had in your mind a method which, notwithstanding the fact that the subject matter with which you wanted to become acquainted was unknown to you, I nevertheless perceived indeed tended to good progress in learning and was founded on natural reasons. You held that the Aristotelians disputed violently enough about Method, but in practice used little method; that Ramus' opinion on this matter tended to produce good results,

doch volghdet ghy noch dijn eyghen sin. Ick ondertusschen overweghende uwe redenen, teghen schriften en woorden van anderen, ende daerdeur leerende dat ick niet en wiste, viel eintlick int vermoeden, my des Oirdens eyghenschap ende wesen grontlick bekent te sijn, ende dat (na leerlinghens ghemeenen aert) met sulcken versekertheyt, dat ick oock mijns selfs hooft betrouwende, hebbe my Euclides (die ick acht int stuck des Oirdens, onder de ouden wat besonders te wesen) in ettelicke punten wel laten bevalen, ende eintlic in verscheyden stoffen een voortganck ghevolcht, soodanighe als dit voorbeelt uijswijst: welcke, hoewel ick vermoede datse V. E. niet in alles behaghen en sal, overmits verscheyden personen in sulcx ghemeenelick tot eenich verschil gheneghen sijn, doch achte ick datse daer in sal mercken, eenighe pylen uijt haren koker ghekommen.

Dander reden is, dat V. E. den ghenen die hun niet dan in Euclidische * beghinselen en oeffenen, sonder tot de * daet te com-
men, Spieghelechtsers noemde, die haer schaduwte heftelick be-
strijden sonder gheraken: welcke manier V. E. niet volghende, dede maken verscheyden * reetschappen noodich tot de daet,
als om door t'ghesicht * onghenakelicke langden te meten, Gront-
teyckening ~~van~~ van sterckten opt velt te beworpen, en dier ghe-
lijcke, doende sulcx al self metter handt, ende meer soude ghedaen
hebben, hadde sy niet tot grooter ende nootlicker saken, te we-
ten der Regieringhe, ghedronghen gheweest. Nu hoewel mijn
meyning altijt was, dat der * Spieghelechtsers spieghelechtsen, tot
voordering van der * Doenders daden comen strecken: Noch-
tans om mette sicke te bewijzen, hoe my V. E. ghevoelen van-
de vermenghinghe deser twee bevalt, ende dat ick niet en be-
gheer datse my onder de eenvoudighe Spieghelechtsers rekent, soo
heb

Elementis.
Praxin.

Instrumenta.
Distantias in-
accessibiles.

Theoricorum
theoriz.
Practicorum
effecta.

but all the same you followed your own way. Meanwhile considering your arguments against the writings and words of others and learning thus what I did not know, I at last began to suppose I was thoroughly acquainted with the properties and nature of the Method, and such (as is common with pupils) with such assurance that, also trusting my own brains, I found Euclid (whom I consider to stand out specially among the Ancients in the matter of Method) much to my liking on several points, and finally in different matters followed a course such as shown in this example; in which, though I suspect it will not please Your Honour in every respect, since different persons usually tend to differ somewhat in such things, yet I deem you will note some arrows that have come from your quiver.

The other reason is that Your Honour called those who only study Euclidean principles, without proceeding to practice, "sham-fighters", who violently fight against their shadow without touching it; Your Honour, not following this method, caused different instruments to be made, required for practice, e.g. in order to measure inaccessible lengths by sight, to make plans of fortresses in the field, and the like, doing all this with your own hand, and you would have done more, if you had not been obliged to perform greater and more necessary things, to wit, matters of Government. Now, although I have always been of the opinion that the theories of the Theoreticians can serve to further the practical work of the Practicians, yet, in order to prove with the documents how much Your Honour's view about the combination of these two is to my liking and because I do not wish you to reckon me among the simple "sham-fighters", I have sent

Theoricæ con-
templationes
magnitudinū.

heb ick haer dit werckelic voorbeeld teegheschickt: Het wel-
ke, hoewel dattet noch al maer (ghelückmen seght) Burghen
inde locht, ofte noch eyghentlicker, papiere bolwercken en sijn.
Doch commet de sake veel naerder, dan * Spieghelsche ghe-
dachten der grootheden ghescheyden van stof: want anghesien
teyckeninghen ende redenen der omstandighen, voor het dade-
lick werck moeten gaen, soo schynet datment eenichsins deel
des dadelicx wercx soude meughen noemen. Het selve believe
V. E. t'ontfanghen tot teycken van dienstwillighe goede ghe-
neghentheyt, door welke ick haer wensche voorspoet in Regie-
ring, ende gheluck in al haer doen. Uyt Delf den 25^{en} van
Sporkel int 1594^e laer.

CORT.

you this actual example, which, though still they are only (as is said) castles in the air, or, even more properly expressed, bastions of paper, yet comes much nearer to the matter than theoretical ideas of magnitudes separated from matter. For since drawings and descriptions have to precede the practical work, it seems that it might to some extent be called a part of the practical work. May Your Honour be pleased to accept this as a token of faithful and good affection, by which I wish you prosperity in Government and good fortune in all your doings.

From Delft, the 25th of February in the year 1594.

TEN eersten sullen verclaert worden de beyckeninghen der eyghen woorden ende namen van desen handel, door 21. * bepalinghen. *Definitiones.* Ten anderen de manier der teyckeninghe van een volcommen feshouckighe sterckte int cleen. Ten derden het ghebou van een der ghelijcke volcommen feshouckighe sterckte int groot. Ten vierden de teyckeninge ende rghebou der volcommen anderhouckighe dan feshouckighe sterckten, soo wel int groot als int cleen. Voort alsoo den leerlinck uijt het bovescreven sal verstaen hebben de eyfch, eyghenschappen, ende omstandighen van een volcommen sterckte, ende connende daer deur begripen de * verschillen dier tusschen de * Boumee- *Quaestiones. Architectos.* sters vande beste manier der sterckten ommegeen, soo sullen de selue verschillen daer na bescreuen worden: maer wantmen om daer af wel te oirdeelen, eerst de kennis behouft van het wit deses handels, soo sullen ten vijfden de voornaemelicke drie punten van dies verclaert worden. T'voorseyde wit, daermen hem int oirdeelen dickwils na ghevoughen moet, aldus bescreven sijnde, soo sullen ten sesten volgen ettelicke verschillen op een volcommen sterckte: Ende ten laesten sommige verschillen op onvolcommen sterckten, diemen na ghelegentheydt der plaetsen moet maken. Al twelck begrepen sal sijn in seven Hooftsticken. *Capitulum.*

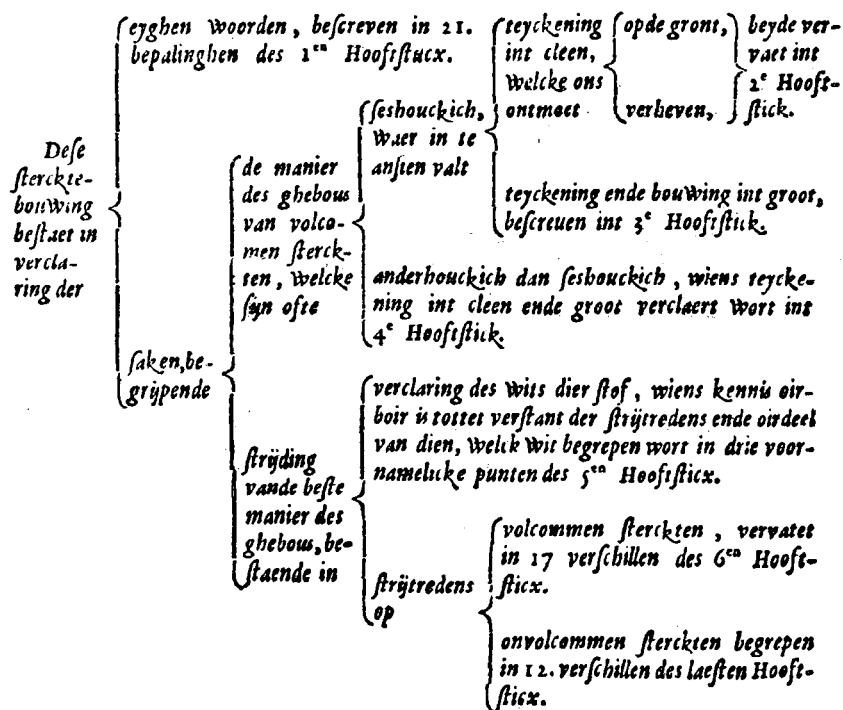
Ende

THE ARGUMENT

First will be explained the proper words and names of this treatise in 21 definitions. Secondly, the manner of drawing a regular hexagonal fortress on a small scale. Thirdly, the building of a similar, regular hexagonal fortress on a large scale. Fourthly, the drawing and building of a regular fortress different from a hexagonal one, both on a large and on a small scale. Furthermore, as the learner will have understood from the above, the nature, properties and circumstances of a regular fortress; he can thereby conceive the differences that are in use among the architects of the best fortresses, which differences will be expressed afterwards. But to make it quite clear, it is first necessary to know how far the scope of this treatise extends. Therefore, fifthly, the same will be explained in the 3 special points. The said scope, by which one must often be guided in judgment, thus being known, sixthly, there will follow certain differences from regular fortresses, and lastly certain differences from irregular fortresses, which must be made according as the place and situation will permit. All this will be described in 7 Chapters.

Methodi.

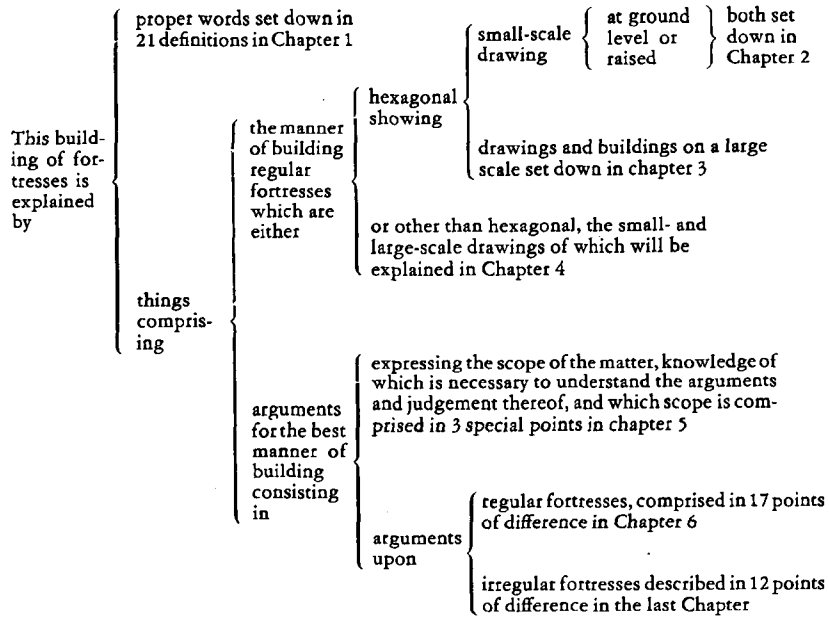
Ende om noch ooghschijnlicker te verclaren het wesen des * Oirdens deser stof, soo vervaten wy andermael het bovescreven tafelwijs als volghet.



Ende tot noch meerder claerheyt van alles, soo sul-
len de nootlicke uijtheemfche woorden, als Italiaen-
sche, Françoische, ende Latinsche, tot verscheyden
plaetsen inde canten nevens haer Duytsche ghestelt
worden.

1^e H O O F T -

And to explain even more clearly the method of this work I repeat the above once more, in tabulated form, as follows.



For clarity, the necessary foreign words like Italian, French and Latin, will be given in several places with the Dutch equivalents in the margin.

I^e HOOFSTICK,

I^e Caput.

Inhoudende de * bepalinghen der eyghen namen ende woorden die tot desen handel behooren.

Definitiones.



DOE wel ons voornemē is de Stercktenbouwing te beschrijven, soo en verstaen wy daer niet mede, een ghemeen verhael van alle sterckten der voorleden tijden, maer alleenelick vande ghene die teghenwoordelick de bequaemste gheacht worden, na den eyfch vande middelē die de cloucke vianden nu ghebruiicken om die te overwinnen. Maer wantmen voor al behouft kennis der eyghen woorden ende namen van desen handel, om te meughen verstaen t'gene daer deur gheseyt wort, soo sullen wy soodanighe als ons voor de onervaernen duncken verclaringhe te behouven eerst bepalen, door t'behulp der drie ghemeeene manieren van formen, als grondteyckeninghe, verheven teyckening, ende lichamelicke teyckening, die int volgende 2^e Hoofdstick met acht verscheyden formen afghebeelt sijn: welcker formen eerste vande grontteyckeninghe is; Maer want sommighe deelen daer in cleen ende onfsienlick vallen, soo sijn die inde 2^e, 3^e, 4^e, ende 5^e formen meerder ghetrocken: De 6^e ende 7^e sijn van verheven teyckeninghe, de 8^e van lichamelicke.

I^e BEPALING.

BOLWERCKEN sijn de uijstekende hoofden der sterckten, als inde eerste form de ses bolwercken B, C, D, E, F, G, ofte inde 3^e form de twee bolwercken A, B. Angaende den * oirspronck des naems, die schijnt dese: Ghelijck het * reetschap dat de nijren oirdentlick beteyckent, sijn naem heeft van werck ende uijr, als ofmen wilde segghen een werck dat de uijren onderscheyt, alsoo crijcht dit hooft den naem bolwerck, van wegghen werck en bolle, twelck soo veel te segghen is, als werck om te wederstaen de bollen of clooten des viants die daer op gheschoten worden, oock om van daer bollen na den viant te schieten. De Italianen dese Duytsche naem navolghende, segghen in ghebroken tael *baluardo*, ettelicke *belouardo*, ander *balluardo*, t'welck eenighe * bepalende, meijnen t'selve te comen ven *bellum*, dat crijch beteeckent, ende *guarda* dat is bewaernis, als oft den sin waer bewaernis teghen den crijch: Maer soo hun den rechten Duytschen oirspronck bekennt waer, ick vermoede dat sijt soo niet bepalen en souden, te meer dat de Françoisen het Duytsch noch naerder commende, dat *boulevard* heeten.

Ital. *Beluardo*,
Frāç. *Boulevard*.

Etymologiam.

Instrumentum.

Definientes
Als *Iacomo*
Cassiratto libr.
1 cap. 9.

A

2^e BEPA-

CHAPTER 1

Containing the definitions of the proper names and words
belonging to this treatise

Although I have undertaken to write of fortification, yet it is not my intention to give a general review of all the fortresses of the past, but only of those which at present are thought to be the fittest to resist the force that a strong enemy may use against them. But because first of all it is necessary for us to have knowledge of the proper words and names of this treatise, in order better to understand that which is meant by them, I think for the unlearned people it is first of all necessary to explain the definitions by means of three commonly used manners of images, as by ground planning, elevation and bodily drawing, which in Chapter 2 are expressed in eight different figures, of which the first expresses the ground planning; but because some parts in it are small and inconspicuous, therefore in the 2nd, 3rd, 4th and 5th figures they are drawn larger. The 6th and 7th are of elevations and the 8th is of bodily drawing.

DEFINITION 1

Bastions or *bulwarks* are the projecting parts of fortresses, as in Figure 1 the six bastions B, C, D, E, F, G, or in Figure 8 the two bastions A, B. Concerning the derivation of the same "bullwork", it seems to be this: just as firework¹⁾ has its derivation from fire and work, so bulwark or bullwork derives from bull and work, which means a work to resist the bullets or shot that the enemy shoots against it, or thence to shoot bullets to the enemy. The Italians, following the Dutch word in broken language, call it *baloardo*, some *belouardo* and others *balluardo*, which would seem to be derived from *bellum*, which signifies war, and *guarda*, that is defence, as if it were a defence against the war. But if they correctly understood the Dutch derivation, I think they would not define it like this, the more so because the French, following the Dutch more closely, call it boulevard.

¹⁾ Concerning the derivation of "bulwark", instead of Stevin's comparison with "uurwerk": a work or instrument which distinguishes the hours, we have borrowed for curiosity from the translator of 1604 his explanation by "vuurwerk" (firework).

2^e BEPALING.

*Ital. Ripari.
Frang. Remparts.*

WALLEN zijn de eerde dammen tusschen twee bolwercken liggende, als KH in d'eerste form, C Q R I inde 6^e form, C inde 8^e form. Ende hoe wel men alle eerde dammen of hooghden int gemeen wallen mach heeten, doch wort dese naem hier wat eyghentlicker ghenomen.

3^e BEPALING.

CADEN zijn de buytecanten des grachts, als in d'eerste form, *bdc*: Inde 6^e form *bLP*: Inde 8^e form D.

4^e BEPALING.

Grand fossé.

GROOTE gracht noemt men t'gene tusschen bolwercken en wallen ter eender, ende de caden ter ander sijde begrepen is.

5^e BEPALING.

*Ital. Fossata oock
Cavatta.
Frang. Contre-
fossé.*

MIDDELGRACHT is die ontrent het middel der groote gracht light: Als inde eerste form *kbi*: Inde 6^e form Y: Inde achtste form E.

6^e BEPALING.

*Ital. Terraglio,
Terra pieno,
Strada.
Frang. Terrepain,
Chemin, Allée.
Hoochduyts Lauff.*

LEEGHE walganck is de wech die op den ondersten wal light; hoghe walganck die op den bovensten light. Als inde 1^e form tusschen de twee linien *o, p*, Inde 6^e form SK, beteycken den leeghen walganck: Maer *q, r*, inde eerste form, Q i inde 6^e form, ende F inde 8^e form bedien den hooghen walganck.

7^e BEPALING.

Parapetto.

Gordien.

*Grammatica.
Etymologians.*

*Ital. Cortina,
nueve Coltrina.*

BORSTWEER is het ghene daermen achter beschut can staen tot de borst toe, als inde 1^e form *no, pq*, inde 6^e form *kT* ende *iR*, borstweeren des hooghen ende leeghen wals, welke door de ghebruick oock Gordinen ghenoemt worden, om datmen daer achter schuyt als achter een gordine. Dese naem gordine comt van (soot de Duytsche * Letterconst uijtleght) *gort* ende *in*, als ofmen wilde segghen een dinc datmen ingort: welcken Duytschen oorspronck de Italianen inde stercken oock navolghende, segghen *cortina*, de Françoisen *courtine*.

8^e BEPALING.

*Hoochduyts Ab-
dachungen.*

AFDAKINGEN zijn de bouenste schoonsche sijden der borstweeren, als Rc ende Td inde 6^e form, G ende H inde 8^e form; welke de Hoochduytschen *Abdachungen* noemen: Wort alsoo gheseyt, van wegghen dat de form gelick is ande ghemeen daken ofte afdakinghen der huysen.

9^e BEPA-

DEFINITION 2

Walls or ramparts are the dams or banks of earth that stretch between two bastions ¹⁾ as KH in Figure 1; CQRI in Figure 6; C in Figure 8. And although we may call all earthen dams or heights commonly walls, yet this name is more proper here.

DEFINITION 3

Bank is the outside of the ditch, as bdc in Figure 1; bLP in Figure 6; D in Figure 8.

DEFINITION 4

Large ditch we call that which is shut in between the bastions and the walls on the one hand and the bank or outside of the ditch, on the other.

DEFINITION 5

Middle ditch (cunette) is that which lies about the centre of the large ditch, as khi in Figure 1; XY in Figure 6; E in Figure 8.

DEFINITION 6

Lower wallway is the way that lies on the lower wall; *higher wallway* is the one that lies on the uppermost wall; as in Figure 1 between the two lines o, p and Sk in Figure 6 refer to the lower wallway, but qr in Figure 1, Qi in Figure 6 and F in Figure 8 indicate the higher wallway.

DEFINITION 7

Parapet is that behind which men may stand protected breast-high, as no and pq in Figure 1, kT and iR in Figure 6 are the parapets of the lower and higher walls, which are according to custom also called *curtains*, because men can hide themselves behind it like behind a curtain. This name curtain (according to Dutch etymology called *gordijn*) is derived from *gort* and *in*, as if one would say: a thing that is girded in, from which the Italians in their fortresses call it *cortina* ²⁾ and the French *courtine*.

DEFINITION 8

Shelvings are upper slopes of the parapets, as Rc and Td in Figure 6, G and H in Figure 8, which in German are called *Abdachungen*, because they resemble the sloping roof of a house ³⁾.

¹⁾ The wall between two bastions is also called "curtain" or "great or large curtain" (cf. Definition 7), but Stevin uses this name too for the walls of a bastion, which later on are indicated by "facen" (cf. note on p. 57). In Definitions 6 and 7 a distinction will be made between higher and lower curtains.

²⁾ That the Italian and the French should have imitated the Dutch in the word *cortina* is doubtful, for Castriotto and Maggi speak already about the *cortina* in many places in their book: *Della fortificatione delle città* (Venice, 1564 and 1584).

³⁾ Evidently Stevin did not yet know the modern names "plongé" and "glacis" for the faintly sloping surfaces of the walls and the contrescarp, or he rejected these gallicisms.

9^e BEPALING.

BESCHOEYING of beschoeyfel is de schoensche sijde die voor de wallen en caden teghen het invallen ghemaect wort: Als inde 6^e form *c S, I V, L b.* De Hoochduytschen noemen die *boschungen*, ende *Futterungen*, dat sijn voeringhen: Ettelicke Francoisen *Talud*, De Italianen *Scarpa*, welck schoe beteekent: Wy heetent beschoeyinghe volghende tegene by ons inde ghebruick is, want de eerden caden diemen teghen het afspoelen met plancken of mueren becleet, wy segghen datse beschoeyt sijn. Maer nadien ick hier vermaent hebbe der Italianen *Scarpa*, ende dat in dese teghenwoordighe crijch hier te lande dickwils ghesproken wort van conterscherpen, welcke naem veel Neerlanders niet verstaende, noch gheen ghelijcknis van scherphuyt siende, ende niet ghenouchsaem wetende wat haer eyghentlicke ghedaente is, soo sullen wy daer af met eene wat segghen. De binnesijde des grachts, als gordinen tusschen twee bolwerken, oock de gordinen der bolwercken self, hebben altemael teghen het invallen haer beschoeyinghen, ofte op sijn Italiaensche haer *scarpa*, der ghelijcke *scarpa* heeft oock de cade opde buytesijde des grachts: Nu om de selue te onderscheyden vande *scarpa* der binnesijde, soo heeten sy die * *contrascarpa*, soo veel te seggen als teghenschoe, of teghenoverbeschoeyfel, dat is beschoeyfel staende teghen over het beschoeyfel der binnesijde. Daerom als de viant de cade ghecreghen heeft, ende hem daer beschanst, daermen dan seght, de viant heeft de *contrascarpa*, (dat is het cabeschoeyfel) ghewonnen, dat moet * beeldwijs heel deurt deel verstaen worden, want om eyghentlick te spreken, soudemen moeten segghen dat hy den (alst immers Italiaens moest wesen) *corridor*, of *strada coperta* veroverd hadde: Ten waer dat hy in drooghe grachten onder d'eerde graefde, tot dat hy deur het cabeschoeyfel uijtcommende, hem daer beschanste, ghelijck wel ghebeurt; in sulcken ghevalle soudemen eyghentlick meughen segghen dat hy meester der *contrascarpa* waer.

Dit is vande Neerlanders conterscherpen gheseyt, hadden sy teghen sulcke verdorven uijtheemsche woorden, soo conterscherpen verstant van haer eyghen goede tael, als plumpe lust om vremde quade te ghebruycken, sy en souden gheen onderwijfinghe behouven.

10^e BEPALING.

BEDECTE wech is die opde calight, daermen achter een borstweer in bedect cangaen, als inde 1^e form *b d e f*, inde 6^e *L P*, inde 8^e *D*.

11^e BEPALING.

STRIICKEN is wanneer men een cloot schiet heel by ende langs een muer, wal, wech, of dierghelijcke, overal ewewijt daer af vliegghende, als

Ital. Scarpa.
Franç. Talud,
oock escarpe.
Hooch. Boschung.
Futterung.

Contrascarpa
eenighe seggen
Fora scarpa.

Figura totum
ex parte.

Ital. Strada
coperta, Strada
da fortire,
Corridor.
Franç. Chemin
couvert.
Hoochd. Gra-
benkluft.
Ital. Nettare,
Scappare.

DEFINITION 9

Scarp is the sloping part of a wall or bank to protect it from falling in, as cS, IV, Lb, in Figure 6. The Germans call it *Boschungen* and *Futterungen*, i.e. linings, several Frenchmen call it *Talud*, the Italians *Scarpa*, which signifies shoe. We call it *beschoeiing*, according to what is in use with us, for of the earthen banks, which we cover with boards or brick walls to prevent them from being washed away by the water, we say that they are *beschoeid*, i.e. shod or protected. But, since I have here spoken of the Italian *Scarpa* and because in the present wars in our country this word *conterscherpen* is often used, which word many Dutchmen do not understand, while it neither has any likeness with sharpness, and while they do not know sufficiently what its proper shape is, therefore I will say something about it. The inner side of the ditch, as the curtain between 2 bastions or the curtains of the bastions themselves¹⁾, are altogether made leaning, to prevent them from falling into the ditch, or as the Italians say, have their *scarpa*; the outside of the ditch has a similar scarp. To distinguish the one from the other, they call the outside *contrascarpa*, that is a scarp opposite, meaning the scarp of the bank, or outside of the ditch, over against the scarp of the inner side. Therefore, when an enemy has conquered the bank or outside of the ditch, and entrenched himself in it, we say the enemy has the *counterscarp*, i.e. he has conquered the flat side of the ditch, but this should be understood figuratively the whole by the part, for if we should speak properly (in the Italian manner) we must say that the enemy has conquered the *corridor* or *strada coperta*. Except when as in dry ditches, when an enemy has dug in the earth until he has cut through the outside of the ditch and entrenched himself there, as often happens, in such a case we might properly say he is master of the *counterscarp*.

The Dutch call it *conterscherpen*, but if they had against such ill-favoured strange words as *conterscherpen* an understanding of their own good tongue, as they have an unpleasant desire to use bad and strange words, they would here need no teaching.

DEFINITION 10

Covered way is that which lies on the outside of the ditch, in which men are covered with a parapet, as bdef in Figure 1; LP in Figure 6; D in Figure 8.

DEFINITION 11

Striking (flanking) is when we fire a shot all along a wall, or a way, or such like, which flies off everywhere at equal distance, as for example, when

¹⁾ Likewise Stevin must have rejected the word "face". As early as 1673 Jonas Moore, on page 17 of his book: *Modern Fortification*, calls the Face the foremost part of the Bastion, etc.

Strisciare,
Fiancheggiare,
Scortinare,
Franç. Nettoyer,
Flâncquer,
Raser.
Hoochd. Stre-
ichen.

als by voorbeeld wanneer eē cloot commende uijt den strijckhouck I P H (welcke strijckhouck hier onder inde 12^e bepaling verclaert sal worden) langs de groote gordine, bolwerckx gordine, middelgracht, bedectewech, bedectewechs borstweer, of langs de ghemeene landgront alsoo de strepen inde selve form dat anwijzen, men seght dat sodanighen cloot de voornomde plaetsen strijckt, oock datter een strijckschote is. Maer clooten die teghen de mueren, wallen, of wegghen ancommen, dat die qualick of niet en strijcken. De Italianen segghen *nettare*, *scoppare*, *strisciare*, *fiancheggiare*, *scortinare*, de Françoisen *nettoyer*, *raser*, *flancquer*, dat vaghen, scheeren, ende sijdeling schieten beteyckent: De Hoochduytschen ghebruijcken het woort *streychen*, t'welck wy (hoe wel vaghen en scheeren oock niet onbequaem en sijn) om de ghemeenschap dier tael met de onse, navolghen, ende daer voor strijcken segghen, te meer dattet bequaem ende verstaenlick is, sijn * grondt wel beteyckenende, want een cloot die langs eenighen muur vlieght, wy segghen ghemeenelick datser langs henen strijckt: Voort ghelijck een strijckstock af strijct het cooren, ofte saet dat buijten de mate steeckt, alsoo strijckt sulck een vlieghende cloot af, het ghene datse op wallen wegghen of muren ontmoet.

Subiectum.

Hier machmen noch dit by segghen, nademael ons woort strijcken vande Italianen ghevolght woort, dieder *strisciare* af maken, soo en can den * oirpronck self van *strisciare* voor ons Duytschen niet oneyghen wesen.

Etymologia.

12^e BEPALING.

Ital. Fianchi.
Franç. Flancs.
Hoochd. Wynkel
der Streychen.

Strijckhoucken sijn uijt welke de sterckte rontom tot verscheyden plaetsen gestreken wort, als inde 1^e form de houcken I P H, ende Q K; De Hoochduytschen noemense *Wynkel der streychen*, de Italianen *Fianco*, dat sijde bediet, de Françoisen *Flanc*: T'welck ettelicke Neerduytschen navolghende, heeten se flanckeringhe, maer t'schijnt oneyghentlick genouch gheseyt te wesen, want ghelijck schietinghe gheen cortau en is, alsoo flanckeringhe (dat strijcken wil beteecken) gheen flanc; Maer ghelijck schieting is een werck der cortau, alsoo flanckeringhe een werck des flancx. Ende als flanckeringhe oock flanc bediet, siet doch eens wat bescheyt datter is inde reden van een die seght; *Dese flanckeringhe maect opde conterscherpe goede flanckeringhe*; wat meynt hy datse opde conterscherpe een groot swaer ghesticht maect datter niet en is? Het schynt wel neen. Om dan te schuwen alle misverstant; dat dicwils uijt onverstaen woorden inde sake volght, soo heeft ons best ghedocht, oock inde veranderinghe van dese naem, de reden meer plaets te gheven dan quade ghewoonte.

Ital. Orecchione,
Mafese. Coglione.
Franç. Oreillon.
Hoochd. Flügel,
Docke. Schutte.

13^e BEPALING.

SCHVTSBL is t'gene daer de strijckhouck mede beschut ende be-
waert wort, als inde eerste form P l m M: Inde 8^e form I, K, L, M.

14^e BEPA-

a shot comes out of the striking angle IPH (which striking angle will be explained in Definition 12) along a great curtain, the curtain of a bastion, middle ditch, covered way, parapet of a covered way or along the face of the ground, as the lines in the figures show, we say that such a shot strikes the above-mentioned place and call it a striking shot. But a shot which hits a wall, or way, strikes badly or not at all. The Italians call this striking *nettare*, *scoppare*, *strisciare*, *fiancheggiare*, *scortinare*; the French call it *nettoyer*, *raser*, *flancquer*, which means sweeping, shaving and sideways shooting. The Germans use the word *streychen*, which (although it were not unfit for us to call it sweeping or shaving) to follow the similarity of that language with ours, we term striking, because it is the more significant, and also expresses the subject better, for of a shot that flies along a wall we commonly say that it strikes all along it. Furthermore, as a strike strikes off the corn or seed that lies above the measure, even so does such a flying shot strike all that it meets upon walls, ways and banks.

To this may be added that for as much as our word to strike is followed by the Italians who make of it *strisciare*¹⁾, the etymology of the word *strisciare* is not improper for our Dutch.

DEFINITION 12

Striking angles (flanks) are those angles from which the fortress is struck at several places, as IPH and QK in Figure 1. The Germans call them *Wynckel der streychen*, the Italians *Fianco*, which means side, the French *Flanc*, which some of our Low Countrymen following, call *flanking*. But this seems to be spoken improperly enough, for as shooting (in a cannon) is not the cannon, so *flanking* (which means striking) is no flank; but as shooting is a work of the cannon, so flanking is a work of the flank. And if flanking also would mean flank, what reason there should be in the words: *This flanking makes upon the counterscarp good flanking*; would you not imagine that one says that upon the counterscarp there is made a large building called a flank, which is not there? Wherefore, to avoid all misunderstanding which often follows of words not understood, I have thought it best, in the changing of this term rather to give place to reason than to evil custom.

DEFINITION 13

*Orillion*²⁾ (or Ear) is that wherewith the striking angle is covered, as PlmM in Figure 1 and I, K, L and M in Figure 8.

¹⁾ Stevin's intention with the last paragraph of this Definition 11 (which is lacking from the German translation of 1608), is not clear. However, it has induced us to maintain the word "striking" next to "flanking", which was soon used in England; cf. Moore, p. 19 (General Rules, under 1: "All the parts of a Fort ought to be flanked, that is, defended from another part.").

²⁾ The spelling "Orillion" occurs in Webster, *New Int. Dictionary of the English language*, U.S.A. 1958. In the *Cyclopaedia or Universal Dictionary of Arts and Sciences*, by E. Chambers (London, 1778-1786) the word is to be found as "Orillon", under which notation it is known also in the military literature on fortification (i.a. Moore, p. 83).

14^e BEPALING.

BOVEPLAETS, middelplaets, ende onderplaets, sijn drie verscheyden ruymten inden strijckhouck, deen boven dander, daer het gheschot staet ende sijn deysing in heeft, als inde 3^e form den vloer daer de letteren NOPQR op staen, bereycken de boveplaets, ende t'parck daer CEX in sijn de middelplaets, ende daer BHG in commen de onderplaets.

Superieure, Moyenne, & inferieure place. Ofte Premiere Seconde & Troisieme place, oock Casemates.

15^e BEPALING.

BOSGATEN sijn de openheden die inde borstweeren der drie plaetsen ende elders ghemaect worden, om t'geschot in te legghen, ende daer deur te schieten: Als inde 3^e form de bosgaten der boveplaets N,O, P,Q,R der middelplaets C,E, ende vande onderplaets by I K.

Ital. Cannoniere, Balestriere, Bombardiere, Fersteie, Hockd, Schachten.

16^e BEPALING.

TANT is het deel des borstweers dat tusschen twee bosgaten blijft staende; als inde 2^e ende 3^e form al de deelen der borstweeren tusschen de bovescreven bosgaten.

Merlane, Dado. Hochd, Psailer.

17^e BEPALING.

CATTEN sijn seker hooghden der sterckten, als inde eerste form de catten opde bolwercken ligghende B,C,D,E,F,G: Inde 7^e form A; Inde 8^e form AB, om daer mede het velt te ontdekken, ende den viant van te verder verandering te moghen doen. De Italianen heeten se *Cavallieri*, t'welck ridders of ruijters te peerde beteekent, segghende des naems oirspronck te commen van weghen de hooghde der ruijters, want ghelijckse boven t'voetvolck uijtsteken, alsoo haer *cavallieri* boven wallen en bolwercken. Ende om alsoo eenighen oirspronck te segghen van dese naem catte, die by ons Neerduytschen inde ghebruyck gherocht is, soo en sien ick nu gheen narder dan dese: Ghelijck een catte sit en pronct ende en loert na de muys, ende eenighe int ghesicht ghecreghen hebbende, haer beste doet om die te vernielen, alsoo oock desen berch, welcke bycans liggende ghelijck een catte sit, ende eenighe vianden hemlieden daer voor ontdeckende, sy doet haer beste om die t'onder te brenghen: Doch en wil ick hier mede een beter niet versnaden, maer ghebruijcke de vrijheyte, die voor yghelick int *anspil van der namen oirspronck ghemeen is.

Cavaglieri.

Cirolamo

Maggh

Etymologiam.

Allusione etymologiae nominum.

18^e BEPALING.

PLATTE vormen sijn catten of bolwercken vooren heel plat wesen: Als wanneer opde gordine, of daer achter geleyt wort een hooghde die vooren plat is sonder punt, ghelijck de bolwercken hebben, die

Piatta forma.

DEFINITION 14

Higher place, middle place and lower place are three different spaces in the striking angle or flank, the one above the other, wherein the ordnance stands and has its recoiling, as in Figure 3, where the floor NOPQR refers to the upper place, CEX to the middle place and BHG to the lower place¹⁾.

DEFINITION 15

Embrasures are the open places or spaces that are made in the parapets of the three places and elsewhere to lay ordnance in, and from which to fire, as in Figure 3 the embrasures of the higher place N, O, P, Q and R, of the middle place C and E²⁾ and of the lower place near IK.

DEFINITION 16

Merlon or tooth is that part of the parapet between two embrasures, as in Figures 2 and 3 all the parts of the parapets between the above embrasures.

DEFINITION 17

Cavaliers are mounts, raised in the fortress, as in Figure 1 the cavaliers that lie upon the bastions B, C, D, E, F and G; A in Figure 7; A and B in Figure 8; to discover the field and to repel the enemy from afar. The Italians call them *cavallieri*, which means knights or horsemen, which name is said to originate from the height of horsemen; for, as horsemen in an army overtop the foot, so their *cavallieri* outtop any wall or bastion in a fortress. And to explain the derivation of the name *Cats*, used by the Dutch, I can only say this: as a cat sits and watches for a mouse and at first sight of her prey tries to destroy it, so these heights, which almost lie like cats, as soon as an enemy appears, use all their force to repel him. However, I will not here scorn a better word, but take the liberty which is free for everybody in the allusion to the derivation of names.

DEFINITION 18

Platforms are mounds of earth, cavaliers or bastions, being wholly flat in front, as when upon a curtain, or behind a curtain, a height is raised, which in front is flat, without a point as a bastion has, which height or cavalier is called a

¹⁾ Stevin writes in the margin: "ofte Premiere, Seconde & Troisieme place; oock Casemattes", to which names he reverts in Definition 21.

²⁾ The Embrasure S is not mentioned in this Definition, perhaps because it does not belong to the upper or higher place, though it lies on the same height (cf. the legend to Figure 3).

In der 7^e Hoofst.
stuk 2^e versciil.
Genus.
Species.

hooghe of catte wort dan platte form ghenoeemt. S'gelijcx wanneer baijten de groote gordine gheleydt wort een uijsttekende hooft vooren h'el plat sijnde (twelck meest te pas comt voor gordinen met inwendige houcken, om die platte sijde strijckelick te krijghen, als t'sijnder plaets *breeder salverclaert worden) sulck hooft ofte bolwerck heet oock Platte form: Inder voughen dat Platte form ghenouchsaem *gheslacht is, diens twee *afcomsten sijn Plattecat ende Platbolwerck.

19^e BEPALING.

Condamine.
Hooch. Holgang.

TEGHENGRAF is de overwelfde ganck, welke ligt onder inde leeghe wal, rondom de sterckte: Als inde 6^e form *fgb*: Ende wort teghengraf gheheeten, om datmen daer mede teghenstaet of verhindert het ondergraven der vianden.

20^e BEPALING.

Ital. Sortite.
Fran. Sorties of
Fausses portes.
Hooch. Aufval.

HEYMEELICKE uijtganghen sijn die, daermen heymelick door uijt de sterckte gaet, welker uijtcomst nu ter tijt meest ghestelt wort inde binnesijde des schutfels, als inde 5^e form den heymelicken uijtganck *DEFG*, waer af de deure der uijtcomst verstaen wort te ligghen baijten den tant vande onderplaets, als inde 3^e form tusschen *K* ende *L*: Ende worden heymelicke gheheeten, tot onderscheyt der openbare uijtganghen deur de poorten over de brugghen.

21^e BEPALING.

Casemates.

Flans.

DE huyskens, ghehuchten, ende int ghemeen gheseyt weerplaetsen, welckemē hier en daer tot meerder bewaernes antvolmaect lichaem der sterckte bouwet, die noemen wy *Moortcuijlen. De Françoisen ende Italianen heeten se *casemates*, twelck schijnt een Spaensche naem vergaert van *case* ende *matta*, al oft sy wilden segghen, *casapor donde se matta*, dat is huys daermen deur vermoort, t'welck door een gebruyckelicke Duytsche naem moortcuijl gheseyt mach worden. Eenighe hebben voormael de middelplaets ende onderplaets der *strijckhoucken oock *casemates* ghenoeemt, maer de gewoonte heeft byde laetste scrijvers inghebrocht, dat sy se nu eyghentlicker heeten *moienne & inferieure place*, ofte *seconde & troisieme place*, misschien om datmen se nu niet, ghelijckmen eertijts pleecht, als huysen bestoten ende overwelft en maectt, soo t'sijnder plaets breeder gheseyt sal worden.

M E R C T.

Definitie.

Wx souden de woorden ende namen hier vooren *bepaelt, op noch veelderley wijsse, ende met seer goede verstaenlicke beteykeninghe connen uijtspreken, in plat Duytsch, sonder daer toe vijntheemsche

platform. Likewise, when upon a large curtain any flat-headed defence is thrust out (which commonly happens with curtains with re-entering angles, to strike the flat side of them, as will be better expressed elsewhere ¹⁾), such a head or bastion is also called a platform, so that from this general term have sprung two special words: flat cavalier and flat bastion.

DEFINITION 19

Countermine is a vaulted passage, which lies under the lower wall round about the fortress, as fgh in Figure 6 and is called countermine, because men there resist or hinder the mining by an enemy.

DEFINITION 20

Secret sallies are those by which men secretly leave a fortress, the exits of which are commonly placed in the inside of the orillion of a bastion, as in Figure 5 the secret sally DEFG, the door of which is understood to be outside the merlon or tooth of the lower place, as in Figure 3 between K and L. They are called secret to distinguish them from the public exits at the gates across the bridges.

DEFINITION 21

The small houses, commonly called places of defence, which are made here and there in the complete body of a fortress to ensure better defence, are called murdering-holes. The French and Italians call them *casemattes*, which seems to be a Spanish name, made up from *case* and *matta*, as if they wanted to say *casa por donde se matta*, that is a house whence men kill, which with a customary Dutch word may be called a murdering hole. Some have formerly called the middle and lower places in the striking angles *casemattes*, but the last writers have according to custom now come to refer to them as *the middle and lower place*, or *second and third place*, perhaps because men nowadays do not make them as in former times like closed and vaulted houses, as will in its proper place be explained more in detail ²⁾.

NOTE

We might express the words and names defined above in many other ways and with a very good and intelligible significance in Dutch without needing foreign and corrupt language for it, and use those variants in the following

¹⁾ For this expression see Chapter 7, 2nd Difference. By "large curtain" is meant the curtain between two bastions (cf. note 1 on p. 55). A platform later on acquired the meaning of emplacement for ordnance. A flat bastion is no correct idea.

²⁾ For this explanation see Chapter 6, Difference 17: "vande moortcuylen" (on casemates). From this as well as from the end of Definition 21 it is evident that Stevin rejected the obsolete casemates of the Old-Dutch system of Fortification, but advocated a modern construction, of the type which afterwards was to be designed by Coehorn.

sche verdorven tael te behouven, ende die verscheydenheden, int volghende als *ouervloet der woorden ghebruijcken, om daer mede som- *Copia . verborum.* wijlen te veel *selfwoordicheyt te schuwen, als by voorbeelt, beneven *Tautologiam.* *Gracht, Bedestewesh, Strijcken, Strijckschote, Strijckhouck, Schutsel,* noch te segghen *Veste, Sloop, Grachtschans, Loopschans, Vaghen, Scheeren, Vaeghschote, Scheerschote, Sydschote, Vaeghouck, Scheerhouck, Sydhouck, Decksel, Oir, Vleugel,* en dierghelijcke: dan wy hebben voor ons ghenomen, meerder clærheys halven, eenvoudelick byde bepaelde te blyven.

Beneven de voorscreven uitlegginghen, soo sijn tot meerder clærheyt, by elcke der acht volghende vormen, de beteyckening haerder deelen int corte schriftelick ghestelt.

2^e H O O F T S T I C K

*Inhoudende voorbeeltsche teyckening, van een
feshouckighe sterckte int cleen.*

WANTMEN de sterckten al veroirdent moet hebben, oft immers behoort te hebben, eermen ant bouwen comt, om deur misgrippinghe niet qualick te maken t'gene men daer na swaerlick soude connen veranderen, deur de groote costen die daer an hanghen, soo ist inde ghebruijck, datmen van te vooren verscheyden formen teeckent, na gheleghenheyt der plaats, ende den eysch van allen omstandighen, op dat de personen die daer af te spreken hebben, deur soodanighe formen malcander wel verstaen meughen, ende eintlick het beste daer af besluyten. Dese formen worden ghemaect op tweederley wijze, eerst int platte op papier, daer na lichamelick van poteerde, was, hout, of ander stof, eintlick comtmen tottet eyghen ghebou. Om welcke natuerlick eirden hier oock te volghen, soo nemen wy eerit voor de teyckening van een volcommen *feshouckighe evesijdeghe sterckte, int ront *Hexagonum castrum equilaterum circulo inscriptibile.* bescrivelick, sonder ons te becommen met eenich belet, achterdeel of voordeel van omligghende hooghden, leeghden, Zeen of marasschen, maer als op een bequaem even lant, daermen al op bouwen mach, datter behoort tot een volcommen sterckte na de wijze deses tijts, te weten met dobbel gordinen, deen hooghe dander leeghe, met drooghe grachten, hebbende yder *strijckhouck drie plaetsen. Ende want de teyckeninghe *Flanc.* int platte ons op tweederley wijze ontmoet, deene grontteyckeninghe, dander verheven, die elck haer besonder maten vereyschen, soo sullen wy meerder clærheys halven, al de maten die tot de grontteyckening noodich sijn, in een besonder besteek vooren stellen, daer na als wy tot de verheven

pages as a plenty of words in order thus to eschew sometimes excessive tautology, e.g. saying besides *Gracht*, *Bedectewech*, *Strijcken*, *Strijckschote*, *Strijckhouck*, *Schutsel*, also *Veste*, *Sloot*, *Grachtschans*, *Loopschans*, *Vaghen*, *Scheeren*, *Vaeghschote*, *Scheerschote*, *Sydschote*, *Vaeghhouck*, *Scheerhouck*, *Sydhouck*, *Decksel*, *Oir*, *Vleugel*, and the like; but we have resolved, for the sake of greater clarity, to keep simply to the words defined above.

Besides the aforesaid explanations, for greater clarity there has been added to each of the eight following figures the brief written description of the significance of their parts.

CHAPTER 2

Containing an exemplary description of
a hexagonal fortress on a small scale

All fortresses must be designed (or at least ought to be so) before the building is undertaken, lest through errors anything should be ill-handled, which afterwards could be but hardly remedied, because of the great cost such works involve. Therefore is it a custom that we should first make drawings of various figures, according to the situation of the place and nature of the work, that all those whom it concerns, through such designs may understand each other, and finally arrive at the best plan. These figures are to be made in 2 ways, first plain by a ground plan upon paper and afterwards bodily with potter's earth, wax, wood or other matter; lastly, the building itself is undertaken. To follow this order also here, I have first described a regular equilateral hexagonal fortress, which can be constructed within a circle, without being troubled by any hindrance, drawback or advantage, as nearby high or low grounds, sea or marsh, but as it were upon even plain ground, upon which a man may build all that belongs to a regular fortress, after the manner of the present time, viz. with double curtains, one high; the other low, with dry ditches, every striking angle having three places and describing the ground plan in two ways, one at ground level, the other raised, each of which requires its special dimensions. For the sake of clearness, I have therefore first noted down all the dimensions necessary for the ground plan in a special description; then, coming to the raised plan, I have likewise given another

verheven teyckeninge commen, een ander besteck vande maten diemen inde selve behouft.

*Methodum ex
dichotomias
tium in partes.*

Tis oock te weten, dat wy int bescrijven van dien, gheen * Oirden uijt halving des heels in deelen en volghen, maer stellen vooren, t'ghene in dadelicke teyckeninghe bequaemlick voorgaet.

*Argumenta-
tione.*

Doch eer wy tottet bescrijven deser maten commen, willen den erva- ren leser dit noch te vooren segghen, dat by aldien hy eenighe maten of oirdeninghen vindt, die na sijn goetduncken niet bequaem en waren, dat wy de plaets om reden daer af te gheuen, niet hier, maer (op dat leering mer gheen * strijding verduystert en worde) int volghende 6^e ende 7^e Hoofstuck gheschickt hebben.

MATEN DER GRONTTEYCKENING.

TEN 1^{en}, elke sijde des selhoucx daer de bolwercken op gheteyckent worden, sal lanck wesen 1000 voeten: daer by verstaen sijn Delfsche voeten, van welcker verlijcking met ander maten, gheseyt sal worden int 1^e * verschul des 6^e Hoofstuckx.

Questione.

Merlone.

Ten 2^{en}, van yder hoock des selhoucx, tot de voorsijde des * tants vande middelplaets, sal sijn 180 voeten.

Flanc.

Orellen.

Flanc.

Ten 3^{en}, de breedte des * strijckhoucx opde voorsijde des tants vande middelplaets, met de dicke des * schutfels, t'samen 140 voeten.

Ten 4^{en}, de breedte des * strijckhoucx, ghemeten opde voorsijde des tants vande middelplaets, 30 voeten.

Merlone.

Flanc.

Orellen.

Ten 5^{en}, de dicke des selven * tants 20 voeten.

Ten 6^{en}, als men de lini beteyckenende de breedte des * strijckhoucx, met haer * schutfel (welcke hier boven int 3^e punt gheseyt is dat sijn sal van 140 voeten) noch voorder uijttreckt 120 voeten, soo sal de ca die daer teghenover moet staen, ghetrocken worden over het uiterste punt van die lini, alsoo dat de groote gracht daer breet sal wesen 120 voeten.

*Chemin couvert
of corridor.*

Fossata.

Ten 7^{en}, de * bedecte wech sal opden houck teghenover het middel der groote gordine, breet wesen 20 voeten.

Ten 8^{en}, de * middelgracht sal door haer middelstrijckelick ghestelt worden van het binnebosgat der middelplaets, ende sal opden houck teghenover het middel der groote gordine, breet wesen 20 voeten, ende voort overal even wijt.

Orellen.

Parapetto.

Ten 9^{en}, de langde des * schutfels 100 voeten.

Ten 10^{en}, de dicke des * borstweers vande onderste gordine, soo wel des bolwercx als vande groote, 20 voeten.

Allie.

Scarpa of talud.

Ten 11^{en}, de breedte des ganx daer achter 20 voeten.

Ten 12^{en}, dicke des * beschoefels vanden hooghen wal 10 voeten, daertoe noch de dicke des borstweers 20 voeten, comt t'samen 30 voeten. Dit boveborstweer sal men voort leyden, ende daer af maken een boven-

description of the dimensions required.

It is also to be understood that in doing so I follow no method of halving the whole into parts, but set down first that which for effective planning ought to be described first.

But before expressing the above-mentioned dimensions I must tell the experienced reader, that if he finds any dimensions or dispositions which seem in his opinion not correct, that I have appointed the places for giving reasons thereof not here (because the teaching should not be complicated by arguments), but in Chapters 6 and 7.

DIMENSIONS OF THE GROUND PLAN

1. Every side of the hexagon upon which the bastions shall be described, shall be 1000 feet long (viz. Delft feet), whose comparison with the measures of other nations will be dealt with in the first difference of Chapter 6.

2. From each side of the hexagon unto the front side of the merlon of the middle place shall be 180 feet.

3. The breadth of the striking angle upon the front of the merlon of the middle place, with the thickness of the orillion, shall be 140 feet.

4. The breadth of the striking angle, measured in front of the merlon of the middle place, 30 feet.

5. The thickness of the merlon itself 20 feet.

6. If we produce the line indicating the breadth of the striking angle and the orillion (which in point 3 is said to be 140 feet wide) 120 feet, then the opposite bank must be drawn through the uttermost point of this line, so that the great ditch shall there be 120 feet wide.

7. The covered way shall be 20 feet broad at the corner over against the centre of the great curtain.

8. The middle ditch shall be designed such that it may be striked from the innermost embrasure of the middle place, and it shall be 20 feet broad at the corner, over against the centre of the great curtain, and further everywhere equally wide.

9. The length of the orillion shall be 100 feet.

10. The thickness of the parapet of the undermost great curtain, as well as of the curtain of the bastion, shall be 20 feet.

11. The breadth of the way behind the parapet shall be 20 feet.

12. The thickness of the scarp of the higher wall shall be 10 feet, and the thickness of the parapet shall be 20 feet, which together make 30 feet. This uppermost parapet must be produced, and of it an upper garland must be made

bovenste * crans des bolwerckx, ghelijck vant onderste borstweer den ondersten crans ghemaect wort, treckende de bolwerckx gordinen uijt de boveplaetsens binnensten houck, ende latende voor langde der middelplaets 30 voeten. *Ghirlanda.*

Ten 13^{en}, breedte des ganckx daer achter, dat is breedte des hooghen wal-ganckx 50 voeten. *Terreplain.*

Ten 14^{en}, dickte des binnebeschoeyfels vanden hooghen wal 20 voeten. *Scarpa.*

Ten 15^{en}, breedte der strate tusschen de huysen ende den wal 30 voeten.

Ten 16^{en}, dickte vant beschoeyfel der * catte 10 voeten, daer toe de dickte van haer borstweer 20 voeten, comt tsaemen 30 voeten. Ende sul-len de voorlijden der catte, ghetrocken worden uijt den binnensten houck der boveplaets, ende t'begrip tusschen het borstweer der boveplaets ende de catte, sal sijn voor langde der boveplaets 30 voeten. *Cardigiera.*

Ten 17^{en}, salder in eenen houck daer twee * bedeckte weggen verga-deren, gheleyt worden een wech, daer soo wel peerden en vee, als men-schen door moghen commen, uijt de gracht opde bedeckte wech, te we-ten al rijfende sonder trappen, vande gront des grachts af, tot op de be-deckte wech toe, t'welck is in als 40 voeten, de selve wech sal lanck we-sen 240 voeten, boven breed 20 voeten, ende sal ghetrocken worden uijt de buijtesijde des * strijckhoux. Wortse van hout ghemaect, men canse, *Chemins couvers.* *Flanc.* wanneer men wil, te lichtelicker af breken.

Ten 18^{en}, sullen der ghelijcke weggen gheleyt worden in yder houck daer twee * borstweeren der bedeckte weggen vergaren, om daer door te commen uijt de bedeckte wech op haer borstweer, welcke weggen lanck sullen wesen 40 voeten, boven breed 20 voeten, ende sullen als de voor-gaende sonder trappen sijn, ende ghetrocken worden uijt de buijtesijde des * strijckhoux. Ende wort oock verstaen, dat der ghelijcke weggen sullen gheleyt worden binnen de sterckte, in yder houck daer twee wailen vergaderen, waer mede men climmen sal vande strate opden hooghen-walganck, om grof gheschut ende alle nootlickheyt daer op ende af te brenghen. *Parapet.*

Ten 19^{en}, salder een overwelfselken commen, in yder deel des grooten wals dat op het * schutsel light, om daer deur vande leeghewalganck tusschen twee bolwercken, te moghen commen over de middelplaets, inde leeghewalganck der bolwercken, ende alsoo sonder verhindernis rondt-om de heele sterckte te moghen gaen. T'selfde overwelfsel moet soo lee-ghe sijn, dattet vant borstweer daer voor ligghende ghenouch bedeckt sy, te weten van 6 voeten hoog, ende 6 voeten breed. *Orellen.*

Ten 20^{en}, de twee * bosgaten der middelplaets, sullen breed wesen daer sy ten nausten sijn, 2 voeten, sullen oock soo geleyt worden, dat men daer door sien can tot den houck van het * borstweer der bedeckte wech, die teghenover t'middel vande groote gordine comt. *Cannonieres.* *Parapet du corridor.*

B

Ten 21^{en},

upon the bastion, as of the undermost parapet the undermost garland was made, drawing the curtains of the bastion from the innermost corner of the uppermost place, leaving 30 feet for the length of the middle place.

13. The breadth of the way behind the parapet, that is the breadth of the higher wallway, 50 feet.

14. The thickness of the scarp at the inside of the higher wall 20 feet.

15. The breadth of the street between the wall and the houses 30 feet.

16. The thickness of the scarp of the cavalier 10 feet and the thickness of the parapet upon it 20 feet, which together make 30 feet. The foreside, or outside of the cavalier, shall be drawn from the inner angle of the upper place, and the distance between the parapet upon the upper place and the cavalier shall for the length of the upper place be 30 feet.

17. In a corner where two covered ways meet shall a way be laid, rising from the bottom of the ditch, which is 40 feet deep unto the covered way, upon which horses, cattle and men may go out of the ditch into the covered way; therefore it must be without steps and must be 240 feet long and above 20 feet wide; and it must be drawn out of the outside of the striking angle. If made of timber it can, if need be, easily be destroyed.

18. Similar ways shall be made in every corner where two parapets of the covered way meet, to pass out of the covered way upon its parapet, which ways shall be 40 feet long and 20 feet wide above, and made without steps as the other, and shall be drawn out of the outside of the striking angle. And it is also to be understood that similar ways shall be laid within the fortress in every inner corner where two walls meet, for ascending from the street to the higher wallway, to bring ordnance and all other necessities there up and down.

19. A little vault must be made in each part of the great wall upon the orillion of the bastion, to come from the lower-wall way between two bastions over the middle place into the lower-wall way of the bastion, so that there may be free passage round the whole fortress. This same vault must be laid so low that it may stand sufficiently covered behind the parapet before it, to wit, 6 feet high and 6 feet wide.

20. The two embrasures of the middle place, at their narrowest, must be 2 feet wide, and are so to be fashioned that a man may look through them unto the angle of the parapet of the covered way that lies over against the centre of the large curtain.

Mirioni. Ten 21^{en}, de langde vande onderplaets, dat is de openheyt tusschen den *tant vande onderplaets ende den tant der middelplaets, 30 voeten.

Ten 22^{en}, de dichte des tants vande onderplaets 20 voeten.

Cannonieres. Ten 23^{en}, de drie *bosgaten der onderplaets, sullen opt nouste wijs sijn als dander 2 voeten, ende soo verre buijewaert strecken, datmen daer deur het *cabschoeytsel mach strijcken.

Contrascarpa. Ten 24^{en}, int *borstweer der boveplaets sullen vijf bosgaten commen, welker drie binnenste alsoo sullen getrocken worden, datse op de buijtesijde het borstweer der bedeckte wech connen *strijcken, maer de twee buijtenste bosgaten in sulcker voughen, datse ter eender sijde de leeghe groote gordine connen strijcken, ende buijewaert soo verre schieten als het *schuifsel toelaet.

Oreillon. Ten 25^{en}, inde wallen en catten die achter de bovescreven *bosgaten der drie plaetsen ligghen, sullen overwelfselen ghemaect worden, 12 voeten breed, ende 20 voeten lanck: Angaende de hoogte der selver, ghemerckt sijn ons soo weynich ontmoet inde volghende verheuen teyckening als in dese grontteyckening, soo stellen wy hier alleenelick als by ghedachtenis, dat de selue sal wesen van 7 voeten, te weten soo leeghe, datse vande *tanden bedect sijn: Ende wort verstaen dat achter elck bosgat soo wel der ghene die tot verscheyden plaetsen inde leeghe gordinē meughen ghemaect worden, als inde *strijckhoucken, sulck een overwelfsel sal commen. Voort sullen de steyghers om te commen vande boveplaets na de middelplaets, oock vande middelplaets na de onderplaets, tot haer bequamen oirt na den eyfch gheleyt worden.

Merloni. Ten 26^{en}, de poorten sullen wijs sijn 10 voeten, enden staen int middel der groote gordine, het overwelfsel rechtuijs streckende deur den wal.

Flanc. Ten 27^{en}, salder ten einde der poorte een walleken liggen, dick 40 voeten, hebbende van binnen sijn *borstweer ende bosgaten: Ende ter sijden sal noch een deur staen van wijde als de voorgaende, te weten 10 voeten, ende de reste na den eyfch. Wort oock verstaen, dat de houten brugghe voor de poorte over de gracht heel rechtuijs liggen sal, ende soo gemaect sijn, datmen se in tijt van noot lichtelick wechdoen, ofte af breken can.

Sortie. Ten 28^{en}, de *heymelicke uijtganghen sullen inde bolwercken overwelft sijn, & breed wesen 8 voeten, hebbende haer incomst van binnen inde houcken daer twee wallen vergaderen; Ende op datter peerden meughen deur commen, sullen eenvaerdich dalen sonder trappen 40 voeten diep, te weten tot de deur der uijtcomst toe, welcke staen sal in elcke binnesijde des *schutfels, ten einde des tants vande onderplaets, ende wort verstaen dat die overwelfselen hooch sullen sijn 8 voeten.

Oreillon. Ten 29^{en}, om van binnen de sterckte tot des *strijckhoucx onderplaets te commen, op datmen daer deur bequamelick grofgheschut, met ander noodlickheyt brenghen ende uijthalen mach, soo salmen daer henen gaen

21. The length of the lower or undermost place in the flank, i.e. the open space between the merlon of the lower place and the merlon of the middle place must be 30 feet.

22. The thickness of the merlon of the lower place must be 20 feet.

23. The three embrasures of the lower place shall at their narrowest be 2 feet wide, and thence stretch so far outward that the shot from them may strike the counterscarp.

24. In the parapet of the uppermost place shall be five embrasures, whereof the three innermost are to be so fashioned that they may strike the outside of the parapet upon the covered way, but the two outermost must be so made that they may strike the lower great curtain, and thence so far outward as the orillion will give them leave.

25. In the walls and cavaliers that lie behind the said embrasures of the three places, vaults must be made 12 feet wide and 20 feet long. Concerning their heights, in the raised plan following there will be as little occasion to speak of them, as here in the ground plan: therefore I say here, by way of remembrance, they shall be 7 feet, namely so low that they may be covered by the merlons. And furthermore understand that behind every embrasure, both those that may be made upon the lower curtains, and those in the striking angles, such a vault shall be made. Moreover, the stairs that will lead from the uppermost to the middle place, and thence to the lower place, are to be made in the most convenient place, as required.

26. The gates must be 10 feet wide and shall stand in the midst of the large curtain, the vault stretching right out through the wall.

27. At the end of the gate a little wall is to be made, 40 feet thick, upon which shall be a parapet with embrasures in it, and on one side a door is to be made, as wide as the gate, viz. 10 feet, and the rest accordingly. Furthermore note, the wooden bridge on the ditch before the gate shall lie quite straight on, and it must be so made that it may be removed, or easily destroyed, when necessary.

28. The sallies in the bastions are to be vaulted, and to be 8 feet wide, having their entrances on the inside, in the corner where two walls meet, and to the intent that horses may pass, they shall be made sloping gradually without steps, 40 feet deep, viz. unto the door at the exit into the ditch which is to be set at each inside of the orillion, close to the corner¹⁾ of the undermost place. And further understand that the vault is to be 8 feet high.

29. To go within the fortress into the lower place, in the striking angle, for the ease of bringing ordnance and other necessities in and out, so shall you go there

¹⁾ In agreement with the better wording in the manuscript of 1604, "ten einde des tants" has been translated by "close to the corner".

gaen door den bovescreven *heymelicken uijganck, tot datmen comt *Serie.* ontrent de overwelfelen die ten einde der selve onderplaats staen, van daer af salder een besonder overwelfde ganck gheleyt worden, streckende na het voorscreven overwelfel, alsoo datmen daer van achter in comen mach.

Ten 30^{en}, om tot sulcken einde als boven, van binnen de sterckte oock te comen tot des *strijckhoucx middelplaats, oock opde leeghe walganck, welke altsamen thien voeten hoogher ligghen dan de ghemeene landtgron, soo salmen vande binnedeure des heymelicken uijganck legghen een ander overwelfde ganck, breet ende hooch 8 voeten, rijfende in als 10 voeten, ende uijt commende int binnenste overwelfel dat ten einde der middelplaats staet. Belanghende de incomst des *teghengrafs *Flanc.* die sal bequaemlick staen ter plaats daer het selve teghengraf ende den heymelicken uijganck malcander ontmoeten. *Contramina.*

GRONTTEYCKENING

Ichnographia.

na de voorscreven maten.

OM nu uijt dese maten een grontteyckening te trecken, ende om ten eersten den selhouck te hebben, soo neem ick met den passer uijt de voetmate 1000 voeten, voor een sijde des selhoucx, ende want de selve sijde even is ande *halfmiddellijn van haer omscrivelick rondt, door *Semidiametro sui circumscriptibilis circuli.* het 15 voorstel des 4 boucx Euc. soo treck ick daer mede opt *middel-punt A een verborghen rondt B C D E F G, deele dat met de selve wijde des passers in ses even deelen B C D E F G, ende trecke linien van punt tot punt, hebbe alsoo den begheerden selhouck. *Centrum.*

Ten 2^{en}, stel ick den passer op 180 voeten, voor de langde van yder houck des selhoucx, tot de voorsijde des *tants der middelplaats, teycken die van B tot H over deen sijde, ende van B tot I over dander sijde: Daer na van C tot K ende van G tot L, ende soo voort met al dander derghelijcke. *Meriana.*

Ten 3^{en}, om te hebben de breedte des *strijckhoucks, met de dichte van haer *schutfel soo treck ick H M lanck 140 voeten, ende rechthouckich op B C. Inder selver voughen treck ick I N rechthouckich op B G, ende K O rechthouckich op C B, doende der ghelijcke op al dander der ghelijcke plaatsen. *Flanc. Orillon.*

Ten 4^{en}, treck ick H P 30 voeten, voor breedte des *strijckhoucx opde voorsijde des tants vande middelplaats, teyckenende der gelijcke 30 voeten van K tot Q, ende soo voort op al dander der ghelijcke linien. *Flanc.*

Ten 5^{en}, teycken ick H R 20 voet inde lini C B, voor dichte des selven *tants, trecke voort R S *evewijdich met H P, doende der ghelijcke op *Meriana. Parallela.* alle

through the secret way before spoken of, until you come near the vaults that stand at the back of the said lower place. Thence, another special vaulted way shall be made stretching into one of those vaults, so that the entrance shall be at the end of it 1).

30. In like manner for the purpose before spoken of, to come into the middle place of the striking angle, and also upon the lower wallway (both of which lie 10 feet higher than the common land) from the innermost door of the sallies, make another special vault 8 feet high and 8 feet wide, rising in all 10 feet and ending in the innermost vault that lies at the back of the middle place. Concerning the way into the countermine, it shall fitly stand at the place where the same countermine and the secret sally meet.

GROUND PLAN

according to the above-mentioned dimensions

1. To frame a ground plan according to the above-mentioned dimensions, and first of all to make a hexagon, I take with the compass from the foot measure 1000 feet for one side of the hexagon, and because the same side is equal to the radius of a circumscribed circle, according to the 15th proposition of the 4th book of Euclid 2), I draw upon the centre *A* a blank circle *BCDEFG* and divide that circle by the same width of the compass into six equal parts *BC*, *CD*, *DE*, *EF*, *FG*, *GB*, and draw lines from point to point, and thus I have the required hexagon.

2. I set the compass at 180 feet for the length of each angle of the hexagon to the foreside of the merlon of the middle place, making it from *B* to *H* on one side, and from *B* to *I* on the other side; likewise from *C* to *K* and from *G* to *L* and so forth with all the others in the same way.

3. To have the breadth of the striking angle, with the thickness of the orillion, I draw *HM* 140 feet long, and perpendicular to *BC*. Similarly, I draw *IN* at right angles to *BG* and *KO* perpendicular to *CB* and do the same in all other similar places.

4. I draw *HP* 30 feet for the breadth of the striking angle upon the foreside of the merlon of the middle place, making the like 30 feet from *K* to *Q* and so forth on all other similar lines.

5. I make *HR* 20 feet on the line *CB* for the thickness of the same merlon; then I draw *RS* parallel with *HP* and do the same in all other similar places.

¹⁾ This point of the Dimensions does not contain a single measure; see, however, point 29 on p 83.

²⁾ Here Stevin quotes from Euclid's *Elements* the 15th proposition of the 4th book, on the construction of the regular hexagon. We will not go into this matter here, but in Chapter 4 we shall discuss the application of the 11th proposition for the construction of the pentagon (see note 1 on p. 117).

alle dander derghelijcke plaetsen. Daer na teycken ick het punt T int middel van H R, ende derghelijcke punt by K ter plaets van V, ende by L ter plaets van X. Daer na treck ick van A deur t'punt C een oneindelicke lini, oock derghelijcke oneindelicke linien, deur al dander derghelijcke punten. Voort van het punt T, treck ick een ander lini deur het punt O, ghenakende de oneindelicke A C in Y. S'ghelijcx de lini van het punt V, deur t'punt M, ghenakende de oneindelicke A B in Z, daer na de lini Z X, ende by aldien int hantwerck niet ghemist en is, soo sal de selve lini Z X comen deur t'punt N. Desghelijck salmen oock tot al dander derghelijcke plaetsen doen.

Ten 6^{en}, om te hebben de breedte des grachts, soo treck ick de lini H M noch voordor tot a, alsoo dat M a doet 120 voeten: Trecke daer na een lini van punt Q door t'punt a, tot datse de oneindelicke voortghetrocken A B, comt te ghenaken int punt b: Daer na neem ick met de passier de langde B b, teycken die van C tot e, te weten inde oneindelicke voortghetrocken A C, ende trecke de lini P e, sniende de lini Q b in d. Dit soo wesende, de twee linien e d ende d b, beteecken de caden van die sijde der sterckte, ende opde selve wijze salmen al dander caden trecken, ende de gracht sal van M tot a breed sijn 120 voeten, na de begheerte.

Chemin couvert.

Ten 7^{en}, om de *bedeete wech te teycken, soo treck ick een oneindelicke lini van A deur d, ende door al derghelijcke ander, ende teycken van d tot e, de langde van 20 voeten, voor de breedte der bedeete wech daer sy ten smalsten is, ende trecke de lini van Q deur e, tot datse de oneindelicke voortghetrocken A B, comt te ghenaken in f, neme daer na met den passier de langde b f, ende teycken die van e tot g, te weten inde oneindelicke voortghetrocken A C, ende trecke de lini g e, inder voughen dat de twee linien g e ende e f, beteycken het *borstweer der bedeete wech vā die sijde der sterckte, ende t'gene datter begrepe is tusschen dat borstweer ende de uijtersten der caden e d, d b, beteykent de bedeete wech, welke alsoo oock sal ghetrocken worden rondtom de sterckte tot al dander plaetsen.

Parapetto.

Fossata.

Ten 8^{en}, om de *middelgracht te hebben, soo teycken ick t'punt h int middel van M a, ende trecke daer door V i (ofte om noch eygentlicker te segghen, soo sal die lini ghetrocken worden na i, wijt een punt staende een voet van het punt V na O toe, te weten daer het middel der nauffte plaets des binnebosgats comen sal, volghende het inhoudt des voorgaende 8^{en} punts) sniedende A e in k, ende ghenakende A f in i. Over beyde sijde van dese lini k i, treck ick haer twee *ewewijdeghe, eindende beyde in A e ende A f, oock alsoo, datter vande lini k i, tot yder lini die daer neven ghetrocken is, plaets blijft van 10 voeten, die berekenende inde lini A e, oft M a, comt t'samen voor de wijde des middelgrachts opden houck teghen over het middel der groote gordine, 20 voeten, ghelijck

Parailles.

After that I mark point T in the midst of HR and a similar point near K at V and near L at X. Furthermore from point A I draw an infinite line through point C and also such infinite lines through all other similar points. Moreover, I draw from point T another line through point O, meeting the infinite line AC in Y. Likewise, the line from point V through point M meeting the infinite line AB in Z, after that the line ZX, and if no fault is made in the construction, the same line ZX shall come through point N. The same shall also be done in all other similar places.

6. To have the width of the ditch, I draw the line HM further out to a, so that Ma is 120 feet long. Afterwards I draw a line from point Q through point a until it meets the infinite line AB in point b; then I take with the compass the length of Bb, applying it from C to c upon the infinite line AC, and draw the line Pc, intersecting the line Qb in d. This being done, the two lines cd and db represent the banks of the ditch on that side of the fortress, and similarly I shall draw all the other banks on the other sides of the fortress and the ditch from M to a shall be 120 feet wide, as was desired.

7. To draw the covered way I draw an infinite line from A through d, and thus through all similar points, and mark from d to e a length of 20 feet for the breadth of the covered way where it is at the narrowest, and draw the line from Q through e until it meets the infinite line AB in f. Then I take with the compass the length of bf and mark that from c to g, viz. upon the infinite line AC, and draw the line ge so that the two lines ge and ef represent the parapet of the covered way upon that side of the fortress, and the space between that parapet and the ends of the banks cd, db, represent the covered way, which will also be drawn round the fortress in all other places.

8. To have the middle ditch, I draw point h in the midst of Ma and draw therethrough Vi (or, properly speaking, the line must be drawn unto i from a point standing one foot from point V towards O, viz. where the middle of the narrowest place of the innermost embrasure must be made according to the contents of the above point 8), intersecting Ae in k and meeting Af in i. Upon either side of the line ki I draw two parallel lines, both ending in Ae and Af, so that from the line ki unto each of the lines drawn beside it, there remains a space of 10 feet, which being reckoned upon the line Ae or Ma amounts for the breadth of the middle ditch, at the corner opposite the centre of the large curtain, to 20 feet as before set down in the dimensions. Furthermore, as this part of the

ghelijck boven inde maten ghestelt is. Voort ghelijck dit deel der middelgracht hier geteyckent is, alsoo sal al de reste des middelgrachts rondt om de sterckte ghetrocken worden.

Ten 9^{en}, om te hebben de langde des * schutfels van 100 voeten, ick *Oreillen.* teycken van het punt P af, inde lini P e, 100 voeten, als P t; daer na treck ick de lini t m * ewewijdegh met P M, te weten t'punt m inde lini M V, *Parallelam.* ende den * ongheschickten vierhouck m M P t, is het begheerde schutfel. *Trapezium.*

Ten 10^{en}, soo moet de dicke des * borstweers vande onderste groote *Parapetto.* gordine, sijn van 20 voeten, de selve teycken ick van n tot o, ende treck door o een * ewewijdeghe met n, teycken oock der ghelijcke dicke voor *Parallelam.* de onderste borstweeren der bolwercken.

Ten 11^{en}, teycken ick van o tot p 20 voeten, voor de breedte des leeghenwalgancx, ende trecke door p de ewewijdeghe met o.

Ten 12^{en}, teycken ick van p tot q 30 voeten voor dicke des * beschoeyfels, ende borstweers vanden hooghen wal, ende trecke door q de *Scarpa.* * ewewijdeghe met p. Voort beleyde ick dit bovenste borstweer alsoo, dat *Parallelam.* daer uijt comt een bovenste * crans des bolwerckx, ghelijck uijt het onderste borstweer den ondercrans ghemaect wert, treckende die bolwerckx *Ghirlanda.* bovegordinen, uijt de nevenstaende boveplaetlens binnensten houck, ende latende voor langde der middelplaets 30 voeten.

Ten 13^{en}, teycken ick van q tot r 50 voeten, voor breedte des * hooghe *Terreplain.* walgancx, ende trecke door r een * ewewijdeghe met q. *Parallelam.*

Ten 14^{en}, teycken ick van r tot s 20 voeten, voor dicke des * binnebe- *Scarpa.* schoeyfels vanden hooghen wal, ende trecke door s de ewewijdeghe met r.

Ten 15^{en}, teycken ick van s tot t 30 voeten, voor breedte der strate tus- *Parallelam.* schen de huysen ende den wal, ende trecke door t de * ewewijdeghe met s. *Scarpa.*

Ten 16^{en}, neem ick voor * beschoeyfel der catte met haer borstweer *Ghirlanda.* r'samen 30 voeten, teycken op sulcken dicke den * crans der catte F, ende trecke de voorsijden der selver uijt den binnenhouck der boveplaets, latende tuschen het borstweer der boveplaets ende de catte 30 voeten, voor langde der boveplaets: Doe voort de bovescreven dinghen op alle ander dergheleijcke oirten.

Ten 17^{en}, om te hebben den wech daermen door comt uijt de gront des grachts na de * bedecte wech, soo teycken ick t'punt u, alsoo dat t u *Sirada coperta.* doet 20 voeten, trecke daer na de lini P u, neem daer uijt de langde u x van 240 voeten, ende hebbe den begheerden wech u x c.

Ten 18^{en}, om te hebben den wech daermen door gaet vande * bedecte *Corridor.* wech tot boven op haer * borstweer, soo teycken ick t'punt y, alsoo dat f y *Parapetto.* doet 20 voeten, trecke daer na de lini Q y, neem daer uijt de langde y z van 40 voeten, ende heb den begheerden wech y z f.

Ten 19^{en}, soo moet een overwelfselken gheleyt worden, in yder deel des grooten wals dat op het * schutsel light, als ter plaets van d, uijtcom- *Oreillen.* mende

middle ditch is here laid out, so shall all the rest of the middle ditches be drawn round the fortress.

9. To have the length of the orillion 100 feet I mark from point P upon the line Pe 100 feet, which is Pl. After that I draw the line lm parallel to PM, viz. point m in the line MV and the irregular quadrangle mMPl is the desired orillion.

10. For the thickness of the parapet of the lower large curtain, which must be 20 feet, I mark this from n to o, and draw through o a line parallel to n ¹⁾, and take likewise a similar thickness for the undermost parapets of the bastions.

11. I mark from o to p 20 feet for the breadth of the lower wallway, and draw through p a line parallel with o.

12. I mark from p to q 30 feet for the thickness of the scarp, and the thickness of the parapet of the higher wall, and draw through q a line parallel to p; furthermore I lay out this uppermost parapet, so that it makes the upper garland of the bastion, as of the undermost parapet the lower garland was made, drawing the upper curtain of the bastion, from the next inner corner of the upper place, and leaving for the length of the middle place 30 feet ²⁾.

13. I mark from q to r 50 feet for the breadth of the higher wallway, and draw through r a line parallel with q.

14. From r to s I mark 20 feet for the thickness of the scarp of the inside of the higher wall and draw through s a line parallel with r.

15. I mark from s to t 30 feet for the breadth of the street between the houses and the wall, and draw through t a line parallel with s.

16. I take for the scarp of the cavalier with its parapet 30 feet, draw at such thickness the garland of cavalier F, and draw the foreside of the same cavalier from the inner corner of the higher place, leaving between the parapet of the higher place and the cavalier 30 feet for the length of the higher place. Thus are the aforesaid things done in all similar places.

17. To have the way by which we must ascend from the bottom of the great ditch to the covered way, I mark point u, so that cu shall be 20 feet. Afterwards I draw the line Pu and out of that the length ux 240 feet and thus I have the required way uxc.

18. To have the way to go up from the covered way upon its parapet, I mark point y, so that fy is 20 feet. After that I draw the line Qy, out of that I take the length yz 40 feet and so I have the required way yzf.

19. Then must a small vault be made, in each part of the rampart of the orillion, as at δ ³⁾, coming out on one side in the middle place, on the other in

¹⁾ In this point and in points 11, 12, 13, 14 and 15 the letters n, o, p, q, r, s and t for convenience represent parallel lines (see also Fig. 1).

²⁾ A comparison of this point 12 of the Ground plan with point 12 of the Dimensions will elucidate the contents. Also for the other points such a comparison is recommended.

³⁾ The letter δ , although occurring in Fig. 1, is not mentioned in the legend to this figure. The vault concerned is indicated in Fig. 3 by X . . . Y.

mende op deen sijde inde middelplaats, op dander sijde in des bolwerck leeghe gordijnganck, te weten 6 voeten hooch en breed, ende dat tot sulcken einde als int voorgaende 19^e punt der maten gheseyt is.

Cannoniers.

Flanc.

Ten 20^{en}, soo moeten wy hebben twee * bosgaten der middelplaats des * strijckhouck: Maer want het begriip vande eerste form daer toe te cleen is, ende dat alles te onsenlick soude wesen, soo sullen wy inde 2^e form een grooter strijckhouck alleen stellen, alwaer met A B beteyckent wort de lini H P der 1^e form, te weten de breedte des strijckhouck van 30 voeten: Dese A C bediet ghinste H R diē des * tants van 20 voeten: Deur dese C D salmen verstaen een deel van die groote gordine R K: met dese B E wort beteyckent die P l binnesijde des * schutsels, dese C F is voor die R S binnesijde des tants, welke C F vande voortghetrocken E B gherocht wort int punt G. Om hier op nu de bosgaten te trecken na de begheerte, soo teycken ick G H met C I, elck 2 voeten, voor breedte der bosgaten daer sy ten nausten sijn, treck daer na H K in sulcker voughen, dat mender langs henen sien can een deel der gordinen A D. Voort I L recht na den punt des borstweers vande * bedecte wech, dieder, soo de form volmaect waer, ligghen soude teghen over het middel der groote gordine. Dit soo wesende, men can na het inhoudt des 20^{en} punts der maten, deur beyde die bosgaten sien den selven houck vant borstweer der bedecte wech, want G E binnesijde des schutsels strecket van selfs henen, ende I L is daer na ghetrocken.

Merlone.

Orcillon.

Corridor.

Merlone.

*Scarpa.
Orcillon.
Parabelam.*

Ten 21^{en} moeten wy teyckenen de langde vande onderplaats, tusschen den * tant vande selve onderplaats, & den tant vande middelplaats. Hier toe nemen wy meerder claehteyts halven een besonder form, te weten de derde, alwaer A beteyckent den tant der 2^e form, wiens voorsijde met haer * beschoeyfel is B, ende C D bediet de gordine, E F de binnesijde des * schutsels. Inde selve form treck ick de lini G H * ewewijdeghe met B, ende alsoo datter tusschen beyde de linien sijn 30 voeten voor begheerde open middelplaats.

*Merlone.
Scarpa.*

Ten 22^{en}, treck ick inde voornomde 3^e form de lini I K ewewijdeghe met G H, ende alsoo datter tusschen beyden sijn 20 voeten, voor de diē des * tants, metgaders noch 3 voeten voor * beschoeyfel. Om inde selve de bosgaten na den eyfch te teyckenen, te weten alsoo dat de beschoeyfelen der wallen en caden de volcommen strijckingen niet en verhinderen, soo treck ick eerst de beschoeynghe der seluer K L, I M, alsoo datter tusschen beyden sy 6 voet, voor de diē des beschoeyfels op de hooghe des gheschots.

Cannoniers.

Ten 23^{en}, teycken ick inde selve 3^e form, de twee * bosgaten by K ende I ghelijck int 20^e punt die der middelplaats gheteyckent waren, voort noch een int middel alsoo de selve form opentlicker anwijst.

Ten 24^{en}, soo sijnder noch te legghen de vijf bosgaten der boveplaats, welke

the lower curtain of the bastion, which vault must be 6 feet high and 6 feet wide, and must serve the purpose as described in point 19 of the dimensions.

20. We must have two embrasures in the middle place of the striking angle. But because Figure 1 is too small and because all might not be well discernible in it, therefore in Figure 2 I will set forth a greater striking angle alone, in which AB shall designate the line HP of Figure 1, viz. the breadth of the striking angle 30 feet. This AC represents that HR, the thickness of the merlon 20 feet. This CD shall be understood to be part of that large curtain RK; this BE signifies that PI, the inner side of the orillion; this CF stands for that RS, the inside of the merlon, which CF is intersected by the produced line EB in point G. Now upon this to lay out the embrasures as is required, I set down GH with CI, each two feet for the width of the embrasures at the narrowest place. After that I draw HK in such a manner that when looking along it part of the large curtain AD can be seen. Furthermore I draw IL right unto the corner of the parapet of the covered way, which should lie opposite the centre of the large curtain if drawn perfectly. This being so, we may according to point 20 of the dimensions see through both embrasures the same corner of the parapet upon the covered way, for GE, the inside of the orillion, extends of itself in that direction, and IL has been drawn accordingly.

21. We must draw the length of the lower place between the merlon of the said lower place, and the merlon of the middle place. For better clarity, we will take a special figure, to wit Figure 3, in which A represents the merlon of Figure 2, whose foreside with its scarp is B, and CD represents the large curtain, EF the inside of the orillion. In the same figure I draw the line GH parallel to B, so that between these two lines are 30 feet for the required open space in the middle place.

22. In Figure 3 just mentioned I draw the line IK parallel to GH, and so that there be between them 20 feet for the thickness of the merlon and 3 feet for the scarp of the wall. To draw the embrasures in it as required, in such a way that the scarp of the walls, and sides of the ditch, shall not impeach the perfect flanking, I therefore draw first their scarps KL, IM, that there be between the two 6 feet for the thickness of the scarp at the height the ordnance stands at.

23. I set down in the same Figure 3 the two embrasures at K and I, as in point 20 were drawn those of the middle place, and one more in the midst of them, as appears more clearly in Figure 3.

24. Now there still remain to be laid out the five embrasures in the higher place, which we designate in Figure 3 by N, O, P, Q, R. The three innermost

welcke wy inde 3^e form beteecken met N, O, P, Q, R. De drie binnenste N, O, P, worden verstaen alsoo gheleyt te wesen, dat de buijtesijden al strecken na de punt des borstweers der *bedecte wech, om het selve borstweeer te connen *strijcken, oock alsoo dat P de leeghe bolwerex gordine strijcken can. Maer de twee buijtenste bosgaten Q R ligghen soo, datse ter eender sijde strijcken connen de leeghe groote gordine C D, ende de buijtesijden der selve twee bosgaten sijn ghetrocken na den houck des *schutsels by S, om aldaer soo verre sijdeling te meughen schieten als het schutsel toelaet, twelck soo sijnde, Q can oock de leeghe bolwerex gordine strijcken. Corridor.
Nettoyer.
Orillon.

Ten 2^{en}, om te hebben de overwelfelen inde wallen achter de bosgaten, soo treck ick eerst inde voorscreven 2^e form de lini M N, beteyckende her *beschoeyfel des wals achter de bosgaten der middelplaats, alsoo datter begrip tusschen de twee linien C F ende M N, breed wesende 30 voeten, bediet den openen onbedecten vloer der middelplaats. Voort teycken ick inden wal de twee begheerde overwelfelen O P, elck breed 12 voeten, lanck 20 voeten. Ende wort verstaen datmen derghelelike overwelfelen oock legghen sal achter de *bosgaten der boveplaats ende onderplaats, oock achter de bosgaten diemen tot verscheyden plaatsen inde leeghe gordinen mach legghen, om t'gheschot sijn deysing in te nemen, soot noodich waer. Angaende den steygher om vande boveplaats bedectelick ende bequaemlick te commē inde middelplaats, die sal geleyt worden an T V inde 3^e form: Welverstaende dat de voorscreven T V een gat is lanck 20 voeten ende breed 10 voeten. Om welker ghestalt noch eyghentlicker te verklaren, soo teycken ick X Y, bediedende den overwelfden ganck, dieder street vande middelplaats deur den hooghen wal tot inde leeghe gordijnganck, daer int 19^e punt af gheseyt is. Nu wanneer dese steygher T V, afcomt tot inde ganck X Y, soo salmen dan ter sincker handt om meughen keeren na de deure X, om te commen inde middelplaats, & ter rechterhandt, om te commen inde leeghe gordijnganck. De reden waerom t'gat T V maer 20 voeten lanck ghenomen en wort, ende dat de reste des steyghers onder de eerde gaet, is om t'gheschot boven ter plaats van S sijn deysing te meughen nemen. Dese steygher wort verstaen met een muer vande middelplaats ghesceyden te wesen, welcke muer beteyckent is met de twee linien daer de deure X in staet, ende comt hoogher dan den vloer der boveplaats (alsoo oock doen de muerkens daer t'gat des traps mede beset is) vier voeten, verstreckende voor borstweeren. Voort om dander steygher te hebben, daermen door comt vande middelplaats inde onderplaats, soo sal de selve steygher boven beghinnen an deen sijde des ganck X Y, ende sal voort strecken onder S, tot datse uijtcomt in het overwelfel dat achter het buytebosgat vande onderplaats staet. Inder voughen dat by aldien Scarpa.
Cannoniers.

N, O, P are understood to be so laid out that the outside all look to the corner of the parapet of the covered way, to be able to flank the parapet itself, and also that P may flank the lower curtain of the bastion. But the two outermost embrasures Q, R must lie so that on one side they may flank the lower large curtain CD, and the outsides of the same two embrasures are drawn towards the corner of the orillion at S, to shoot so far sideways as the orillion will permit, which so being, Q can likewise flank the lower curtain of the bastion.

25. To have the vaults in the walls, behind the embrasures, I draw first in the (already mentioned) Figure 2, the line MN, representing the scarp of the wall behind the embrasures in the middle place, the space between the two lines CF and MN, being 30 feet broad, representing the open uncovered floor of the middle place. Then I mark in the wall the two required vaults O, P, each 12 feet broad and 20 feet long. And it is to be understood that similar vaults shall also be made behind the embrasures in the upper place and in the lower place, and likewise behind the several embrasures which may be made at various places upon the lower curtains for ordnance to recoil into if necessary. Concerning the stairs to go down secretly and conveniently from the upper place into the middle place, they will be connected to TV in Figure 3, which TV is a hole 20 feet long and 10 feet broad. To explain its form more properly, I draw XY for the vault that goes from the middle place through the high wall into the lower curtainway, which is spoken of in point 19. Now when we descend along the stairs TV into the way XY, we may turn upon the left hand to the door X to enter upon the middle place, and turn upon the right hand to go to the lower curtainway. The reason why the hole TV is taken but 20 feet long, and that the rest of the stairs goes underground, is that the artillery over it, at the place S, may take its recoil. This stair is understood to be separated from the middle place by a wall, which wall is shown by the two lines wherein the door X stands, and it is raised four feet higher than the floor of the higher place (as are also the little walls with which the hole of the stairs is provided) serving as parapets. Then to have the other stair by which one descends from the middle place into the lower place, the same stair shall begin at the side of the way XY, and shall stretch forward under S until it comes forth in the vault that stands behind the outermost embrasure in the lower place, so that if we consider the whole breadth of the ways as

men de heele breedte des ganck wil anſien voor een trap, ſoo canmen vande boveplaets tot inde onderplaets commen met eenen rechten ſteygher.

Rampars.

Ten 26^{en}, moeten wy de poorten hebben, om van welke teyckenin- ghe in grooter form meer beſcheyts te ſien, ſoo ſtellen wy daer af de vol- ghende 4^e form, alwaer A B C D bediet de dicke der * wallen, inde ſelve teycken ick E F 10 voeten, voor de wijde der poorte: Ende van E F tot G H is een overwelfſel recht uijt onder deur de wallen.

Parapetto.

Ten 27^{en}, teycken ick ten einde der poorte een walleken als I, dick 40 voeten, t'welck verſtaen wort van binnen metgaders dander ſijden een * borſtweer met boſgaten te moeten hebben, dicke twee voeten: De voor- ſcreven dicke van 40 voeten, is op dat een groot ſtick gheſchots ligghen- de teghen over t'middel der poorte, daer op ſijn deyſinghe mach nemen. Voorts ſal ter plaets van K noch een poorte ſijn, breed als de voogaende 10 voeten. Voor dit walleken ſal noch ligghen een diepte grachtsche wiſſe, breed 10 voeten, als de ghetippelde plaets aenwijſt, de ſelve diepte ſal rondtom beſchut ſijn met houten lenen, datter menſchen, peerden noch waghens in en vallen. Noch ſalder over deſe diepte een valbrugghe comen voor de poorte K, ter plaets van L. De viercante plaets M is tot deſen einde; Alſter uijtwarende waghens comen deur de poorte K, welke ſiende datter incommende waghens onder het overwelfſel E F G H ſijn, ſoo meughen die uijtwarende waghens wijcken inde ſelve plaets M, om die invarende te laten deurlyden.

*Sorties ou ſauſſes
portes.*

Oreillon.

Ten 28^{en}, ſijnder de * heymelicke uijtganghen te teyckenen, hier toe nemen wy de volghende 5^e form, alwaer A B C een bolwerck bediet, ende D den houck daer twee wallen vergaren. In deſen houck wort ver- ſtaen een deur te weſen, vande welke een overwelfde ganck gheleyt wort 8 voeten breed, eenvaerdich dalende na E, van daer na F, ende ſoo voort na G toe, uijt commende inde binneſijde des * ſchutſels voor de tant vande onderplaets opde gront des grachts, die 40 voeten leegher light dan de ghemene landtgront daer de doore D opſtaet. Inder vou- ghen dat den ſelven ganck in als 40 voeten dalen moet. Voort gheliickſe over deen ſijde keert van E na F tot G, alſoo keettſe over dander ſijde van E na H tot I.

Flanc.

Ten 29^{en}, om te teyckenen de wech daermen van binnen de ſterckte bequamelick duer comen mach na de onderplaets des * ſtrijckhoucx, welke verſtaen wort in als 30 voeten leegher te ligghen dan de gemeene landtgront, ſo ſalmen daer henen gaen van D tot E inde 5^e form, van daer tot K, van waer af een ander overwelfſel ghelcyt ſal worden, om van achter te comen int overwelfſel dat ten einde vande onder- plaets ſtaet.

Ten 30^{en}, volgt de ganck daermen van binnen de ſterckte door mach
comen

steps, we may come down from the higher place into the lower by one straight stair.

26. Furthermore, to have the gates of the fortress, which for more ease I have set forth in greater form, as in Figure 4, where ABCD represents the thickness of the walls, in this I mark out EF 10 feet for the width of the gate, and from EF unto GH is a vault right through under the walls.

27. At the end of the gate I set forth a little wall, as I, thick 40 feet, which is to be understood to have within, together with the other sides, a parapet two feet thick with embrasures in it; the aforesaid thickness is taken 40 feet to the intent that a piece of great ordnance lying upon it right opposite the middle of the gate, may have room to recoil. Furthermore at the place K shall another gate be laid as broad as the first, to wit 10 feet. Before this little wall shall a depth be made ditchwise, 10 feet broad, as the dotted place in the figure shows, which depth shall be protected round about by wooden railings to prevent men and horses, or waggons from falling in, and over this depth shall a drawbridge be made before the gate K in the place L. The square place M is to this end that waggons or carts going out through the gate K, noticing incoming waggons under the vault EFGH, may stay there to give the incomers leave to pass.

28. Now to lay out the secret sallies I take the following Figure 5, where ABC represents a bastion and D the angle where two walls meet. In this corner is supposed to be a door, from which is led a vaulted way 8 feet broad, evenly descending towards E, thence to F, and so forth unto G, coming out into the bottom of the ditch at the inside of the orillion, before the merlon of the lower place, which bottom of the ditch lies 40 feet under the level of the ground where the door D stands, so that the said way must in all sink 40 feet. Moreover, as it turns upon the one side from E unto F and then towards G, so upon the other side it turns from E unto H and so unto I.

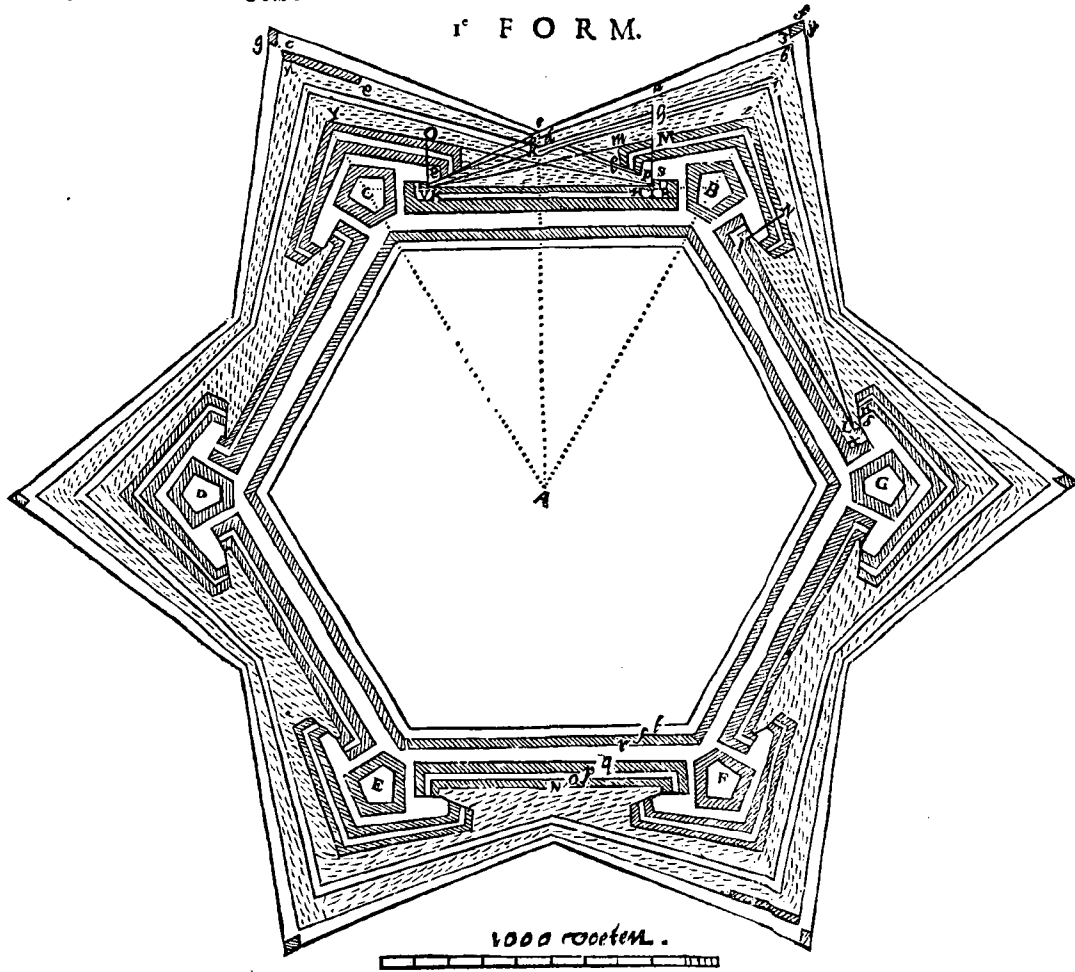
29. To lay out the way to go easily from the inside of the fortress into the lower place in the flank, which is to be understood to lie in all 30 feet lower than the level of the ground, so shall you go from D unto E as in Figure 5 and thence unto K, whence another vault shall be laid to come from behind into the vault at the end of the lower place.

30. Now to have the passage from the inside of the fortress into the middle

commen tot de middelplaats, van daer opde leeghe walganck rondtom de sterckte. Hier toe nemen wy wederom de 5^e form, alwaer vande bin-
nedeur D af, noch een ander overwelfde ganck gheleyt is, streckende na
L, hooch en breed als dander 8 voeten, maer rijfende in als 10 voeten
(want soo veel light de leeghe walganck of middelplaats hoogher dan
de ghemeene landtgront) ende uijt commende int binnenste overwelf-
fel dat ten einde der middelplaats staet. Angaende de incomst van het
* teghengraf die sal wesen ter plaets daer het selve teghengraf ende den *Continua.*
* heymelicken uijtganck malcander ontmoeten bijde buijtendeure des *Fauſt pte.*
heymelicken uijtganck tusschen G ende F.

C I^e F O R M.

place, and thence into the lower wallway, round about the fortress, I take again Figure 5, where from the door D another vaulted way has been made, stretching towards L, as high and broad as the other, 8 feet, but rising throughout 10 feet (for so much lies the lower wallway or middle place higher than the ground level) and coming out into the innermost vault that stands at the end of the middle place. Concerning the entrance to the countermines, this shall be at the place where it meets the sally at the outer door of the sally between G and F.

1^{re} FORM.

DEELEN DER 1e FORM,

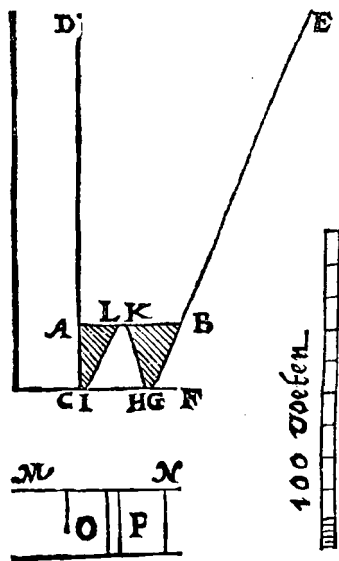
Wesende grontteykening van een heele stercte.

ts	Straete tusschen de huijsen ende den wal.
sr	Binnebeschoeyssel des hooghen wals. <i>Scarpa, Falda, salita.</i>
rq	Hooghewalganck. <i>Terrapieno.</i>
qp	Borstweer met beschoeyssel des hooghen wals. <i>Parapetto.</i>
po	Leeghe walganck. <i>Allée.</i>
on	Borstweer der leeghewal. <i>Parapetto.</i>
Ma	Groote gracht. <i>Grand fossé.</i>
khi	Middelgracht. <i>Fossetta.</i>
bdc	Caden.
bdef	Bedecte wech. <i>Strada coperta.</i>
cux	Ganck om te climmen uijt de gracht opde bedecte wech.
fyz	Ganck om te climmen vande bedecte wech op haer borstweer.
IPSRTH	Strijckhouck. <i>Flanck.</i>
PlmM	Schutsel. <i>Oreillon.</i>
PlmMZN	Bolwerck.
BCDEFG	Catten. <i>Cavaillieri.</i>

PARTS OF FIGURE 1,

being the ground plan of a complete fortress

ts	Street between the houses and the wall.
sr	Scarp of the inside of the higher wall.
rq	Higher wallway.
qp	Parapet, with scarp of the higher wall.
po	Lower wallway.
on	Parapet of the lower wall.
Ma	Great ditch.
khi	Middle ditch.
bdc	Bank or counterscarp.
bdef	Covered way.
cux	Passage out of the ditch up to the covered way.
fyz	Passage out of the covered way up to the parapet of the same.
IPSRTH	Striking angle.
PlmM	Orillion.
PlmMZN	Bastion or bulwark.
B, C, D, E, F, G,	Cavaliers.

2^e FORM.DEELEN DER 2^e FORM,

Wesende grontteyckening van een stryckhouck met haer middelplaets.

GE Des schutfels binnesijde.

CD Deel der leeghe grootte gordine.

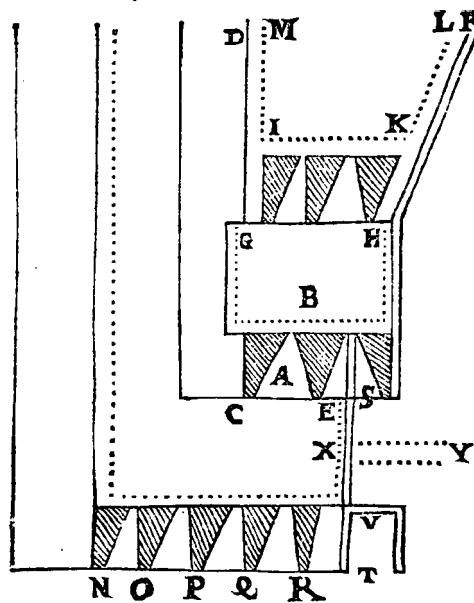
ACIL Het binnebof gat. *Canoniere.*

KHGB Het buijtebof gat.

LIKH Den tant. *Merlone.*

MCFN Des stryckhouck middelplaets.

OP De overwelffelen daer achter.

3^e FORM.DEELEN DER 3^e FORM,

Wesende grontteyckening van een stryckhouck met haer drie plaetsen.

HF Binnesijde des schutfels.

KL Haer beschoeyfel. *Scarpa.*

CD Deel der leeghe gordine.

MI Haer beschoeyfel. *Scarpa.*

GBH De onderplaets.

Tusschen GH comen haer drie bofgaten.

CEX De middelplaets.

CE Haer twee bofgaten.

Daer NOPQR op staen is de boveplaets.

NOPQR Haer vijf bofgaten.

S Een bofgat ligghende opde hooghde van dander NOPQR.

XY De overwelfde ganck vande middelplaets na des bolwerck leeghe gordijnganck.

TV Het bovenste gat des steyghers, om te comen vande boveplaets na de middelplaets.

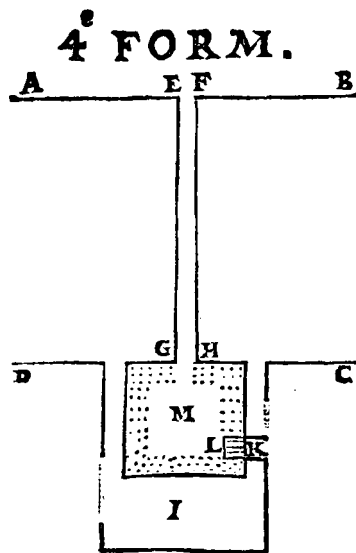
4^e FORM.

PARTS OF FIGURE 2,
being the ground plan of a striking angle with its middle place

GE	Inside of the orillion.
CD	Part of the lower great curtain.
ACIL	Inner embrasure.
KHGB	Outer embrasure.
LIKH	Merlon.
MCFN	Middle place of the striking angle.
O, P	Vaults behind it.

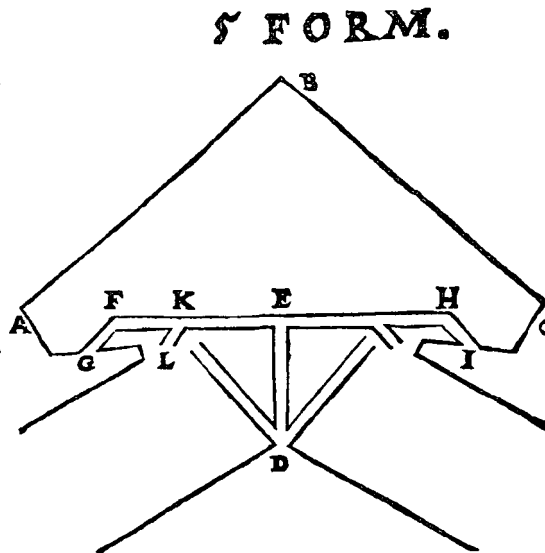
PARTS OF FIGURE 3,
being the ground plan of a striking angle with its 3 places

HF	Inside of the orillion.
KL	Scarp of the orillion.
CD	Part of the lower great curtain.
MI	Scarp of the lower great curtain.
GBH	Lower place.
Between G and H	are its 3 embrasures.
CEX	Middle place.
C, E	Its two embrasures.
Where the letters N, O, P, Q, R	stand is the upper place.
N, O, P, Q, R	mean its 5 embrasures.
S	An embrasure, lying at the level of the embrasures N, O, P, Q, R.
XY	Vault from the middle place unto the lower way of the curtain of a bastion.
TV	Upper hole of the stairs to descend from the upper to the middle place.



DEELEN DER 4^e FORM,
Wesende gronteyckening
van een poorte.

- A B C D Dikte der wallen.
 E F Wijde der poorte.
 E F G H Overwelffel door de wallen.
 I Walleken ten einde der poorte.
 M Plaets tusschen het walleken I ende het overwelffel.
 K Tweede poorte.
 L Valbrugghe daer voor.



DEELEN DER 5^e FORM,
Wesende gronteyckening van een
bolwerck met sijn inwendighe
overwelfde ganghen.

- D Deure inden houck daer twee wallen vergaren.
 D E F G Heymelicken uijtganck ter eender sijde.
 D E H I Heymelicken uijtganck ter ander sijde.
 G, I, Deuren der Heymelicke uijtgancken inde binnensijden der schutfels.
 D E K L Ganck na de onderplaets.
 D L Ganck na de middelplaets.

D

WANT

PARTS OF FIGURE 4,
being the ground plan of a gate

ABCD	Thickness of the walls.	M	Place between the little wall I
EF	Width of the gate.		and the vault.
EFGH	Vault through the wall.	K	Second gate.
I	Little wall at the end of the gate.	L	Drawbridge before it.

PARTS OF FIGURE 5,
being the ground plan of a bastion with its inward, vaulted ways.

D	Door in the corner where two walls meet.	G, I	Doors of the secret ways out on the insides of the orillions.
DEFG	Secret exit upon one side.	DEKL	Way towards the lower place.
DEHI	Secret exit upon the other side.	DL	Way towards the middle place.

Contemplatie.

Plano infinito.

Mathematicos.

WANT de voorgaende grontteijckeninghe alleenelick bethoont dei sterckten ghestalt int anſien van langde en breedte, ende dat de *ſpieghelinghe vande gheleghentheyt in hoochde of diepte tot volcommen kennis ſeer noodich is, ſoo ſullen wy nu ande verheven teyckeninghe commen; om den ſin van welke wat breeder uijt te legghen, ſoo neem ick dat een lichamelicke ſterctē, doorneden wort met een *oneindelick plat door r'middel tuſſchen twee bolwercken (ſulcx is de gebruik van doen byde *Wiſconſtnaers, die alſoo hemelen ende eerde doornien, om te vinden wat inde ſne ſtaet) ofte om meer na de ghemeene maniere te ſpreken, genomen datter gemaeft ſy een lichamelick houten voorbeelt eender ſterctē, ende dattet in twee gheſneden of gheſaecht worde, door r'middel tuſſchen twee bolwercken: Dit ſoo ſijnde, de form welke haer in die ſne verthoont, is de ghene die wy nu voornemen te teyckenen ende beſcrijven.

MATEN DER VERHEVEN

*teyckening, ſpruytende uijt een ſne door het
middel der groote gordine.*

Rempart.

Scarpa.

Terreplain.

Parapetto.

Scarpa.

Allée.

Parapetto.

Scarpa.

Mathematic.

Contrascarpa.

Foffetta.

Arithmetice.

Corridor.

Terreplain.

Parapetto.

Allée.

Parapetto.

Grand ſcſſe.

Foffetta.

Parapetto del
corridor.

TEN 1^{en} ſoo moetter opden ghemeenen landtgront gheteykent ſijn de breedte der ſtrate tuſſchen de huysen ende den *wal vā 30 voeten.
TEN 2^{en} de dickte des *beſchoeyfels vanden wal 20 voeten.
TEN 3^{en} breedte des *hooghen walgancx 50 voeten.
TEN 4^{en} dickte des *borſtweers vanden wal 20 voeten.
TEN 5^{en} dickte des *beſchoeyfels daer voor 10 voeten.
TEN 6^{en} breedte des *leeghe walgancx 20 voeten.
TEN 7^{en} dickte des *borſtweers daer voor 20 voeten.
TEN 8^{en} dickte des *beſchoeyfels vande leeghe wal 8 voeten.
TEN 9^{en} breedte der groote gracht opde bovecant gemeten 140 voeten:
Soo veel te moetē doē, volgende r'geſtelde, wort *Wiſconſtick bevonden.
TEN 10^{en} dickte des *cabefchoeyfels 8 voeten.
TEN 11^{en} breedte der *middelgracht 20 voeten, welverſtaende dat de binneant der ſelve middelgracht, ſal commen $88 \frac{2}{7} \frac{4}{1}$ voeten vant beſchoeyfel der gordine. Hoemen die langde volghende r'geſtelde *Telconſtick vindt, ſal int 3^e Hoofſtick vermaent worden.
TEN 12^{en} breedte der *bedecte wech 20 voeten.
TEN 13^{en} hooghde des *hoeghe walgancx 40 voeten.
TEN 14^{en} hooghde des *borſtweers daer voor 47 voeten.
TEN 15^{en} hooghde des *leeghe walgancx 10 voeten.
TEN 16^{en} hooghde des *borſtweers daer voor 17 voeten.
TEN 17^{en} diepte der groote gracht: 40 voeten.
TEN 18^{en} diepte der *middelgracht 15 voeten.
TEN 19^{en} hooghde des *borſtweers vande bedecte wech 7 voeten.
TEN 20^{en}

For as much as the aforesaid ground plan only shows the state of a fortress with respect to its length and breadth, and because the theory of the situation in height and depth is very necessary for the perfect knowledge, we will now proceed to the raised drawing; for the better expressing of the meaning whereof I suppose that a bodily fortress be cut through the midst between two bastions by an infinite plane (which is the manner of doing amongst the mathematicians, who thus cut through heaven and earth to find what is in the section) or to speak more like the common custom, suppose there be made in wood a bodily model of a fortress, and that it were cut or sawn in two pieces, in the midst between the two bastions. This being so, that form which shows itself in the section is that which we here take upon us to draw and describe (commonly called a profile).

DIMENSIONS OF THE RAISED PLAN

springing from a section through the midst of the great curtain.

1. Upon the common ground must be laid out the breadth of the street between the houses and the wall or rampart 30 feet.
2. The thickness or breadth of the scarp of the wall inwardly 20 feet.
3. The breadth of the higher wallway 50 feet.
4. The thickness of the parapet upon the higher wall 20 feet.
5. The thickness of the scarp of the wall before the parapet 10 feet.
6. The breadth of the lower wallway 20 feet.
7. The thickness of the parapet before this way 20 feet.
8. The thickness of the scarp of the lower wall 8 feet.
9. The width of the great ditch measured at the upper edge 140 feet, to so much does it amount according to the plan, as is mathematically found out.
10. The thickness of the counterscarp 8 feet.
11. The width of the middle ditch 20 feet. Note that the inner side of the said middle ditch shall be made $88\frac{24}{71}$ feet from the scarp of the curtain. How that length or distance according to the plan may be arithmetically found, shall be shown in Chapter 3 ¹⁾.
12. The breadth of the covered way 20 feet.
13. The height of the higher wallway 40 feet.
14. The height of the parapet before the same wallway 47 feet.
15. The height of the lower wallway 10 feet.
16. The height of the parapet before the same wallway 17 feet.

¹⁾ See pp. 107-109 in Chapter 3, where, however, the calculation itself has been omitted "as these rules should be derived from their proper places".

Ten 20^{en} soo salmen de afdakinghe des borstweers vanden hooghen wal, oock des borstweers vanden leeghen wal soo legghen, datmen daer langs henen sien mach de twee derdendeelen van het * cabeschoeyfel. *Contrascarpa.*

Ten 21^{en} sal de afdakinghe van het * borstweer der bedecte wech, gheleyt worden na den loop der * sightlijn, commende van het borstweer der leeghte gordine, over het borstweer der bedecte wech, tot den ghemeen landgront, welcke langde van het borstweer af, gerekent tot op den ghemeenen landgront, comt te wesen 126 voeten. Het * Telconstich vinden van welcke langde, int 3^e hoofstlick verclaert sal werden. *Parapetto. Linea visualis. Arithmetica inventio.*

Ten 22^{en}, het * teghengraf sal ligghen onder de leeghe wal, 8 voeten vant uiterste des * beschoeyfels, ende sal breedte sijn 5 voeten, hooch 6 voeten, ende boven overwelft. *Contramina. Scarpa.*

Ten 23^{en}, soo salder achter elck borstweer een banck ligghen, hooch 3 voeten, breedte 3 voeten, om als men daer op staet, int velt te meughen sien, maer daer af wesende, datmen alsdan uijt het velt niet ghesien en wort.

VERHEVEN TEYCKENING

na de voorschreven maten.

TEN 1^{en} treck ick inde volghende 6^e form den ghemeenen landgront (diemen anders * stichteinderslijn noemt) A B, teycken daer in A C 30 voeten, voor breedte der strate tusschen de huysen ende den * wal. *Linea Horizontalis.*

Ten 2^{en} C D 20 voeten voor dickte des * beschoeyfels vanden wal. *Rempart.*

Ten 3^{en} D E 50 voeten voor breedte des hooghen * walgancx. *Scarpa.*

Ten 4^{en} E F 20 voeten voor dickte des * borstweers vande hooghen wal. *Terreplain.*

Ten 5^{en} F G 10 voeten dickte des * beschoeyfels daer voor. *Parapetto.*

Ten 6^{en} G H 20 voeten breedte des * leeghe walgancx. *Scarpa.*

Ten 7^{en} H I 20 voeten dickte des * borstweers daer voor. *Allée.*

Ten 8^{en} I K 8 voeten dickte des * beschoeyfels vande leeghe wal. *Parapetto.*

Ten 9^{en} I L 140 voeten voor de breedte des * grooten grachts op de bo- *Scarpa.*

vecant ghemeten. *Graud fossé.*

Ten 10^{en} M L 8 voeten dickte des * cabeschoeyfels doch alsoo dat N K doet $88\frac{2}{3}$ voeten na het inhoudt des voorgaenden 11^{en} punts. *Contrascarpa.*

Ten 11^{en} N O 20 voeten voor breedte der * middelgracht. *Fosséta.*

Ten 12^{en} L P 20 voeten breedte der * bedecte wech. *Corridor.*

Ten 13^{en} D Q 40 voeten hooghde des * hooghen walgancx. *Terreplain.*

Ten 14^{en} E R 47 voeten hooghde des * borstweers daer voor. *Parapetto.*

Ten 15^{en} G S 10 voeten hooghde der * leeghe walgancx. *Allée.*

Ten 16^{en} H T 17 voeten hooghde des * borstweers. *Parapetto.*

Ten 17^{en} K V 40 voeten diepte der * groote gracht. *Grand fossé.*

Ten 18^{en} X Y 15 voeten diepte der * middelgracht. *Fosséta.*

Ten 19^{en} P Z 7 voeten hooghde des * borstweers vande bedecte wech. *Parapetto de strada coperta.*

17. The depth of the great ditch 40 feet.
18. The depth of the middle ditch 15 feet.
19. The height of the parapet of the covered way 7 feet.
20. The shelving of the parapet, both of the upper and of the lower wall, must be laid so that when looking along it you may see $\frac{2}{3}$ parts of the counterscarp.
21. The shelving of the parapet of the covered way shall be laid by a line stretching from the top of the parapet of the lower curtain, and passing over the parapet of the covered way, to the common ground, whose length from the edge at the covered way to the said ground shall be 126 feet. The arithmetical finding of this length shall be expressed in Chapter 3¹⁾.
22. The countermine shall lie under the lower wall 8 feet from the outside of the scarp, and shall be 5 feet broad, 6 feet high, and vaulted over.
23. Behind every parapet shall a step be made, 3 feet high and 3 feet broad, that thence a man may see the field, without being seen from the outside field if he is not on the step.

RAISED PLAN

according to the aforesaid dimensions

1. I draw (as in Figure 6 following) the common ground (which otherwise we call the level or horizontal line) AB, marking therein AC 30 feet for the breadth of the street between the houses and the wall.
2. CD 20 feet for the thickness of the scarp of the wall.
3. DE 50 feet for the breadth of the higher wallway or rampart.
4. EF 20 feet for the thickness of the parapet upon the higher wall.
5. FG 10 feet for the thickness of the scarp on the foreshore of it.
6. GH 20 feet for the breadth of the lower wallway.
7. HI 20 feet for the thickness of the parapet before that way.
8. IK 8 feet for the thickness of the scarp of the lower wall.
9. IL 140 feet for the width of the great ditch measured at the upper edge.
10. ML 8 feet for the thickness of the counterscarp, so that NK makes $88\frac{24}{71}$ feet according to the contents of the foregoing point 11.
11. NO 20 feet for the width of the middle ditch.
12. LP 20 feet for the breadth of the covered way.
13. DQ 40 feet for the height of the higher wallway.
14. ER 47 feet for the height of the parapet and the wall together.
15. GS 10 feet for the height of the lower wallway.
16. HT 17 feet for the height of the parapet before the lower wallway and the wall together.
17. KV 40 feet for the depth of the great ditch.
18. XY 15 feet for the depth of the middle ditch.
19. PZ 7 feet for the height of the parapet before the covered way.

¹⁾ See p. 107 in Chapter 3, where the calculation, based on similarity of triangles, has been given, viz. $180 \times 7/10 = 126$.

SIMON STEVINS

24

Contrascarpa.

Parapetto.

Scarpa.

Parapetto.

Contramina.

Parapetto.

Ten 20^{en} teycken ick spunt *a* int * cabeschoeyfel *L b*, alsoo dat *a L* sijn de twee derdendeelen van *L b*, ende trecke op dat punt *a* twee linien *R a*, *T a*, Ende op de lini *R a* treck ick de buijte sijde vant * borstweer des hooghen wals, als *F c* rechthouckich op *A B*, met haer * beschoeyfel *c S*: Sghelijcx op de lini *T a* de buijtesijde des borstweers als *I d*.

Ten 21^{en} treck ick de lini van *T* * borstweer der leeghe gordine, deur *Z*, tot datse den ghemeenen landtgront comt te ghenaken in *e*, ende *P c* comt lanck te wesen 126 voeten voor t'ghene datter verheven moet sijn.

Ten 22^{en} om te teyckenen het * teghengraf, soo neem ick van *V* tot *f* 8 voeten, ende van *f* tot *g* 5 voeten, treck daer boven den booch *b*, die hooch comt 6 voeten, ende hebbe het begheerde teghengraf *g h f*.

Ten 23^{en} teeken ick achter de drie * borstweeren *R, T, Z*, de banken *i, k*, elck hooch 3 voeten, ende breet oock 3 voeten, tot sulcken einde als int voorgaende 23^e punt gheseyt is.

Contraghiera.

Toot hier toe is bescreven de verheven teyckening, spruijgende uijt een sne door t'middel der groote gordine, maer alsoo de * catte heur daer in niet en verthoont, so sullen wy om de verheven ghestalt der selve oock te sien, stellen de 7^e form, spruijgende uijt een sne door het middel des bolwercx, welcke door het middel der catte streck, alwaer wegghen en grachten oock veel breeder sijn, soo inde 1^e form blijktt.

De vloer van dese catte wort verstaen te ligghen 40 voeten boven den vloer des hooghen wals.

De borstweeren daerop noch 7 voeten hoogher.

De borstweeren sullen als vooren gheseyt is dick sijn 20 voeten, de beschoeyfelen daer voor 10 voeten.

De afdakinghe des borstweers vande catte sal in sulcker scheefsheyt ligghen, datmen daer langs henen sien can de twee derdendeelen van het * cabeschoeyfel.

Contrascarpa.

Daer wort oock verstaen, dattet voorscreven borstweer sal strecken rondom de catte heel befloten, soo wel over de binnesijde na de sterckte toe, als over de buijtesijde na de gracht, op datmen daer niet bloot en staet, voor de ghene daermen van achter buijten de sterckte, af mocht ghesien ende beschooten worden.

Scarpa.

Terreplain.

De meyning is oock, datmen boven na de vloer sal gaen, door een steyger ghewrocht binnen inde catte, wiens deure staen sal int * beschoeyfel, uijtcommende op den * hooghewalganck.

Van alle welcke dinghen wy andermael souden meughen int langhe verhalen, de manier om de verheven teyckeninghe daer af te trecken, van punt tot punt, maer want het selve door de voorgaende bescrevinghe openbaer genouch is, soo laten wijt cortheyts halven daer by blijven, stellende alleenelick de voorscreven 7^e form van dien als hier na blijft.

DEELEN

20. I mark point *a* in the counterscarp *Lb*, so that *aL* is $\frac{2}{3}$ parts of *Lb*, and I draw to point *a* two lines *Ra* and *Ta*, and upon the line *Ra* I draw the outside of the parapet of the higher wall (*Fc* perpendicular to *AB*) and mark the scarp of it *cS*, then do the like upon the line *Ta* for the outside of the lower parapet *Id*.
21. I draw the line from parapet *T* of the lower curtain through *Z*, until it meets the common ground or level line, in point *c*, and *Pc* will be 126 feet, which is what must be raised ¹⁾).
22. To set out the countermines, I take from *V* unto *f* 8 feet and from *f* to *g* 5 feet; then I make the arch *h* 6 feet high and thus I have the desired countermines *ghf*.
23. I draw behind the three parapets *R*, *T*, *Z* the benches or steps *i*, *k*, each 3 feet high and 3 feet broad, for such purposes as is spoken of in the former point 23 ²⁾).

Hitherto has been set forth the raised drawing, springing from a section through the middle of the great curtain, but in this way the cavalier does not show itself in it; therefore I will, to show the same raised, set down Figure 7 proceeding from a cut through the middle of a bastion, which runs through the midst of the cavalier, where the ways and ditches are much broader, as is shown in Figure 1.

The floor of this cavalier is understood to lie 40 feet above the floor of the higher wall.

The parapets upon the cavalier 7 feet higher.

The parapets shall be as aforesaid 20 feet thick and the scarps before it 10 feet.

The shelving of the parapet of the cavalier shall be askew, such that from the inner edge a man may see $\frac{2}{3}$ parts of the counterscarp.

It is also understood that the said parapet shall be made round about the cavalier, and enclose it wholly, both from the inside to the fortress and from the outside to the ditch, in order that one is not exposed there to those by whom one might be seen and fired at from outside the fortress.

It is also meant that one will ascend to the floor of the cavalier by a stair made within it, whose door shall be set in the scarp of the cavalier, and come forth upon the higher wallway.

Of all which we might again give a long description of the raised drawing, from point to point, but because the same has been spoken of before and has been made clear enough, therefore, for shortness sake, I leave it, setting only down the aforesaid Figure 7 thereof as here follows.

¹⁾ Note that point *c* in Fig. 6 occurs twice.

²⁾ See p. 95. In Fig. 6 the step behind parapet *Z*, unlike those behind *R* and *T*, has not been indicated by a letter.

DEELEN DER 6^e FORM,

*Wesende verheuen teyckening
spruytende uijt een sne door
i' middel der groote
gordine.*

AC Breede der strate tusschen
de huysen ende den wal.

CDQ Binnebeschoeyfel des
wals.

Qi Breede des hooge walgancx.
i Haer banck.

iR Borstweer daer voor.

Rc Afdakinghe des borstweers.

cS Beschoeyfel des hoogen wals.

Sk Breede des leeghe walgancx.
k Haer banck.

kT Haer borstweer daer voor.

TD Afdakinghe des borstweers.

IV Beschoeying der leeghe gor-
dine.

ghf Teghengraf.

IL Breede der groote gracht.

XY Middelgracht.

bl Cabeschoeyfel.

LP Breede der bedectewech.

PZ Borstweer met sijn banck.

Zc Sijn afdakinghe.

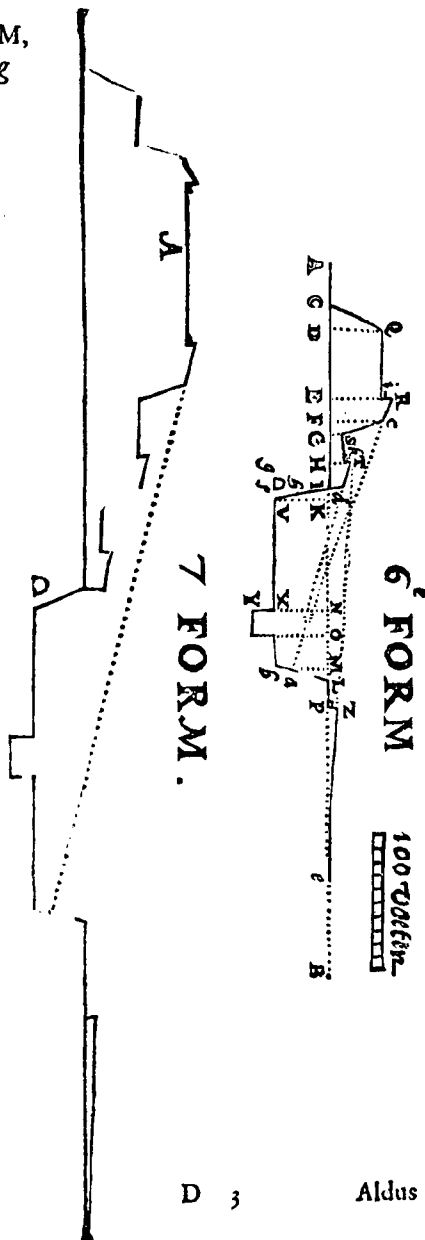
cB Ghemeen en landtgront, ofte
stichteinder.

DEELEN DER 7^e FORM,

*Wesende verheuen teycke-
ning spruytende uijt een
sne door i' middel
des bolwerckx.*

A De catte.

Dander deelen sijn openbaer
ghenouch door de verclaring
der 6^e form.



D 3

Aldus

PARTS OF FIGURE 6,
*being raised, springing from a section through the middle
of the great curtain*

AC	Breadth of the street between the houses and the wall.	kT	Parapet before it.
CDQ	Inward scarp of the wall.	TD	Shelving of the parapet.
Qi	Breadth of the higher wall- way.	IV	Scarp of the lower curtain.
i	Its bench or step.	ghf	Countermines.
iR	Parapet before it.	IL	Width of the great ditch.
Rc	Shelving of the parapet.	XY	Middle ditch.
cS	Scarp of the higher wall.	bL	Counterscarp.
Sk	Breadth of the lower wall- way.	LP	Breadth of the covered way.
k	Its bench or step.	PZ	Parapet with its bench or step.
		Zc	Its shelving.
		cB	Common ground or horizon- tal line.

PARTS OF FIGURE 7,
*being raised, springing from a section through the middle
of the bastion*

A The cavalier.

The other parts are clear enough
from the explanation of Figure 6.

The ground plan and the raised plan thus being marked out in plane, it shall be necessary for those that desire to have perfect knowledge of the properties and ordering of the fortresses, that they shape these flat drawings into bodily forms of some matter fit for the purpose, as wood, wax or clay, for even as in describing the World it is good beside the globe's flat counterfeiting, yet to have several corporeal globes, as that of the earth, of the fixed stars, of the planets and such like, so likewise are here also the bodily forms of fortresses very useful to know all their particulars more fundamentally, and not only to understand what others say, but that we may out of the diversity of opinions judge the best.

The flat counterfeiting of such a bodily fortress with two bastions is as is shown in Figure 8; the proper names of those parts which are set down in the definitions in the first Chapter are here briefly collected to understand them better ¹⁾.

¹⁾ In addition "Figure 9" is given on p. 101 from the 1604 manuscript, which was also referred to in the Introduction. This may perhaps meet Stevin's wish, expressed on p. 103, for a larger model of a half-bastion.

Aldus verclaert wesende de gronteyckeninge ende verheven teyckening int platte, soo ist oirboir voor de ghene die volcommen kennis vande eyghenschappen ende oordeninghen der sterckten begheert, dat hy sulcke platte teyckeninghen doe namaeken in lichamelicke formen van eenighe bequame stof, als hout, was, of pooterde : Want ghelijc inde

Cosmographia.
Sphaerum.

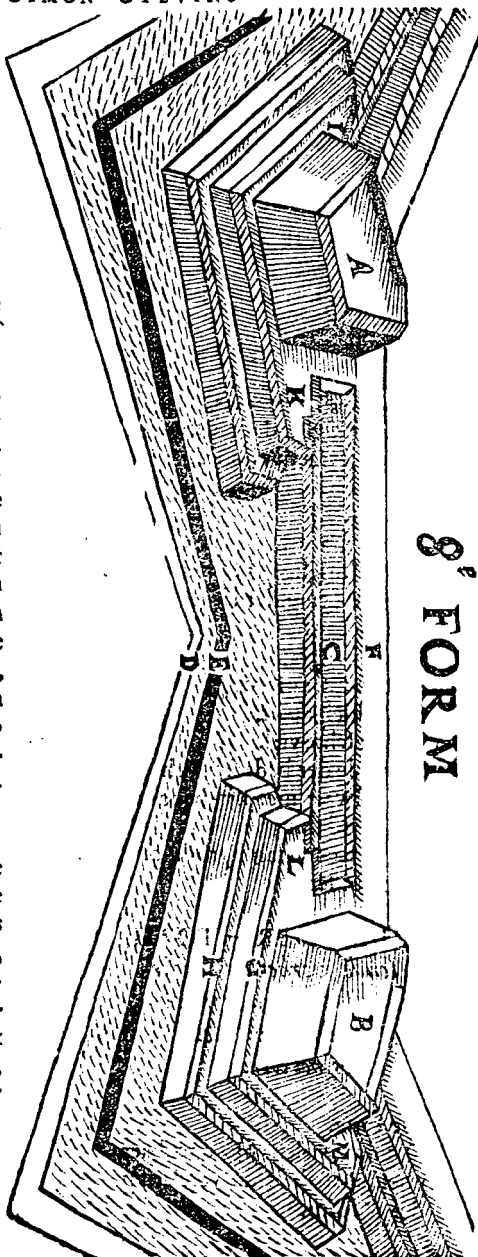
Planeta.
rum.

* Weereltsbescribing goet is, beneven der * clootē platte afbeeldinghen, noch te hebben verscheydē lichamelicke clooten, als des eertrix, der vaste sterren, der * Dwaelers, en dierghelijcke : Alsoo sijn hier oock de lichamelicke formen der stercken seer nut, om allen omstandighen dies angaende noch grontlicker te kennen, ende om niet alleen te verstaen wat ander segghen, maer op datmen uijt verscheyden meyninghen vant beste mach oirdeelen.

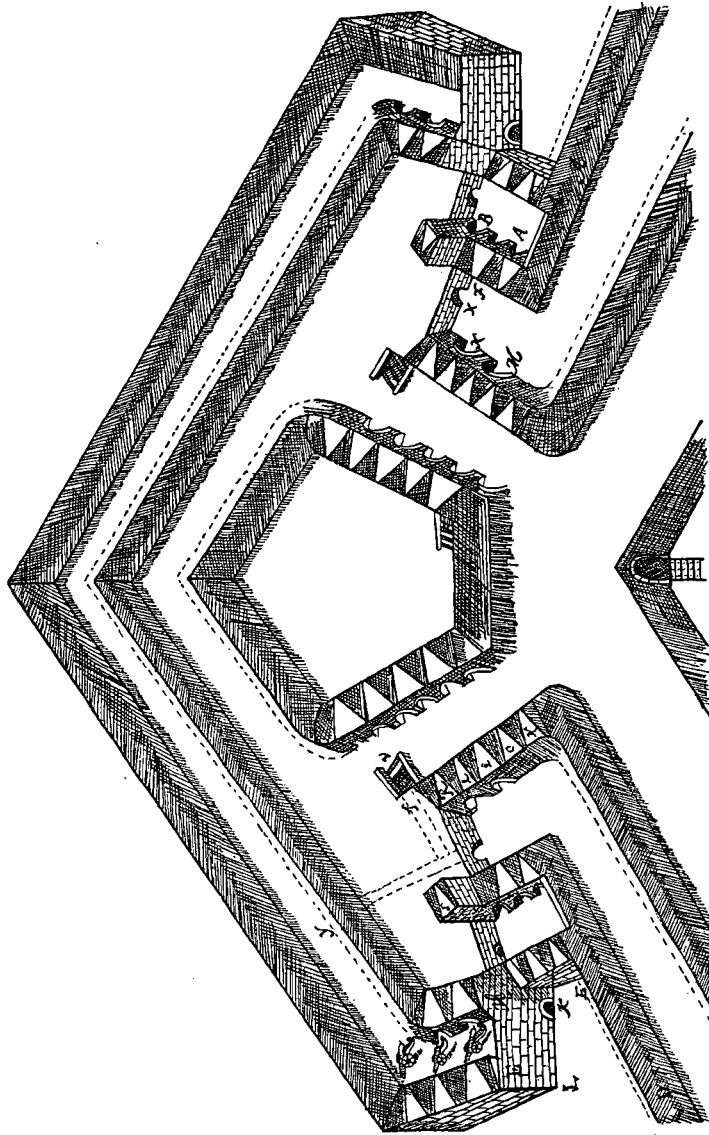
Orthographia.

Definicionb.

De platte * lijfbeeldinghe vā sulcke lichamelicke stercke met twee bolwercken, is als dese volgende 8^e form anwijst, waer af der deelen eyghen namen, die inde voorgaende * bepalinghen des 1^{en} Hoofstlicx bescreven sijn, hier int corte, meerder claerheys halven, by een vergaert worden.



This 9. Figure added by the Translator. See the better expression of the authors meaning.



Trinity Coll. R. 16. 30.



F Hooghe walganck. C De bovegordine.

G Afdakinghe der bove bolwerck gordine.

H Afdakinghe der leeghe bolwerck gordine.

E Middelgracht. D Bedeckte wech.

I, K, L, M, Schutfels. A B Catten.

Beneffens een lichamelick houten voorbeeld met twee bolwercken als hier nevens, soo ist goet te hebben noch twee ander houten voorbelden, het een van een heele volcommen sterckte met haer ses bolwercken, het ander alleenelick van een half bolwerck sonder grachten: De reden is dese: Wanneer die drie houten vormen even groot sijn, soo en soudemen inde form der heele sterckte (welcke dient tot * spieghelinghen des gheheels, van straten, kercke, huysen, met de reste) niet veel bescheyts connen sien vande deelen der drie plaetsen (diens grontteyckening inde 3^e form verclaert is) als * bosgaten, tanden, overwelfselen, trappen, deuren, ende dierghelijcke dinghen inden * strijckhouck commende, dieder al te cleen ende onsenelick souden vallen: Maer een half bolwerck soo groot sijnde als dander heele sterckte, daer in cannen die dinghen op haer mate groot ghenouch cryghen. De form met twee bolwercken, die veel grooter vallen dan twee bolwerckē vande form der heele sterckte, is bequaem om te ondersoucken met een ghespannen draet, alle strijckeninghen commende soo uijt de strijckhoucken, als van borstweeren der wallen en catten, na alle strijckelicke plaetsen.

Contemplationes.

*Cannouieren.
Merlons.
Flancs.*

3^e H O O F T S T I C K

*Vande grontteyckening der wesentlicke stercken
int groot, ende van t'ghebou dat
daer op commen moet.*

H O E W E L de grontteyckening ende t'ghebou opt landt, groote ghemeenschap heeft met de grontteyckening ende verheven teyckening op papier, welcker hier vooren ghenouchsaemlick verclaert schijnen, nochtans heeft dese * daetlicke wercking, soo groot verschil van die * spieghelighe handelinghe, datse wel haer besonder uijtleggingen behouft, daerom sullen wy hier af verclaren t'ghene ons tot de sake noodich dunckt, voor ons nemende datter te bouwen sy op plat even landt, een sterckte van form ende maten als de voorgaende des 2^{en} hoofsticx. Hier toe ontmoet ons ten eesten de teyckeninghe van een * evesij-dich selhouck int ronds bescriuelick, elcke sijde lanck 1000 voeten: welke form by anderen ghemeenelick gheteyckent wort deur t'behulp eens * platcloots, of ander soodanich cleen * reetscaps: Maer om op cortertijt,

*Practica operatio.
Theorica.*

*Aequilaterale
hexagono circulo
inscriptibile.*

*Planisphaerij seu
Astronomij
Instrumenti.*

PARTS OF FIGURE 8

F	Higher wallway.	E	Middle ditch.
C	Higher curtain.	D	Covered way.
G	Shelving of the higher curtain of the bastion.	I, K, L, M	Orillions.
H	Shelving of the lower curtain of the bastion.	A, B	Cavaliers.

Beside a bodily wooden model with two bastions, as in Figure 8, it were not amiss also to have two other wooden models, one of a complete regular fortress, with its six bastions, the other only of half a bastion without the ditches. The reason is this: if these 3 wooden models were all of the same size, then we would in the model of the complete fortress (which serves for the contemplation of the whole, as streets, church, houses, with the rest) not very well be able to perceive the parts of the three places (whose ground plan is shown in Figure 3), such as embrasures, merlons, vaults, stairs, doors, and such like, to be found in the flank, which in it would fall out too small and scantily to be perceived, but half a bastion being so great as the other model of the whole fortress, in it may everything be shown large enough in its measure. The model with two bastions, which turn out much greater than two bastions in the model of the whole fortress, is fit for finding out, with a stretched thread, all flanking proceeding from the striking angles, as from the parapets upon the walls, and cavaliers, unto all places to be flanked.

CHAPTER 3

Of the ground plan of a real fortress on a large scale,
and of the building that must be set upon it

Although the ground plan and the building upon the land have much in common with the ground plan and the raised drawing upon paper, of which heretofore enough seems to have been said, this practical work differs so much from the theory that it needs a particular explanation. Therefore I will from now on say what I think necessary for this matter, supposing that there were a fortress to be built upon plain ground, in shape and dimensions similar to that spoken of in Chapter 2. For this purpose we have first the description of an equal-sided hexagon, drawn in a circle, each side 1000 feet, which figure is by others commonly set out with the help of a flat sphere or astrolabe, or some similar small instrument ¹⁾.

¹⁾ To lay out fortresses, the "practical work", Stevin obviously prefers simple means like ropes and stakes (see p. 105) and the "right-angled cross" (see e.g. Vol. IIA, p. 429, note 8), instead of the more accurate measuring chain with pins and the astrolabe, more generally used by surveyors. The procedure with ropes is still also described by Mallet, on pp. 112-117, 1st part of the *Arbeid van Mars* (Amsterdam, 1672), but Jonas Moore, in his *Modern Fortification* of 1673 (London, 1689) on p. 39 speaks of a "Chain of 30 Feet".

*Mathematica
instrumenta.**Centrum.**Circumscriptibili
in circuli, semi-
diametris.**Radium vel li-
nearum visuale.**Merlene.**Flanc.
Oreillon.**Dioptra.**Flanc.*

tijt, ende met minder moeyte alles volmaecter te hebben, soo soude ick (volghende de ghemeene reghel, welcke inhoudt dat de grootste *wiscon- stighe reetschappen de sekerste sijn) daer toe nemen twee evelanghe coor- den, elck van 1000 voetē, doende deen van dien met een lets ande stock, stekende ter plaets van A, (inde voorgaende 1^e form) als * middelpunt der sterste diemen begheert te bouwen, ende brenghende t'ander einde na B, alsoo dat de coorde ghespannen staende, ick soude daer een stock recht overeinde stellen, beteyckenende een der ses houcken. Om nu een ander houck te hebben ick neem inde slynckerhandt het einde der voor- screven coorde die des * omscrijvelick rontw halfmiddellijn beteyckent, ende inde rechterhandt het een einde der coorde die des selhouck sijde bediet, het ander einde der selver doen ick deur een persoon vast houden an B, gaen alsoo met die twee coorden na C, tot datse beyde ghespannen staen, ende ter plaets daer hun uijtersten vergaderen, daer steke ick een stock C, voor den tweeden houck. Ende om den derdē houck te hebben, soo gaen ick na D, welverstaende dat ghelijck den landmeter ghemeene- lick hem eenen mettet einde der keten doet volghen, alsoo doen ick dien anderen persoon my na comen, tot dat hy mettet einde der coorde is ter plaets van C: Daer wesende, ick treck de twee coorden wederom tot datse beyde ghespannen staen soo stijf als vooren, ende daer die einden vergaderen, twelck sy an D, tot die plaets steke ick een stock, beteycke- nende den derden houck: dergelijcke doen ick om te hebben den vier- den houck E met al dander. De ses houcken alsoo met ses stocken ge- teyckent wesende, ende bevindende mettet oogh dat de drie stocken E, A, B, op een selfde * straet of sichtlini staen, dat s'ghelijcx oock doen F, A, C, ende ende G, A, D, ick trecke langs der eerde een ghespannen coorde vande stock B, tot den stock C, ende langs de selve doen ick een greppelken steken ontrent een halve voet breed, ende een halve voet diep: Dergelijck oock ghedaen wesende met dander vijf sijden, soo heb ick opt landteen selhouckighe form geteyckent met greppelen, ghe- lijck den selhouck B C D E F G opt papier met linien ghetrocken is.

Ten 2^{en} mete ick inde greppel B C, van B af na C, 180 voeten, voor de langde vanden houck tot de voorsijde des * tants, ende ten einde van die 180 voeten, twelck sy ter plaets van H, daer steke ick een land- meters rechtcruys.

Ten 3^{en} om te hebben de brede des * strijchoux met haer * schutsel, beyde t'samen 140 voeten, soo keer ick dat rechtcruys, tot datmen deur de twee * sichtgaetkens of sichtspleetkens, sien can de twee stocken B, C, daer na doen ick steken een stock M, 140 voeten van H, alsoo dat ick de stock M sien can deur dander twee sichtspleetkens des voornoemden rechtcruys.

Ten 4^{en} om te hebben de breede des * strijchoux, soo mete ick 30 voe-
ten

But to do everything in a shorter time and better with less work, I would (according to the common rule that the greatest mathematical instruments are the surest) take for this purpose two equally long ropes, each 1000 feet long, putting one of them with a loop over a stake in place A (as the aforesaid Figure 1 shows) as the centre of the fortress which we intend to build, and carrying the other end to B, so that the rope stands stretched; I would there set up a stake for one of the six angles. Then, to have another angle, I take in the left hand the end of the aforesaid rope which represents the radius of the circumscribed circle, and in the right hand the end of the rope signifying the side of the hexagon, and the other end I cause a man to hold at B, going so forward with both ropes towards C, until they are both stretched, and at the point where their extremities meet I set stake C for the second angle. And to have the third angle, I go likewise towards D, for as the surveyor commonly causes one to follow him at the end of the chain, so do I cause the other man to follow me, until he comes with the end of the rope at C. He there being, I draw again the two ropes until they stand stretched as stiff as before, and where the ends meet, as in D, at that place I drive a stake, signifying the third angle. The same I do to have the fourth angle E, with all the rest. The six angles thus being all set out with six stakes, and finding by the eye that the three stakes E, A, B stand in one line, and that F, A, C and G, A, D do likewise, I draw along the ground a stretched cord from stake B unto stake C and along this line I cause a little furrow to be cut, half a foot wide and half a foot deep. The like being done upon the other five sides, I have upon the ground a hexagonal figure, marked with furrows, like the hexagon BCDEFG, which is drawn with lines upon paper.

Secondly, I measure in the furrow BC, from B towards C 180 feet for the length of the corner or angle unto the foreside of the merlon and at the end of that 180 feet, which is at the place H, there I set down a surveyor's cross¹⁾.

Thirdly, to have the width of the striking angle with its orillion, together being 140 feet, I turn this surveyor's cross until through the two peep holes I can see the two stakes B, C. After that I set down the stake M 140 feet from H, so that I can see stake M through the other two peep holes of the said cross.

Fourthly, to have the width of the striking angle, I take 30 feet upon the line

¹⁾ For this very simple angle-measuring instrument see also the note on p. 103. Stevin still seems to have preferred it to the "Wooden Angle", shown e.g. by Mallet, l.c. 1st part, p. 111.

ten inde lini van H na M, ende ten einde, t'welck sy an P, daer steke ick een stock, doen daer na greppelen van H tot P deur het behulp van een ghespannen coorde alsvoren.

Ten 5^{en} om te hebben de dichte des *tants, ick mete inde greppel van H na B 20 voeten, het einde der selver valt, neem ick, an R: Daer na steek ick een stock int middel vā H R ter plaets van T, ende dergelijcke stock steke ick oock ter plaets van V: Daer na comme ick by Z, steke daer noch een ander stock, ende verstelle die nu alhier dan aldaer, tot dat ickse sien in een rechte lini met de drie stocken B A E ter eender sijde, oock in een rechte lini met de twee stocken M V ter ander sijde. Dese stock Z daer alsof stekende, betijckent het uiterste des houcx van dat bolwerck. Ende opde selve wijze salmen vinden al dander houcken met de noodighe greppelen. Doch soo is te ghedencken, datmen in plaets van verborghen linien, gheen greppelen en moet teyckenen, welcke daer na dwalinghe mochten veroirlaken, wantmen door t'ghesicht, ende door het behulp des rechtcruxs, die verborghen linien niet sienlick en behoofte te legghen, als uijt het bovescreven ghenouch te verstaen is.

Voort soo is te weten wanneer men aldus int groote teyckent, datmen somwijlen kennis behoofte vande langde ettelicker linien, die deur ghebreeck van ander onvolmaecte wercken, niet bequamelick en meughen ghetrocken worden, als by voorbeelt: Ghenomen datmen met de eerde die uijt de groote gracht comt, wil maken de langhe afdakinghe des *borstweers vande bedecte wech, ende dat de borstweeren der leege gordine (van welcker hooghe men die noodighe langde soude meughen affien) noch niet ghemaect en sijn: Genomen oock datment deur *Telconstighe manier sekerder wil hebben, dan deur formen diemen tot sulcx op papier int cleene treckt: Dat is, men wil weten by voeten, de langde der lini P e inde voorgaende 6^e form. Om hier toe te commen: Ick neem datter door t'ghedacht ghetrocken sy een rechte lini van t'punt P, tottet onderste des borstweers T, te weten 7 voeten onder T, dat is 10 voeten boven H: Daerom seg ick; die lini boven H van 10 voeten, gheeft H P 180 voeten (als berekent wort uijt de verheven maten) wat P Z 7 voeten? (want alsoo het *borstweer Z P evelanck is metter borstweer onder T, soo is den driehouck begrepen tusschen P H, ende het leegheste punt des borstweers onder T, ghelijck anden driehouck e P Z) comt P e 126 voeten. Ende ghelijck hier dese lini P e ghevonden is te doen 126 voeten, soo connen al de langden van dander linien oock bekent worden: Als de lini N K (daer in 11^e punt der maten vande verheven teyckening int 2^e hoofstuck af gheseyt is) te doen $88\frac{2}{3}$ voeten: S'ghelijcx de lini I L 140 voeten: Maer want daer toe noodich is *Telconstighe ende *Meetconstighe ervaring, wiens reghelen ons voornemen niet en is hier te bescrijven, als behoorende tot haer eyghen plaetsen

E

ghchaelt

Mitros.

Parapetto della strada coperta.

Arithmetica mada.

Parapetto.

Arithmetica & Geometria.

from H towards M and at the end, which is at P, I put a stake and cut a furrow from H to P by means of a stretched cord as before.

Fifthly, to have the thickness of the merlon, I take in the furrow from H towards B 20 feet, ending, say, in R. After that I set up a stake in the midst of HR at the place T and a similar stake I set up at V. After that I come to Z and set down there another stake, placing it now here, now there, until I see it in a straight line with the three stakes B, A, E on one side, and also in a straight line with the two stakes M, V on the other side. This stake Z, thus standing, represents the outermost angle of the bastion. And in like manner will all the other angles with their necessary furrows be found. But it should be remembered that the blank lines need not be furrowed in the ground, lest they should cause mistakes; for by the eye and the help of the surveyor's cross, those blank lines need not be drawn visually, as may be sufficiently understood from what has been said before ¹⁾.

Furthermore it is to be understood that when we draw this plan on a large scale, we shall sometimes have need of the knowledge of the length of several lines, which through the fault of other imperfect works, cannot so fitly be drawn, as for example: suppose that with the earth that comes out of the great ditch, we want to make the long shelving bank of the parapet that lies before the covered way, and that the parapets of the lower curtain (from whose height one might see the length of the aforesaid shelving) were yet unmade; suppose also that with the help of arithmetic we want to obtain the size more surely than by small figures which we draw upon paper. That is, one wants to know in feet, the length of the line Pc in the former Figure 6. To come to the knowledge whereof, I suppose that by imagination a straight line is drawn from point P unto the lowest part of the parapet T, viz. 7 feet under T, which is 10 feet above H. Therefore I say: the line 10 feet higher than H giving HP 180 feet (as shown before in the raised plan), what shall PZ 7 feet give? (for if the parapet ZP is of equal length as the parapet under T, then the triangle between PH and the lowest point of the parapet under T, is similar to the triangle cPZ), viz. Pc 126 feet. And as this line Pc is found to be 126 feet, so may also all the lengths of the other lines be known. If the line NK (of which was spoken in point 11 of the dimensions of the raised plan in Chapter 2) is $88\frac{24}{71}$ feet, so likewise is the line IL 140 feet. But since this requires arithmetical and geometrical skill, whose rules

¹⁾ After describing how to lay out the outer circumference of the bastioned hexagon Stevin has in fact completed his "ground plan of a real fortress". What follows next only contains two examples of calculations of lengths already discussed in Chapter 2, namely of the width of the glacis of the covered way and of the distance from the middle ditch to the scarp; only the former of these calculations has been further elucidated (see the notes on pp. 93 and 95).

ghehaelt te worden; elcke uijr haer const, soo en segghen wy daer af niet wijder.

VANDE METSELRIE.

De grontteykeninghe alsvooren ghegrippelt wesende, soo refter noch gheleyt te worden vande metselrie, alwaer eerst te bedencen valt, datter een vaste gront moet wesen, die bolwercken en wallen draghen can, sonder in te sincken, ofse omme te vallen, ghelijck somwijlen ghebeurt: Tot dien einde salmen de weycke gront, daert noodich is, met palen heyen, soo diep ende soo dicht by malcander als de gheleghenheyt vereycht.

Scapi.

*Parapetti &
Courantins.*

*Perpendicularis.
Horizontalis.*

Scapa.

*Eetelike Neer-
laatsche ruste-
laers noemenje
oock. Tylaren
aelter een ghe-
voocht ende
Freym.
Ital. Intrastor-
ti, of Spersid.*

Parapetti.

De manier der metselrien van caden met haer * beschoeyfelen, * borstweeren, ende teghengraven, die opden voorscreven vasten gront rondom de sterckte moeten comen, sullen wy deur de volghende form verklaren, in deser voughen: Het ghene datter begrepen is tusschen A B C D E F G, beteykent den buijtensten muer der stercke, met haer overwelft teghengraf, diens maten dusdanich sijn: A G doet 2 voeten, die de metselrie dieper gheleyt wort dan den gront des grachts A. Voort soo is B C de dicke des muers opde bovecant doende 4 voeten. De * hanghende lini B H rechthouckich opden * sichteinder, beteykenende de voorsijde des borstweers, is voortghetrocken tot opden gront des grachts ter plaats van I, inder voughen dat I A is de dicke des * beschoeyfels die voor den wal comt van 8 voeten: Dese lini H I doorsnijt den booch des ouerwelffels int punt D; van tselve punt wort ghetrocken de lini D C. De breedte des teghengrafs is van 5 voeten, de hooghde 6 voeten: De muer na E toe, daer den booch ende de rest op rust, is dick 5 voeten.

Dese muer moet noch hebben haer * steunstijlen, dat sijn verstijvinghen die vande muer na den wal toe ghewrocht worden, op dat de eerde des wals anden muer echte, ende dat deen van dander niet en wijcke. Om de manier van welcke eyghentlicker te verklaren, soo stellen wy de volghende 2^e form, alwaer K L M N de langde breedte ende hooghde van een steunstijl beteykent: der ghelijcke worden anden muer ghewrocht van 10 tot 10 voeten, als de steunstijlen O, P, Q, R, S, T, welverstaende datse ant einde na den wal, dicker sijn dan over de sijde daerse anden muer comen; te weten over de walsijde 3 voeten, ende anden muer alleenelick 2 voeten, om alsoo de eerde die tusschen beyden comt vaster anden muer te doen houden. Voort alsulcke steunstijlen alser gheleyt worden tot verstijving des wals, derghelijcke wordender oock gheleyt tot verstercking der cade, ghelijck de volghende form dat opentlick ghenouch aenwijft. Boven dien soo verthoont haer noch de ghestalt der bancken, V, X, die achter elck * borstweer comen, hooch 3 voeten, ende

it is not my intention here to set down, as they should be derived from their proper places, each from its art, so I will speak thereof not further.

MASONRY ¹⁾

The ground plan being marked out, as said before, there remains now to discuss the masonry, where first of all is to be considered that the ground or foundation must be solid to bear bastions and walls, without sinking or falling as sometimes happens. For this purpose the soft ground ought to be rammed with piles where necessary, so deep and so close to one another as circumstances require.

The construction of the masonry on the outside of the ditch, with its scarps, parapets, and its countermines round about the fortress, upon the aforesaid solid ground, I will express in the following figure in this manner. That which lies between ABCDEFG represents the outermost wall of the fortress, with its vaulted countermine, whose dimensions are as follows: AG is 2 feet, so much the masonry is laid lower than the bottom of the ditch A. Moreover, BC is the thickness of the wall at the upper edge, which is 4 feet. The line BH perpendicular to the level line, representing the front side of the parapet, is produced unto the bottom of the ditch, at the place I, in such a manner that IA is the thickness of the scarp of 8 feet before the wall. This line HI intersects the top of the vault in point D; from the same point is drawn the line DC. The width of the countermine is 5 feet, the height 6 feet. The wall at E, whereupon the vault rests, is thick 5 feet.

This wall must have its buttresses, or stiffenings, so wrought from the wall to the rampart that the earth of the rampart may stick to the wall and that one does not separate from the other. To express this more properly, I set down the following 2nd figure, where KLMN represents the length, breadth and height of a buttress. The like are wrought on the wall, spaced at 10 feet, as the buttresses O, P, Q, R, S, T, it being understood that at the end near the earth they must be made thicker than at the end near the wall, to wit, at the side of the rampart 3 feet and at the wall only 2 feet, to keep the earth between better against the wall. Furthermore, such buttresses as are made for strengthening the rampart, the like shall also be made to strengthen the outside of the ditch, as the same second figure clearly shows. Moreover, we see here the shape of the steps V, X, behind each parapet, 3 feet high and at the top 3 feet broad, of which is spoken

¹⁾ The revetment walls, which in Stevin's system protect both the entire scarp—to the bottom of the ditch—of the lower wall and bastions, and the slope of the counterscarp of the ditch, have been highly praised by Brialmont on p. 114 and in the notes 28, 29 and 30 of his study; on plate II he has, moreover, elucidated their construction. Also with this masonry, which was to be applied only under Coehorn and Vauban, Stevin was therefore far ahead of his time. A noteworthy feature is for instance that Brialmont declares having checked the walls and found them to be much stronger than required to stand up against soil pressure. Hence, they were excessively strong, which is necessary especially against shelling.

In the first section of this part of Chapter 3, where Stevin discusses the necessity of a sound foundation of bastions, ramparts and walls, it appears that he also has already an idea of the method of soil improvement in areas where a usual pile foundation would not suffice.

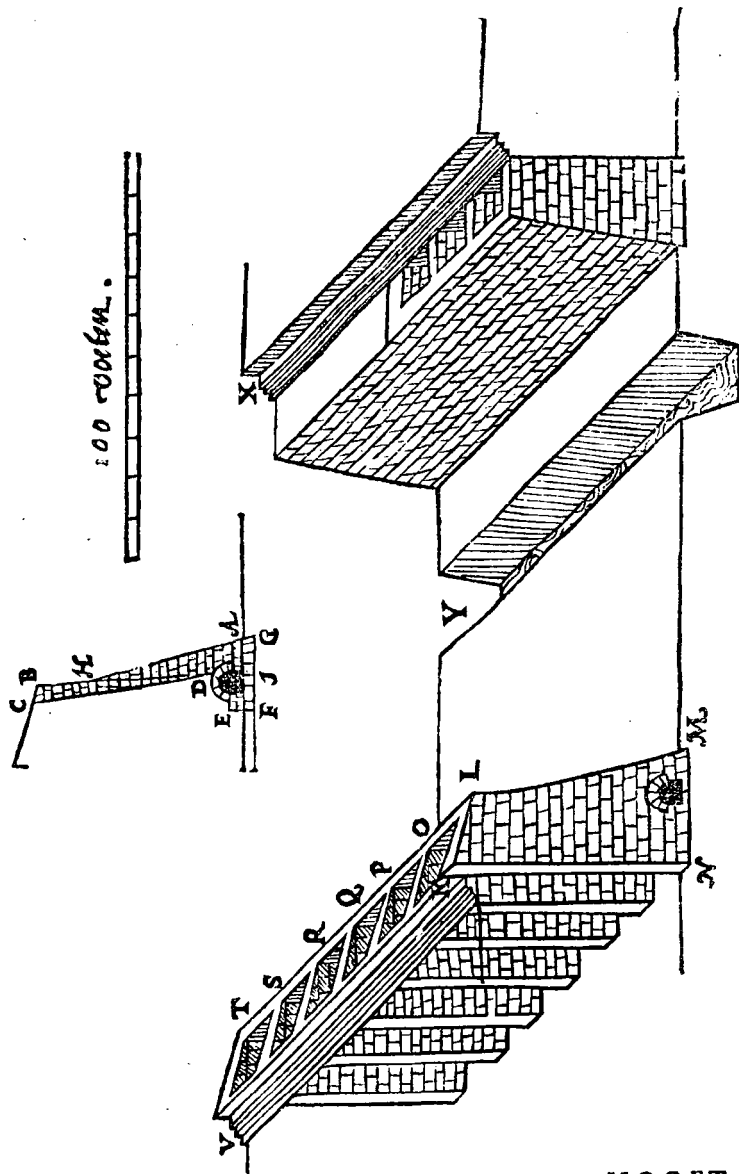
ende boven op 3 voeten breed, daer af gheseyt is int 23^e punt der verheven teyckening int 2^e hoofstuck.

Angaende den hooghen wal met haer borstweer die achter de bovengeschreven leeghe gordine comt, oock de catten opde bolwercken, die sullen teeneemal van goede eerde wesen, besaeyt met eenich bequaem cruyt. M. Aurelio de Pasino raedt hier toe te nemen t'ghene byden Latinen *Medica* ghenoeemt wort, t'welck ick in een cruytbouck op Neerlandts bevinde te heeten Bourgoensche claveren. Deses cruyts eyghenschappen, na het schrijven van Columella, Plinius, Mathiolus, ende ander, souden dusdanich wesen: Ten eersten dattet seer diep inde eerde wortelt, t'welck niet alleen voorderlick en is om de wallen langher in gheduricheyt te houden, sonder vervallen, maer die deurvlechtinghe gheefste oock stercke teghen t'beschieten: Ten anderen soo ist seer goet voeder der beesten, t'welck in tijt van belegheringhe wel te passe comt. Ten derden soo beschermet de wallen in nat weder teghen het afspoeien des reghens, ende in drooch weder voor het afstuen des wints.

in point 23 of the raised plan in Chapter 2.

Concerning the higher wall with its parapet, which wall lies behind the aforementioned lower curtain, as well as the cavaliers upon the bastions, they must all be of good earth and sown with good grass. Marco Aurelio de Pasino¹⁾ recommends taking for this purpose what is in Latin called *Medica*, which I find in a Dutch herbal to be called Burgundian clover. The properties of this herb, as Columella, Plinius, Mathiolus and others write, should be such: first it takes root deep in the earth, which is not only good to make the walls last longer without falling, but the intermingling of the roots with the earth gives it strength against shelling. Secondly, it is good food for cattle, which in time of a siege may do good service. Thirdly, in wet weather it protects the walls from erosion by rain, and in dry weather from being blown away by the wind.

¹⁾ On the importance of Marcus Aurelius de Pasino for Stevin's book, see for instance Introduction, p. 33.



4' HOOFT-

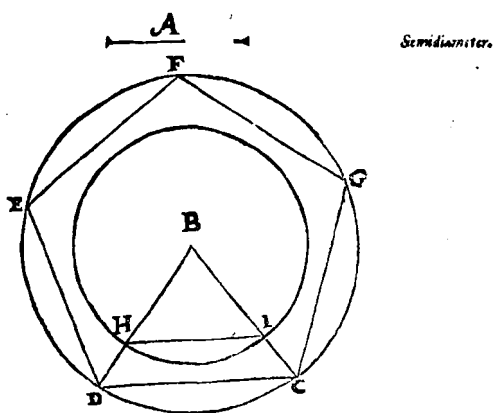
4^e H O O F T S T I C K

*Hoemen de anderhouckighe dan feshouckighe
sterckten soo int groot als int cleen
teyckenen sal.*

Wx hebben int voorgaende tweede ende derde hoofstuck, bescreven de manier der teyckeninghe int cleen oock int groot, van een sterckte op een * evelsijdich seshouck int ront bescrevelick, wiens sijde ende * halfsmiddellijn altijt evelanck sijn, ende daer slechts mede dear ghegaen sonder te segghen hoemen doen soude in stercken diemen van meer of min sijden begheert: De oirsaeck was, dat wy meerder claecheys halven, daer toe dit besonder hoofstuck veroident hadden, om aldaer niet verdrietelike te blijven hanghen, in dinghen welcke in die hoofsticken niet begheert en waren.

Aquilare hexagono circulo inscriptibile. Schikmeister.

Om dan tot de sake te kommen, ghenomen datter gheteyckent moet
sijn int cleen op papier, een evelijdeghe vijf houckighe stercke int rondt
bescrivelick, ende yder sijde des vijf houcx daer de stercke op gheteyc-
kent sal worden, moet even
sijn ande lini A. Vraghe hoe
lanck dat de * halfmiddellijn
daer toe sal moeten wesen? Ick
neem opden passer eenighe
halfmiddellijn B C, die lan-
gher is dan de ghene die ick
behoef, trecke daer mede een
rondt, deyle dat al tastende in
vijf even deelen C, D, E, F, G,
trecke daer in den vijf houck
C D E F G, oock de lini B D,
neem daer na met den passer
de langde der lini A, brenghen
die tusschen de twee liniē B C,
B D, opwaert of neerwaert, tot
datse daer in past, ende * eve-
wijdeghe sy met C D, als de lini H I. Ick open daer na den passer van
B tot H, trecke daer mede een ront, t'welck commende door t'punt I, ick
heb de begheerde halfmiddellijn B H, met welcke ick op een ander pa-
pier dan een rondt treck, daer de begheerde sijden in passen sullen. Vijt
dit voorbeeld des vijf houcx, is ghenouch te verstaen de ghemene reghel
van allen.



Parallèle

1. The first line of the document is a vertical line.

2. The second line of the document is a vertical line.

CHAPTER 4

Teaching how to draw any other than a hexagonal fortress,
on a large as well as on a small scale

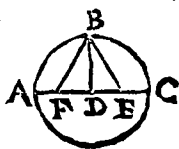
In the foregoing Chapters 2 and 3 I have described the manner of planning a fortress as an equal-sided hexagon (in a circle) on a small as well as on a large scale, whose side and radius are always of equal length, and have continued with it without saying anything of fortresses with more or fewer sides. The reason was that for more clarity I had appointed this particular chapter, without digressing in those chapters upon matters which were not fit to be handled in them.

Now to come to the matter, suppose that there must be described upon paper on a small scale, an equal-sided pentagonal fortress (in a circle), and that each side of the pentagon that the fortress shall be planned upon, shall be equal to the line A. The question is how long the radius of that circle shall be. I take with the compass some radius as BC, which must be longer than that I have need of, describe with it a circle, and divide that circle tentatively into five equal parts, C, D, E, F, G, draw in it the pentagonal figure CDEFG and also the line BD. I take afterwards with the compass the length of the line A, place it between the two lines BD and BC upward and downward until it fits between them and is parallel to CD, as the line HI. Afterwards, I open the compass from B unto H and describe with that width a circle which, passing through point I, gives the desired radius BH, with which I then upon another paper describe a circle, in which the desired sides shall fit. By this example of a pentagon, the general rule of all other figures can be sufficiently understood ¹⁾.

¹⁾ For the construction of the regular penta-, hepta-, octo-, ennea- and decagon on paper (on a small scale) Stevin, with the pentagon as example, first of all gives a method of "trial and error" or "rule-of-thumb". One wonders why, to divide the circumference of the circle, no protractor has been used, because this would not have involved serious calculation problems. Indeed, for large-scale laying out Stevin afterwards does have recourse to goniometric calculations to 7 decimal places! (see p. 117).

Mathematica.

Hier vooren is gheseyt, datmen het rondt sal deelen in vijf even deelen al tastende, doch soo ymant beter gheviel de * wisconstighe wercking van dies na het inhoudt des 11^{en} voorstels van het 4^e bouck Euclidis, hy sal dese manier meughen volghen: Ick trecke int rondt A B C door t'middelpunt D de middellijn A C, deyle D C int middel E, neme met den passer de langde E B, teycken die van E tot F: Twelck soo wesende, de langde F B is even an de sijde des gheschickten vijfhoucx. Ende F D (voor de ghene diefe begheert)

*Practica opera-**tionis.**Theoricus modus.**Mathematici.**Propositiōis.**Tabularum si-**gnorum.*

ande sijde des geschickten thienhoucx. Maer gemerckt datmen in * daetlike handel t'meeſte gherief souct, ende dat de * spiegelighe wijze van Euclides, meer ſtrekt om * Wiſconſtick te verclaren de maectſelen ende eyghenſchappen der gheſchickte lichamen, oock de * everedenheden die der inde linien van ſulcke vormen ſijn, dienende tottet maken der * boochtafels en dierghelijcke, ſoo heeft ons de voorscreven tastende manier aldaer bequaemt ghedocht.

Semidiametro.

Tot hier toe hebben wy vande ghemeene teyckeninghe int cleen gheſeyt, maer want de grontteyckeninghe des 3^{en} Hooftſtick opt landt, int groot oock verclaert is, met een ſelhouck, alwaer beyde de coorden voor ſijde ende * halfmiddellijn evelanck vallen: Soo mocht hier op ymant vrighen, hoemen met ander veelhouckighe vormen doen ſal want de voorgaende manier van dergheleijcke op papier, daer toe onbequaem ſoude wesen. Ghenomen dan datmen begheert een vijfhouck, hebbende elcke ſijde van 1000 voeten, vrighen hoe lanck dander coorde ſal moeten ſijn, die de halfmiddellijn beteeckent, om effen uijt te comen? Men ſal ſien in een * boochtafel, wat * reden de * halfmiddellijn heeft teghen de peze ghetrocken onder den booch lanck wesende een vijfde deel des rondts, dat is een booch van 72 * trappen, ende wort bevonden van 10000000 tot 11755704, want den * halfbooch 36 trappen heeft * halfpeze 5877852, welke ghedobbelt maken t'ghetal alsvoren: Daerom ſeg ick 11755704 gheeft 10000000, wat 1000 voeten? comt voor begeerde langde van dander coorde 805 voeten $7 \frac{9529272}{11755704}$ duym, welverſtaende dat de voet 12 duymen heeft.

*Tabula finium.**Rationem.**Semidiametro.**Graduum.**Semiarum.**Semidiametro.**Rationem Semi-**diametro.*

Ende by aldien datter alſoo te teyckenen waer een ſevenhouck, men vindt de * reden der halfmiddellijn tot de ſijde,

Des ſelfden ſevenhoucx van — 10000000 tot 8673182.

Des achthoucx van — — 10000000 tot 7653668.

Des neghenhoucx van — — 10000000 tot 6840421.

Des thienhoucx van — — 10000000 tot 6180340.

It has been said before that the circle must be divided tentatively into five equal parts, but if any man desires to do it mathematically according to the contents of the 11th proposition of the 4th book of Euclid¹⁾, he may follow this example: I draw in the circle ABC through the centre D the diameter AC and divide DC in the midst at E, take with the compass the length of the line EB, and draw it from E to F. Then the length FB is equal to the side of a regular pentagon, and FD (for him that wants it) is equal to the side of a regular decagon. But since in practice we seek the readiest way, and the theory of Euclid tends more mathematically to explain the making and properties of regular bodies and also the proportions that are in lines of such figures, serving for the making of tables of sines, and such like, therefore the above tentative method seems us to be the more suitable.

Hitherto we have spoken of the common drawing on a small scale, but since in Chapter 3 is also shown the ground plan of a hexagon upon the land on a large scale, wherein both the ropes for the side and the radius are of equal length, the question might here be asked, how we should do with other polygonal figures, because the foregoing manner upon paper would not serve. Suppose then that we desired a pentagon, each side being 1000 feet long, the question is, how long the rope that represents the radius must be that it may fit well. We must seek in a table of sines what is the ratio of the radius to a cord drawn under an arc that is long one-fifth part of the circle, which is an arc of 72 degrees, and it will be found as 10000000 to 11755704, for the half arc of 36 degrees has its sine 5877852, which being doubled makes the aforesaid number. Therefore I say: if 11755704 gives 10000000, what shall 1000 feet give? for the desired length

of the radius shall come forth 805 feet $7 \frac{9529272}{11755704}$ of an inch, well understanding that the foot has 12 inches²⁾.

And if thus a heptagon were to be planned, we find for the ratio of the radius to the side

of the heptagon	10000000 to 8677674.
of the octagon	10000000 to 7653668.
of the enneagon	10000000 to 6840402.
of the decagon	10000000 to 6180340.

¹⁾ Just as on p. 73, point 1, for the hexagon, Stevin cites here for the construction of the regular pentagon the *Elements of Euclid*, namely the 11th proposition from the 4th book, for the "preparation" of which the 10th proposition had first to be solved (see for example the edition by Franciscus van Schooten, Leyden 1617). He gives the well-known figure and describes the construction of the side of a five- and a ten-angle for a given radius. In this respect he was not the only one among the fortress engineers of his time and afterwards. Among these we mention Lorini, *Delle Fortificazioni* (Venice 1597), p. 4 and Adriaan Metius, who on the frontispiece of his *Fortificatie ofte Sterckten-Bouwinghe* (Franeker, 1626) represents the figure for the construction of the pentagon and the decagon. Others, such as Hendrick Ruse, *Versterckte Vesting* (Amsterdam, 1654) p. 49 and Mallet, *Den Arbeid van Mars* (1672), p. 32, give constructions which were intended for all regular polygons, but on closer examination appear to be inaccurate; a construction for the heptagon (seven-angle), which we also found in 18th century manuscripts and which is fairly correct, is among them.

²⁾ These decimal figures for goniometric values contain some inaccuracies, some of which have been corrected in the erratum at the end of the book. Where Stevin speaks of sine (half-cord), he apparently means the sine of 36°.

5^e HOOFTSTICK,

*Inhoudende het wit ofte voornaemlick opsicht,
datmen behouft tot de veroirdening
der sterckten deses tijts.*

ALSOO ons voornemen is, int volghende 6^e Hoofstlick te vergaderen ettelicke * verschillen, aengaende de volcommen stercten, oock int 7^e Hoofstlick eenighe verschillen vande onvolcommen, na de verscheyden ghelegenheden der plaetsen, soo heeft ons oirboir ghedocht, eerst te beschrijven het wit, ofte de voornaemlicke punten, diemen tot oirdening der sterckten behouft, om deur kennis van dien, met vernuft ende meerder sekerheyt vande selve verschillen te meughen oirdeelen. Ick segghe dan: Ghelijck de menschen verscheyden sinnen hebben inde formen haerder cleederen, want ander maecksel ghebruyctmen int een landt als int ander; Ia een selfde landtschap heeft nu mislaghen, int ghene hem voormael wel beviel, ende dat noch naerder comt, een selfde persoon hielt ghister voor bequaem, dat hem hyden ongheschickt dunct; Alsoo gader oock toe inde verscheyden sinnelicheden vande oirdening der sterckten: Daerom ghelijck ymant te vergheefs sijn hooft soude breken, meynende door redenen de menschen te beweghen, dat sy alremael een form van cleederen draghen, na sijn onderwijsinghe, te meer dat hy self niet vast en staet, noch en weet hoe langhe sijn sinnelicheyt dueren sal: Alsoo aerbeyden sy om niet, die inde oirdeninghe der sterckten alleman haer eyghen goetduncken willen andringhen. Doch ghelijck der menschen ghevoelen inde form der cleederen niet in alles soo gantsch verscheyden en is, of sy en hebben yet ghemeens: Als by voorbeeld, alsoo wy tot onse nootlickheyt de teenen niet verscheyden en behouven, wy stekense wel altegaer in een socke, ofte voetelinck, maer beyde de beenen t'samen in een couffe te steken, dat en staet niemant toe, sulck cleyt en wil niemant hebben, want ghemerct wy de beenen verscheyden moeten ghebruycken om te gaen, soo vereyscht de reden datmen elck been sijn besonder couffe gheve: Voort een cleet te veroirdenen t'welck t'ghesicht bedect, inder voughen datmen niet en soude connen sien waermen ghinghe, of watmen dede, niemant en maket, niemant en begheeret, als wesende teghen t'ghemeen ghevoelen. Even eens gader toe met de oirdening vande sterckten, want der * Boumeesters sinnelicheden en sijn daer af niet soo teenemael verscheyden, of sy en hebben door natuerlick ghevoelen yet ghemeens, eenich wit daer sy na loncken, sulcx dat hy die t'selve teghenstaet, ghehouden wort als teghen t'ghemeen ghevoelen te stryden.

Quaestiones.

Archit. Horum.

Om

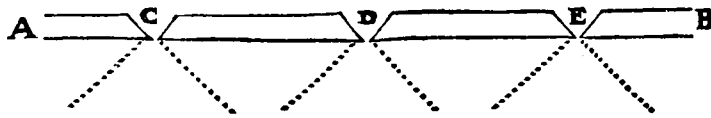
CHAPTER 5

Containing the scope or main points necessary for
building a fortress of the present time

As it is my purpose in Chapter 6 to collect some differences concerning a regular fortress, and in Chapter 7 also certain differences of irregular fortresses according to the different situations, I have thought it fit first to describe in this Chapter the scope or main points which are needful for the building of a fortress, that through knowledge thereof, with ingenuity and more certainty we may judge of these differences. I say then, as men have different tastes in the forms of their apparel, for one nation is clothed after one fashion, another after another, yea a people dislikes at one instant what at another they thought decent and comely, and what is more, one and the same person dislikes today what yesterday he considered seemly, so it is likewise in the different ideas of building fortresses. Therefore, just as it were a vain thing in a man to think by reasoning to persuade people to go all clothed according to his instruction, he himself varying or not knowing how long that taste would continue, so likewise do they labour in vain who in building a fortress want to force their own ideas upon all other men. However, people's taste in the fashion of their apparel is not so different but that they have something in common. For example, as we need not have our toes parted, we put them altogether in one sock or shoe; but to put both legs into one stocking would be unfit, and such a fashion nobody will like, for since we must use our legs separately for going, it is reasonable that we should put them in separate stockings. Furthermore, a garment that would cover a man's sight, so that he could not see where he went or what he did, no man makes or desires, being a thing against common feeling. Similarly, it is in the building of fortresses, for the architects' ideas are not so wholly different but that by natural feeling they have something in common, some scope that they aim at, so that who so repugns is thought to strive against common feeling.

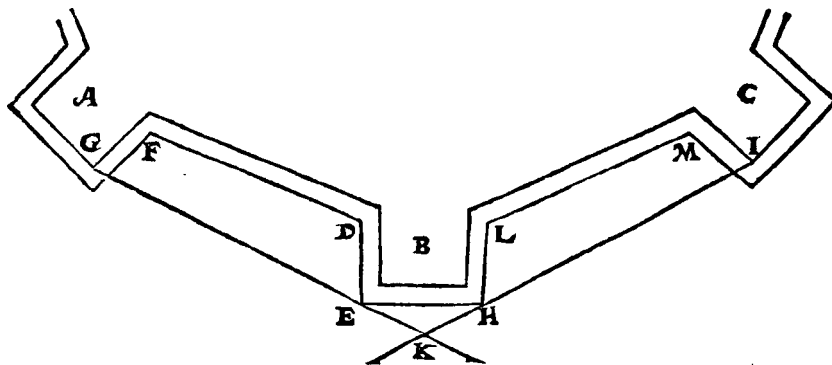
Inventiones.

Om nu te commen tot verclaring van t'selve wit, dienende als proufsteen daermen veel verscheyden *vonden of meyninghen dieder dagelicx voort commen, teghen onderfoucken mach, soo is voor al te weten, datmen in voorleden ouden tijden eermen buscruyt vant, ghemaect heeft tot beschermnis der stercken, effen mueren, hebbende gaten om daer deur te schieten met pijlen, ende sulcke reetschap als men doen gebruycte ghelijck hier onder den muer A B met de gaten C, D, E. Doch want de



verweerders, den viant aldus maer van vooren wederstaen en condon, ghenouchsaem man teghen man, ende dat daer beneven de vianden sich van voor met haer schilden bedecten, ende heel bijde mueren wesende tusschen twee gaten, datse voor de selve gaten bevrijt waren teghen t'gheschot, soo maectemen daer na in die even mueren, viercante uijstekende hoofden, of torren, soo wijt vā malcander * als haer schietinghe ende worpinghe met slinghers treffen conde, ghelijck hier onder de drie torren A, B, C, om uijt de sijden D E, F G, den viant die de muer F D tusschen twee torren bestormde, niet alleen van vooren, maer oock van beyden sijden daer hy gheen schilden en hadde, te beschadighen, den selven muer F D wel te bewaren, ende den storm met meerder versekerheyt te wederstaen.

*Vitruv. lib. 1.
cap. 5. Inter
valla autem
turrem etc.*



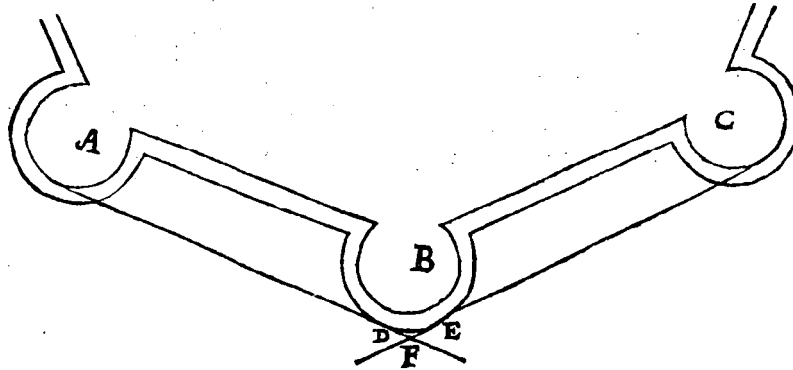
Maer de viant souckende hier teghen oock sijn grootste voordeel, liet de muer tusschen twee torren onbevochten, ende bestormde alleenlick de voorsijden der torren, als de voorsijde E H, want het gheschot al schoon commende

Now to come to explaining the aforesaid scope, serving as it were for a touchstone, to test the various inventions or opinions of which many daily come forth, it is first of all to be understood that men in times past, before gunpowder had been invented, made the defences of their fortresses as even, plain walls with holes in them, to shoot outwards with arrows and such weapons as they then used, as the wall AB with the embrasures C, D, E.

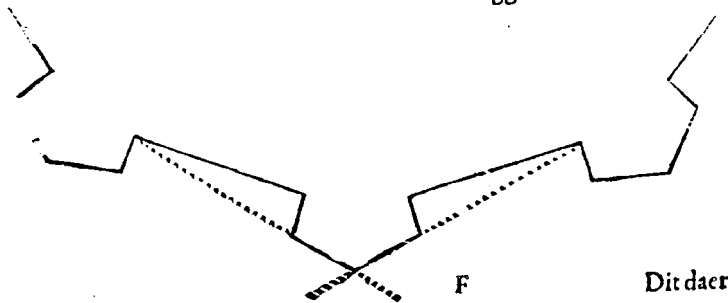
But since the defenders could resist the enemy only right before them, man against man, and because the enemies covered themselves in front with their shields, and being near the wall betwixt two holes they were then out of shot, afterwards they made in these plain walls square projecting heads, or towers, and placed them so far apart, one from the other, as their shots and slings could reach, as the three towers hereunder A, B, C, to shoot out of their sides DE and FG, to strike an enemy that assailed the wall FD betwixt two towers, not only in front, but also upon both sides, where he had no shield, the better to defend the wall FD and to resist the assault with more assurance.

But the enemy seeking also against this his greatest advantage, left the walls betwixt two towers uncontested and assailed only the foreside of the towers, as the foreside EH, for the shot coming from the outermost corners G and I of the

commende van der nevenstaende torren uijterste houcken G ende I, soo was al t'ghene dat inden driehouck E H K stont, bevrijt voor beyde de torren A, C. Sy merckende dese faute, maecten daer na ronde torren, in plaets van viercante, als hier onder A, B, C, om alsoo van een torre, de voorsijde van dander beter te connen sien, ende een met dander beter te bewaren, want het gheschot commende van beyde de sijdtterren A, C, can den viant bestormende de voorsijde der torre B, veel beter gheraken, dan met de voorgaende viercante torren, ende hoewel niet heel volcommelick, nochtans soo is het driehoucken D E F, veel cleinder dan den driehouck E H K.



Maer het grof busgheschut daer na opcommende, deur welcx groote cracht, niet alleenelick een mensch t'seffens, als deur een pijl of slingherkey ghewont of omghebrocht wiert, maer daermen veel menschen, veel leeren, veel * reetschappen mede ter nerdervelde, soo sachmen dat noch *Infra mura.* ronde, noch viercantetorre, ofte hoofden, bequame forme en waren, om des busgheschuts meeste voordeel by te doen, maer dat de hoofden alsoo behoire te liggen, datmē uijt elckē houck vande twee nevenstaende hoofden, daer langs henen mocht schieten vant een einde tottet ander gelijckmen langs de mueren doet tussché twee hoofden liggende, als hier onder.



nearest towers, all that stood within the triangle EKH was free from attack from the two towers A and C. They then noticing this error, made round towers instead of square ones, as hereunder A, B, C, to the intent from one tower better to see the foreside of the other, and better to defend the one with the other, for the shot from both the side towers A, C, can better strike an enemy assailing the foreside of the tower B than if it were a square tower; and although the construction is not perfect, yet the little triangle DEF is much smaller than the triangle EHK.

But afterwards great ordnance coming into practice, through whose great force not only one man at once, as by an arrow or sling, was wounded or slain, but many men, many ladders, and many utensils were overthrown, they then saw that neither round, nor square towers or heads were adequate means of giving great ordnance its greatest advantage, but that the heads should be so fashioned that from every angle of the two nearest heads they might shoot from one end to the other, as we do along those walls that lie between two heads, as shown below.

**Perspectiva.
Machinatio
artium.*

*Scoppare of Net-
tejer.
Definitio.*

*Contrascarpa.
Parapetto della
strada coperta.*

Fossata.

Mant rampart.

Flize.

Contrascarpa.

*Fa't Nettejer
Flanqueer.*

*Obfusum an-
gulum.*

Dit daer na int werck ghestelt sijnde, ende metter daer seer voordere-
lick bevonden wesende (want men mocht de heele stercke rontom be-
sehermen, met sijdelinckse schietinghe langs de mueren ende hoofden,
daermen veel volcx mede ombrengt, sonder noch ans sijn eyghen hoof-
den te breken) men heeft daer op voorder ghelet, (soo wel, dat de sake
ghenouchsaenigherocht tot manier van een besontler const, als ghegront
wesende inde * Doorsichtighen, ende met de * wisconten groote ghe-
meenscap hebbende. Men gaf de nieuwe dinghen (t'welck nieuwe con-
sten alijt vereysken) nieuwe namen, ende ouder anderen noemden
dit schieten langs de muerē, ende langs de sijden der hoofden, *strijcken,
ghelijck daer breeder af gheseyt is inde 11^e * bepaling. Bevondem daer
na, dat dit strijcken niet alleen nut en was langs de gantsche binnesijde
des grachts, maer tot meer ander plaetsen, als datmen met groot voordeel
oock bequamelick conde te weghe brenghen de strijckinghe der *cabe-
schoeyfels. Boven dien de strijckinghe vant * borstweer der bedecte
wech, oock de bebede wech selfs. Daer na wast een tijt lanck inde ghe-
bruyck, de * middelgracht te legghen ontrent het middel der groote
gracht, byde gisse, maer als men breeder acht nam op de nutbaerheyt des
strijckens, men heeftse eintlick na den aert des strijckens ghetrocken.
Voort om dese strijcking niet alleen te hebben langs gordinen, caden en
borstweeren der bedecte weggen, maer oock langs den gemeenen landt-
gront, soo maectmen dobbel wallen, de leegste, als de leeghe groote gor-
dine, met de leeghe bolwerck gordine, om den selven ghemeenen landt-
gront te strijcken: * Den hooghen wal (want dander gordinen te leeghe
waren) diende om de stercke beter bewaert te wesen, oock om den viant
te meer achter sijn schantsen te ontdekken: Vijt dese dobbel wallen, vol-
ghde noch een manier van dobbel bolwercken, diens boveplaetsen soo
wel als de leeghe plaetsen streken haer teghenoverstaende bolwerck
gordinen, ende nevenstaende groote gordinen, met al dander uijtwendighe
strijckelicke sijden: Vorts wiertter tot de stercken met droeghe
grachten, inden * strijckhouck noch een onderplaets veroirdent, om den
gront des selven grachts te strijcken, metgaders het *cabe-schoeyfel, leeghe
gordinen, ende alle strijckelicke plaetsen die daer int ghesicht commen.
In somme *STRIJCKEN, STRIJCKEN segh ick, is eē wir ende voornaemlick
ooghmerck vande veroirdening der stercken deses uijts, ende hy die het
strijcken teghenstaet, die wil een cleet maken daermen twee beenen in
een couste steeckt, of datter ghesicht bedeckt, ick wil segghen hy spreect
teghen t'ghemeen ghevoelen.

TEN anderen machmen hier noch by voughen als voor ghemeene
reghel, dat de * plomphou kichste of onsekerste bolwercken (die
welverstaende na t'behoiren strijckelicke sijn) voor de sterckste ende beste
ghelou-

This afterwards being put into practice and found very serviceable, (because one could defend the whole fortress round about by shooting sideways along the walls and heads, whereby one could destroy many soldiers without yet breaking one's own heads) it has been improved, so that the matter has been developed to a particular art, based upon the perspective and having much in common with mathematics. One gave those new things (which is always necessary for new arts) new names, and among other things named this shooting along a wall and along the sides of the heads, striking, of which is more said in definition 11. It was then found that this striking was not only serviceable all along the inside of the ditch, but in many other places, because one could with great advantage also adequately strike the counterscarp, and moreover the covered way, and the parapet before it. After that it was for a time the custom to lay the middle ditch about the midst of the great ditch, by guesswork, but when one took better regard of the use of striking, one then laid the middle ditch better to be flanked. Moreover, to have this striking not only along curtains, scarps and parapets of the covered ways, but also along the common land, double walls¹⁾ were made, the lowest as the lower great curtain, with the lower curtain of the bastion, to strike the horizon or common land. The higher wall (because the other curtains would be too low) was serving for the better defence of the fortress, and also better to discover the enemy behind his redoubts. From these double walls sprang another manner of double bastions²⁾, whose upper as well as lower places flanked the opposite curtains of the bastions and the great curtains near to it, with all outward flankable sides. Furthermore, in the fortress with dry ditches³⁾, another lower place was ordained in the flank, to strike the bottom of the ditch with the counterscarp, lower curtains, and all other flankable places that appear in sight. Summarizing, *striking*, I say *striking*, is the scope and the special aim for the building of the fortresses of the present time, and he that speaks against striking, wants to make a garment to put two legs in one stocking, or which covers the sight, I say he speaks against common feeling.

Furthermore, there may hereunto be added as a common rule, that the flattest or least sharp bastions (which are made flankable, as they ought to be) are

¹⁾ "Double walls were made". These, as well as the further improvements described by Stevin (see the following two notes), only belonged to his system and the majority of them were not to be applied until about a century later. The bottom wall or "fausse-braye", so characteristic of the Old-Dutch system, must therefore not be confused with Stevin's lower wall, which was of a heavier profile, clad with stone and intended to flank the ditch and particularly the covered way with ordnance.

²⁾ "Double bastions." Like the lower walls or curtains between the bastions, those along the bottom of the bastions, also clad with brick, are characteristic of Stevin's system. They correspond already in many respects with those of the *New Art of Fortification* of 1685 by Menno van Coehorn.

³⁾ "Dry ditches, flanked from the lower striking places". This manner of building induces Brialmont to argue in note 43 on p. 119 of his study: "Le front de Stevin ne peut être appliqué qu'aux terrains élevés. L'auteur dit en commençant qu'il n'a pris cet exemple que pour montrer l'application des flancs-bas." In actual fact, in this respect Stevin's system is not purely Dutch and it is not surprising that his follower Coehorn does not apply proper dry ditches and only two "flanks" instead of three.

ghehouden worden, want anghesien een cloot over de twintich voeten diep inde eerde gheschoten wort, soo canmen de scherpe houcken van ter sijden lichtelick omme, ia dweers deur schieten, maer opde ghene die plomp ghenouch sijn en heefstmen van ter sijden gheen vaten.

TEN derden, dat de * evefsijdeghe sterckten int rondt beschrijvelick, *Equilatera ca-*
 diemen anders gheschickte veelhoucken noemt, de bequaemste *stiraculo m-*
 onde oirboirte formen sijn, want sy vervaten met min wals meer plaets, *stiraculo m-*
 t'welck niet alleen oncostelicker en valt int ghebou, maer boven dien en *stiraculo m-*
 behoefstmenender soo veel gheschor, noch volck niet toe, om die te bescher- *stiraculo m-*
 men: Daer beneven soo hebben haer bolwercken de beste houcken, *stiraculo m-*
 want de onevensijdeghe krijghen sommighe houcken wel plomper oft *stiraculo m-*
 onscherper, maer wederom daer teghen sullen eenighe ander houcken te *stiraculo m-*
 onplomper of scherper moeten sijn, t'welck niet voordelick en is, ghe- *stiraculo m-*
 merckt den ervaren viant de sterckste plaetsen laet beruften, ende de *stiraculo m-*
 cranckste anvalt. Dit voordeel van meette begrip der wallen, en salmen *stiraculo m-*
 niet alleenelick natrachten in gheschickte veelhoucken, maer oock in *stiraculo m-*
 alle formen, soo veel de omstandighen toelaten.

Aldus dan beschreven sijnde dese drie ghemeene voornamelicke pun-
 ten, te weten Strijcken, Plomphouckichste bolwercken, ende meette be-
 grijp der wallen, dienende als wit deses handels, daermen in saken van
 stercken dickwils het oogh op hebben moet, soo sullen wy comen tot
 de twee laetste hoofsticken der * Verschillen, waer in het bedencken der
 selver dickwils sijn ghebruick sal hebben, om vande verscheyden ende
 strijdende sinnelicheden, met meerder ghewisheyt te meughen oordeelen.

6° H O O F T S T I C K

*Van ettelucke * verschillen op een volcommen
 sterckte als de voorgaende.*

Questiones.

IN T beghin des tweeden Hoofsticx, is gheseyt de reden waerom wy
 de verschillen dier opde sake der bouwing vallen, niet en wilden
 menghen met de teyckeninghen des selfden Hoofsticx, oock dat dit
 6° Hoofsticx, metgaders het volghende 7°, tottet besonder verclaren van
 dien veroident waren, ende volghende alsulck besluyt, sullen daer mede
 voort varen in deser voughen.

1° VERSCHIL VANDE MATEN.

DER * Boumeesters sinnelicheden sijn vande maten der stercken *Architectura*
 seer vrescheyden, sommighe willen (als *Girolamo Maggi* seght) dat de
 F 2 langde

considered the best and strongest, for seeing that a bullet is shot into a bank or wall more than 20 feet, sharp angles sideways may be easily overthrown, yea be shot quite through, but upon those angles which are very flat, a sideways shot can take no hold.

Thirdly, equilateral fortresses, which may be described in a circle and which we otherwise term regular polygons, are the fittest figures, for they include more space of ground with less wall, which not only reduces the cost of building, but also requires less artillery and fewer men to defend. Besides, their bastions have the best angles, for unequal-sided figures have some angles flatter, but other angles again must be less flat and sharper, which is not advantageous, seeing that the experienced enemy leaves the strongest places alone, and attacks the weakest. This advantage of greatest enclosure of walls must be sought after, not only in regular polygons, but in all figures, according as conditions permit.

These three common, main points now being described, to wit: Striking, flattest-angled bastions, and greatest enclosure of walls, serving for the scope of this treatise, whereunto in matters of fortification a man must often have an eye, I will come to the last two chapters of the Differences, wherein the remembrance of the same points shall often have its use for the wiser judgement of the different and contrasting opinions.

CHAPTER 6

Of several deviations from a regular fortress,
as that spoken of before

At the beginning of the second chapter were set down the reasons why we do not wish to mix up the differences concerning the matter of fortification with the planning spoken of in the said Chapter. Also, that the Chapters 6 and 7 were appointed for the particular explanation of them; following this decision, we will proceed after this manner.

1st DIFFERENCE

concerning the dimensions and measures ¹⁾

The architects greatly differ in their opinions concerning the dimensions of

¹⁾ By "maten" Stevin understands both the different kinds of units, used for measuring, and the dimensions expressed in these units; this appears already from the opening of the first sentence of the 1st Difference. The former units, which may have all kinds of names: bracci, passi, cannes, toises, feet, palmi, etc. have been translated by *measures*, the word "maat", used in the sense of size (of a curtain, of a flank, etc.) by *dimension*. The dimensions are dependent not only on the different lengths of the units, but also on six points mentioned on pp. 133 and 135.

Ellen.
Stappen.

langde der gordine tusschen twee bolwercken, sy van 600 tot 700 * *Bracci*: Ander van 300 tot 400: *Tartaglia* van 250 tot 300 * *passi*: *Capitan Frate da Modena* 140 *cannes*: *Cataneo* neemt voor verscheyden steden verscheyden langden, als 192, 232, 240, 244, 256, 510 *bracci*: de stercken van 149, 152 *bracci* (soo *Maggi* seght, maer inden druck die ick daer af hebbe vindefe van ontrent soo veel *passi*) *Secretario Fiorentino* 200 *bracci*: *Girrolamo Maggi* van 250 tot 300 *bracci*: *Carlo Theti* van 80 tot 100 *cannes*: *M. Aurelio de Pafino* in sijn twee gheteyckende stercken, ontrent 80 ende 90 * *toises*: *Daniel Speckle* in verscheyden formen 500, 600, oock 650 voeten. Dit is vande groote gordine gheseyt, ende souden derghelijcke verscheydenheden van dander deelen der stercken hier oock menghen vergaren, dan latent om gheen tijt te verliefen.

Vadem.

Ratio.
Definier.

De oirsaken van sulck verschil sijn veelderhande. Ten eersten dat ons somwijlen de naem der maten bedriecht, welke dickmael even eens luydende, nochtans in deen stat veel langer sijn als in d'ander, daerom wanneer de *reden der maten van verscheyden steden niet uitdruckelick ghenouch *bepaelt en wort, soo en hebben wy uijt haer bloote namen gheen sekerheyt: Nu om hier af eenighe verclaringhe te doen, sullen vergaren ettelicke maten in Italiaensche, Francoische, ende Hoochduytschen druck uijghegaen, welke yghelick dieder lust toe heeft, soo teghen malcanderen, als teghen ons Delfsche mate overlegghen mach.

DE Delfsche voet daer de voorgaende teyckeninghen op ghedaen sijn, begrijpt 12 duymen, ende de 12 voeten doen een roede, doch wy en hebben de langden hier vooren deur gheen roeden uijtgesproken, om dat ons altemael voeten gherievigher dochte. Het $\frac{1}{4}$ van een dier voeten is van dese langde:

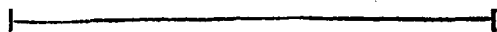


*De vier volghende maten sijn ghetrocken
uijt Carlo Theti.*

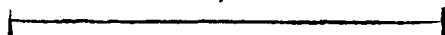
De *canna* heeft 10 *palmi*, den helft van een *palm* is van dese langde:



De *canna* heeft vier *Bracci*, het $\frac{1}{8}$ van een *braccio* is van dese langde:



De *canna* heeft 8 *palmi*, het $\frac{1}{4}$ van een *palm* is van dese langde:



De *passo*

the fortresses; some want (as Girolamo Maggi¹⁾ says) the length of the curtain betwixt two bastions to be between 600 and 700 bracci. Others between 300 and 400. Tartaglia from 250 to 300 passi, Capitan Frate de Modena 140 cannes. Cataneo uses for diverse towns different lengths, as 192, 232, 240, 244, 256, 510 bracci: the fortresses of 149, 152 bracci (which Maggi speaks of, but in the print that I have of them, I find them to be so many passi). Secretario Fiorentino 200 bracci, Girolamo Maggi from 250 to 300 bracci. Carlo Theti betwixt 80 and 100 cannes. Marc. Aurelio de Pasino in his two plotted fortresses about 80 and 90 toises. Daniel Speckle in diverse figures 500, 600 and also 650 feet. This is said of the large curtain. The similar differences of the other parts of fortresses might likewise be set down here, but I leave it in order not to lose time.

The causes of these differences are many. In the first place these measures' names sometimes deceive us: in many places they sound alike, but in one town they are much longer than in the other. Therefore, when the ratio of the measures in the different towns is not expressly enough defined, we cannot out of the bare name have any certainty. Yet to say something thereof, I shall gather various measures, given in Italian, French, and German prints, which every man that is willing may both compare amongst themselves, and against our Delft measure.

The Delft foot on which the foregoing drawings are based contains 12 inches, and 12 feet make a rod; yet heretofore we have said nothing of measuring by the rod, because it was thought more convenient to have everything in feet. One fourth of one of these feet is of this length:

The four following measures have been taken from Carlo Theti.
The canna contains 10 palmi; half a palmo is of this length:

The canna contains 4 bracci; $\frac{1}{8}$ th braccio is of this length:

The canna contains 8 palmi; $\frac{1}{4}$ th palmo is of this length:

¹⁾ The books by the Italian authors mentioned here and on p. 131 and by Speckle are the following:

Girolamo Maggi (and Giacomo Castriotto), *Della Fortificatione della città*, Venice 1564.

Niccolo Tartaglia, *Questi et inventioni diverse (libro 6)*, Venice, 1546.

Capitan Frate da Modena (no work known).

Girolamo Cataneo, *Opera nuova di fortificare, offendere et defendere*, Brescia, 1564.

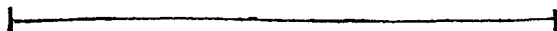
Niccolo Machiavelli (Secr. of Florence), *Arte della Guerra (libro 7)*, Florence, 1521.

Carlo Theti, *Discorsi delle fortificationi*, Rome 1569; Venice 1588-9 (present in the Municipal Library of Haarlem).

Marc. Aurelio de Pasino, *Discours sur plusieurs points de l'architecture de guerre*, Antwerp, 1579 (see Introduction, p. 2, notes 10 en 11).

Daniël Speckle, *Architectura von Vestungen*, Strassburg, 1589.

De *passo* heeft 6 voeten, het $\frac{1}{4}$ van een voet is van dese langde:



*De drie volgende maten sijn ghetrocken
uyt Girolamo Cataneo.*

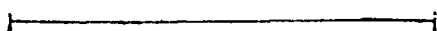
Passo of stap begrijpt vijf Veneetsche voeten, het $\frac{1}{4}$ van een Veneetsche voet is van dese langde:



Dese langde is het $\frac{1}{4}$ van een *braccio Bresciano*:



Dese langde is het $\frac{1}{4}$ van een *piede antico*:



*De vier Volghende maten sijn ghetrocken
uyt Iacomo Castriotto.*

De *canna* heeft 10 *palmi Romani antichi*, het $\frac{1}{4}$ van een dier palmen is van dese langde:



De Fransche *toise* (dat vadem beteekent) heeft 6 voeten, het $\frac{1}{4}$ van een dier voeten is van dese langde:



De *canna* heeft 10 *piedi Vrbinati*, oft *de la Marca*, het $\frac{1}{4}$ van een dier voeten is van dese langde:



De *canna* heeft vier *bracci Toscani*, het $\frac{1}{8}$ van een *braccio* is van dese langde:



De twee Veneetsche *passi*, segt *Castriotto*, doen een *Canna*.

F 3

De vijf

The passo contains 6 feet; $\frac{1}{4}$ th foot is of this length:

The three following measures have been taken from Girolamo Cataneo.
 Passo contains 5 Venetian feet; $\frac{1}{4}$ th Venetian foot is of this length:

This is the length of $\frac{1}{4}$ th of a braccio Bresciano:

This is the length of $\frac{1}{4}$ th of a piede antico:

The four following measures have been taken from Jacomo Castriotto:
 The canna contains 10 palmi Romani antichi; $\frac{1}{4}$ th of one of these palmi is
 of this length:

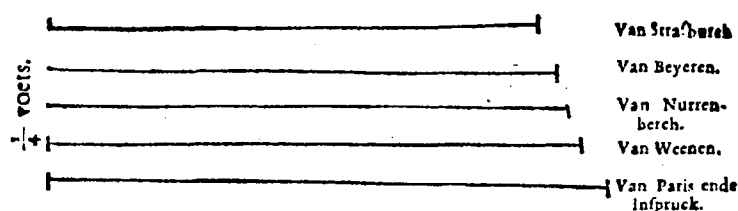
The French toise (which signifies fathom) has 6 feet; $\frac{1}{4}$ th of one of these feet
 is of this length:

The canna contains 10 piedi Urbinati, or de la Marca; $\frac{1}{4}$ th of one of these feet
 is of this length:

The canna contains 4 bracci Toscani; $\frac{1}{8}$ th of a braccio is of this length:

Two Venetian passi (says Castriotto) make one canna.

*De vijf volgende maten zijn ghetrocken
uyt Daniel Speckle:*



Inde ghedruckte vormen van Sebatianus Serlius *Antiquitatum lib. 3.* overgheset uijt het Italiaens int Latin deur Ioannes Carolus Saracenus, staen oock verscheyden maten van *Brachia*, *Palmi*, *Pedes antiqui*, *Pedes recentiores*, die soo wel onder malcanderen, als vande voorgaende seer verschillen.

Tot hiet toe is vande verscheyden langden der maten gheseyt.

Architecti.

Ten tweeden soo comter dickwils verschil der maten tusschen het een ghebou ende het ander, deur dien dat de * Boumeesters hemlieden moeten ghevoughen na de geleghentheyte der plaets, welcke hun belet de gemeene reghel te meughen volghen.

Ten derden ghemerckt datter een gheschot voordræghet alst ander, ia dat een selfde stick met dit buscruijt meer ghewelt doet als met dat, soo en ist gheen wonder dat de menschen vande maten verscheydentlick oordeelen, elck na de ervaringhen die hem ontmoet sijn.

Ten vierden soo sijnder ettelicke die hun rekeninghe maken, met groot gheschut te schieten, datse *artiglieria reale* noemen, daer by verstaende stucken diens clooten swaer sijn van acht pont opwaert: Ander met *non reale*, dat is van acht pont neerwaert, t'welck soo verre niet en draecht.

*Cavaglieri.
Flanca.*

Ten vijfden soo is de meyninghe van sommighe, dat opde groote gordine eenighe versterckinghen commen, als van * catten, platteformen, ofte * strijckhoucken, om de wille van welcker behulp, sy de gordine tusschen twee bolwercken, langher veroirdenē dan de gene dier fulcke versterckinghen niet op en brenghen.

Ten seften willen eenighe, als *Iacomo Castriotto* ende ander, de groote gordine soo lanck, ende de bolwercken soo wijt van malcander hebben, datse van haer teghenoverstaende strijckhoucken met groot gheschot niet betichadicht en worden, welcke reghel ander verwerpen, diens bewijs ende redenen int volghende 8^e verschil deses Hoofstick verclaert sullen worden, teghen de ghene die tot fulcken ende cromme gordinen maken.

I hier ten laesten noch by ghevoughet, dat deen niet gheeren en schynt sijn wetenschap van dander te hebben, voornaemlick vande ghene die
noch

The 5 following measures have been taken from Daniel Speckle:

1/4th of a foot

_____	of Strasbourg
_____	of Bavaria
_____	of Nuremberg
_____	of Vienna
_____	of Paris and Innsbruck

In the printed figures of Sebastianus Serlius ¹⁾, *Antiquitatum lib. 3*, translated from Italian into Latin by Joannes Carolus Saracenus, are also set down various dimensions of Brachia, Palmi, Pedes antiqui, and Pedes recentiores, which differ much among themselves as well as from the measures set down before.

Hitherto has been spoken of the differences in lengths of measures.

In the second place there is often a difference in dimensions betwixt one building and the other, because the architects must often fit their buildings to the situation, which hinders them from following the common rule.

Thirdly, seeing that one piece of ordnance shoots further than another, and that the same piece causes more damage with one powder than with another, then it is no wonder that men differ in their judgments of dimensions, each according to his own experience.

In the fourth place, there are some that make their calculations with great ordnance, which they term *artiglieria reale*, meaning thereby pieces whose bullets weigh from 8 lb upwards; other with *non reale*, which are under 8 lb, which do not carry so far.

In the fifth place, there are some who think that upon the large curtain some fortifications should be made, like cavaliers, platforms, or striking angles, in connection with which help they make the curtain betwixt two bastions longer than the one without such fortifications.

In the sixth place, some, like Jacomo Castriotto and others, want to have the large curtain so long and the bastions so far from each other that from the striking angles that lie opposite them they cannot be damaged by great ordnance, which rule some reject, whose proof and reasons shall be declared in the 8th difference in this Chapter, against them who to that intent make crooked curtains.

Hereunto it should lastly be added, that as one would not seem to have willingly borrowed his knowledge from the other, especially from those that

¹⁾ Besides the work mentioned by Stevin, Serlius also wrote his well-known *Architectura*, quoted for example by Dijksterhuis, the first book of which appeared already in 1551 in Venice (see Haslinghuis, *Bouwkundige termen*, Utrecht 1953, p. 32).

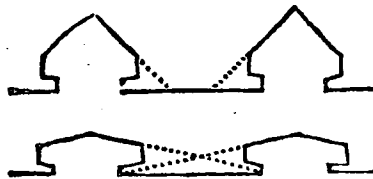
noch leven (met de overleden als Vitruvius Archimedes Euclides en heeft het gheen noot) denckende dat hun * achtbaerheit daer deur soude vermindert worden, soo sijn de menschen in sulck gheval ghemeenelick gheneycht van malcander te verschillen, ende vervolghens soo heeft alles sijn nateurlicken loop. Autoritas.

Angaende de maten hier vooren int 1^e Hoofstuck ghestelt, ick hebbe na het overlegghen der * strijtrekens verscheydener schrijvers, ende van ander omstandighen, daer in ghevolght t'ghene my alsdoen de reden naest dochte: Iffer yet langher of corter, dicker of dunder dant den Leser goetdunckt, hy macht na sijn welghevallen veranderen, ende t'ghene ick verstaen can verbeterd te sijn, daer in wil ick soo lief hem navolghen, als ick anderen gedaen hebbe: T welck de reden oock alsoo vereyscht, gemerckt ons voornaemlick einde niet en behoort te strecken, om staende te houden t'ghene wy eens gheseyt hebben, maer om de alderbeste sterckten te veroirdenen. Argumentum.

2^e VERSCHIL VAN PLOMPE

en scherpe bolwercken.

Hoe wel dattet voor ghemeene reghel ghehouden wort, de scherpe voorhoucken der bolwercken, lichtelicker deurschoten ende nederghelveit te worden dan plompe, nochtans sijn eenighe van meynings, datmen gheen plompe, hoe wel datmen se bequaemlick cryghen mocht, en behoort te veroirdenen, dan datmen om die te schuwen, de bolwercken gordinen uijt het middel, ofte uijt eenich ander punt der groote gordine moet trecken, als inde volghende eerste form; niet uijt den * strijckhouck Plompe. na de ghemeene manier der onderscreven tweede form, welcke alle beyde verstaen worden op een rechte groote gordine gheteyckent te wesen.



Maer om te bewijzen dat de * Boumeesters inde vermaerde sterckten, met goede nateurlicke reden na de plompste houcken trachten, soo sulen wy de * strijtrekens dier stof van punt tot punt overlegghen. Architectura.

1^e Punt, of inde scherpe of plomphouckighe bolwercken de breedste * muerbrak* ghedaen wort. Argumentum.

TEN eersten soo wortet van eenighe voortghebrocht, dat den afgeschoten punt eens scherphouckich bolwercken, smalder muerbrake Breite.
(soo

are still alive (with the dead, like Vitruvius ¹⁾), Archimedes and Euclid, it does not matter), thinking that their authority thereby would be diminished, so men are commonly given to differ from each other in such matters, and thus everything has its natural course.

Concerning the dimensions spoken of by me before in Chapter 2, I have, after considering the arguments of various writers and other circumstances, followed what I thought most reasonable. If there be anything longer or shorter, thicker or thinner than the reader thinks fit, he may (as it pleases him) alter it, and in what I can understand as being improved, I shall as willingly follow him as I have done others. Which in reason ought to be so, since our main purpose ought not to be to maintain what we have once said, but to make the best fortresses.

2nd DIFFERENCE concerning obtuse and acute bastions

Although it is held as a common rule that the sharp-pointed forecorners of bastions will be sooner shot through and overthrown than the obtuse, some are of opinion that we should make no obtuse or flat-angled bastions, although we might conveniently make them, but that we should, to avoid that flatness, draw the curtains of the bastion from the midst of the large curtain, or from some other point in it, as in the first figure following, and not from the flank, according to the common rule of the second figure, both of which are understood to be described upon a straight large curtain.

But to show that the architects in the famous fortresses, with good natural reason, do strive after the flattest angles, we will consider the arguments of this matter from point to point.

1st Point, whether the greatest breach can be made in sharp or flat-angled bastions

First it is said that the point of a sharp-angled bastion being shot off, makes a lesser breach (such is the meaning of the French *breche*: Or, to put it even

¹⁾ It is conceivable that here Stevin mentions Marcus Vitruvius Pollio besides so many other Italian authors as source of knowledge, because the works of this Roman engineer were first published in Italy from about 1490 onwards. He must therefore certainly have attracted Stevin, who, moreover, so much admired the Romans and their military science. (Bodo Ebhardt, *Die zehn Bücher der Architektur des Vitruv und ihre Herausgeber seit 1484*, Berlin, c. 1915).

Etymologia.

(soo noemen wy der Françoisen *breche*: Ofte om noch beter te segghen, sulcx is den *oorspronck van der Françoisen *breche*, want voor ons breken, seyden de Walen ende Picarden *brake*, daer voor de Françoisen noch verder van ons gheseten, oock noch verder vanden oorspronck loopende, segghen, ghelijckse alle foodanighe veranderen, *breche*, daer de Italianen *breccia*, at maken) veroirsaeft om over te stormen, dan een afgheschoten plompen punt: T'welck wel waer is wanneer men elcken punt even lanck af schiet, maer in sulck gheval isser meer stof vanden plompen afgheschoten, als vanden scherpen: Daerom laet de verlijcking na'r behoiren ghestelt worden, te weten datmen op elcken punt even veel schoten schiet, ende dan de sake overweghen, want ghenomen dat den cloot maer 20 voeten (etelicke betuyghen van al veel meer) in d'eerde en vlieghe, soo salmen den voorpunt des rechthouck, ick laet scherper varen, tot opde lengde van (als den *Meier bekend is) $\frac{1}{4}$ 200, dats over de 14 voeten, connen deur ende weder deur schieten, maer opde houcken die plomp ghenouch sijn, en heefmen van ter sijden gheen vaten.

Geometria.

Angaende gheseyt wort, dat wanneer de viant sijn gheschot plant voor t'middel van een plomphouckich bolwerck, dat hy alsdan van die eenighe plaets, muerbrake sal meughen schieten opde twee sijden des bolwelcx: Hier op antwoortmen, dat wanneer de viant sijn gheschot plant voor t'middel der groote gordine, nevens welcke scherpe oft rechthouckighe bolwercken ligghen dat hy van die eenighe plaets, muerbrake sal meughen schieten in vier sijden der bolwercken, want alsoo (ghelijck boven gheseyt is) de clooten dweers deur de scherpe houcken vliegghen, soo sal elck bolwerck op twee sijden beschadicht worden, met groote verspreyding der stof: Maer int plomphouckich bolwerck, daermen om twee gordinen t'seffens te breken van vooren op schiet, blijven de clooten stecken, met veel minder schade.

2. Punt, van der bolwerck gordine bescherminghe
over de groote gordine.

Als des scherphouckich bolwerck gordine ghetrocken is uijt het middel, ofte uijt eenich ander punt der groote gordine, soo canmen (segghen sy) van een deel der selve groote gordine, de bolwerck gordine beschermen. Hier op antwoortmen, dat vande groote gordine gheen goede bescherminghe der bolwerck gordine geschieden en can, overmits datter een groot deel vande selve bedekt blijft, van wegghen de dichte des *borstweers der groote gordine, want by aldienmen (op dat wy sulcx met *doorsichtighe spiegeling verclaren) het *plat der afdakinghe vant borstweer der groote gordine den t'ghedacht oneindelick voortreckt, soo sal al t'ghene dat van het *schuifel ende vande bolwerck gordine onder t'selve plat light, verborghen blijven voor den ghenen die langs de afdakinghe

Tarapetto.
Perspectiva
vicoria.
Platum.
Orillon.

better, this is the origin of the French *breche*, for what we call *breken* is called *breke* by the Walloons and Picards, since the French, being further away from us and deviating even more from the origin, as they change all such words, say *breche*, from which the Italians make *breccia*) for the assailant than the point of a flat-angled bastion, which would be true if both points were shot off at equal length, in which case there would be more material battered off from the flat angle than from the sharp. Therefore, let the comparison be such as it ought to be, to wit, that against each point an equal number of shots are fired, and then consider the matter, for suppose that the shot did fly but 20 feet into the wall (some speak of many more), then shall the forepoint of the right angle (I ignore sharper angles) at the length (as is known to the geometricians) of $\sqrt{200}$, which is more than 14 feet, be shot through and through, whereas upon an angle that is very flat a sideways shot can take no hold.

Concerning what is said when an enemy plants his ordnance over against the middle of a flat-angled bastion, that he may then breach both sides of the bastion from one place, hereunto we answer, that when an enemy plants his ordnance against the midst of the large curtain, upon either side of which lie either sharp or right-angled bastions, that from that one place he may breach 4 sides of these bastions, for (as said above) the bullets flying right through the sharp angles, each bastion will be damaged on two sides, with great scattering of the materials. But in the flat-angled bastion, which, to breach two curtains at once, are shelled in front, the bullets stick in the earth, causing far less damage.

2nd Point, of the defence of the curtain of a bastion by the large curtain

When the curtain of a sharp-angled bastion is drawn either from the midst of the large curtain, or from any other point in it, we may (some say) from part of the said large curtain defend the curtain of the bastion. Hereunto we answer that from any part of the large curtain there can no good defence be made upon the curtain of the bastion, because a great part of the said curtain lies hidden behind the parapet of the large curtain, owing to the thickness of the same parapet; for if (to show it with perspective theory) the plane shelving of the parapet of the large curtain (by imagination) should be extended infinitely, then will all the part of the orillion and curtain of the bastion that lies under the same plane, lie hidden from them that look along the shelving of the aforesaid parapet.

afdakinghe des voorscreven borstweers siet: Maer alsoo en ist niet wanneermen siet uijt den teghenoverstaenden * strijchouck, oft vande schut- *Flanc.* fels gordine, wantmen van daer niet alleen des anders bolwerck gantsche gordine en siet tot den gront toe, maer noch een groot deel vande gront des grachts. Ten anderen soo en canmen int borstweer der groote gordine gheen bequame * bosgaten noch schutfels legghen, om van daer te *Cannieren.* *strijcken, het selve deel der bolwerck gordine datter soude meughen int *Nettayer.* ghesicht commen, uijt oirsaeck dat de strijckschote te schoens deur de langde des borstweers soude moete strecken. Daerom alsoo vande groote gordine gheen strijckingen comt diemen strijcking noemen mach, ende dat uijt den * strijckhouck self gheen rechte strijcking ghedaen en wort, *Flanc.* soo en heeft sulcke bolwerck gordine gheen volcommen strijcking.

Angaende dat ettelicke neven den strijckhouck inde groote bovegordine een inham maken, diens borstweers voorsijde na des scherphouckich bolwerck gordine keert, om door de bosgaten daer in ligghende de selve bolwerck gordine beter te beschermen sonder verhindernis te krijghen vande voorscreven dichte des borstweers der groote gordine; Oock om van dien oirt een deel des velts te ontdekken: Hier op segmen: Ten eersten dat sulcke bosgaten van het * schutsel weynich beschermt sijnde, *Ortillen.* voor de viant seer bloot ligghen, ende dattet beter is des plompen bolwerck gordine te beschermen met bedecte bosgaten dieder inden strijckhouck ghenouch sijn. Ten tweeden wat de ontdekking des velts belangt, dat ander plaetsen der groote gordine, oock der bolwerck gordinen, daer toe veel bequamer sijn, als wesende den viant tot die plaets int velt veel naerder, om hem met vrie schoten te moghen treffen. Ten derden dat de groote gordine ter plaets van dien inham haer volcommen strijcking niet en krijght: Ten vierden dat die bosgaten gheen groote gordinen strijcken en connen: In somme dattet een ghebroken form is daer gheen voordeel uijt en comt.

3^e *Punt, vande strijckschoten langs scherphouckighe
bolwercken met cleen gheschot.*

ANGAENDE datmen het bolwerck van een sterckte die weerdich is den naem van sterckte te voeren, alsoo scherphouckich anlegt, datmen sijn rekeninghe maeckt, de beste volcommen strijckschoten langs de bolwerck gordine te willen schieten vande groote gordine, met cleen gheschut, als muschetten, ofie hantroers, het wort vande ervaeren met goede reden voor onghegront voornemen ghehouden, want die opde eyghenschap des strijckens wel acht neemt, ende recht overdenckt hoe datter op een cleene breede van drie of vier roeden, veroirdent is soo grooten menichte der goede strijckscoten van grof gheschut, dieder commen vande catte, vande hooghe ende leeghe plaetsen des strijchouc, vande

G

hooghe

But this is not so when we look out from the opposite flank, or from the curtain of the orillon, for thence we not only see the entire curtain of the other bastion unto the ground, but also a great part of the bottom of the ditch. Moreover, in the parapet of the large curtain there can neither convenient embrasures, nor fit defence for them be made to scour thence that part of the curtain of the bastion that can be seen, because a flanking shot would have to scour too obliquely along the parapet. Therefore, as from the large curtain there can be no flanking that we may term flanking, and from the striking angle itself no true scouring can be made, therefore the curtain of such a bastion has no perfect flanking.

Concerning the fact that some, near the striking angle in the uppermost large curtain, make a recess, the front of whose parapet is turned towards the curtain of the sharp-angled bastion, that through the embrasures made in it the said curtain might be better flanked, without hindrance from the thickness of the parapet of the large curtain, also thence to see part of the field outside the fortress; against this may be said: First that such embrasures, being poorly protected by the orillon of the bastion, lie very open to the enemy and that it is better to defend the curtain of the obtuse bastion with covered embrasures, of which there are enough in the flank. Secondly, concerning the view of the field, that other places of the large curtain, also of the curtains of the bastion, are much better for this purpose, as being much nearer the enemy in the field to hit him with free shots. Thirdly, that the large curtain at that recess does not obtain its perfect scouring. Fourthly, that those embrasures cannot scour large curtains. In all, that it is a broken form, from which comes no profit.

*3rd Point, of flanking sharp-angled bastions
with small shot*

As to the possibility of making the bastion of a fortress — that is worthy of bearing the name of fortress — so sharp that one can shoot the best flanking shot from the large curtain along the curtain of the bastion with small fire-arms, like musket or pistols, it is held by the practised (with good reason) as a plan without ground, for he that well notes the property of flanking, and correctly considers that on a small width of 3 or 4 rods come so many good flanking shots of great ordnance that are fired from the cavaliers, from the high and low places of the striking angle, from the high and low curtains in the

*Refer.
L'effrayement.*

hooghe ende laaghe schuttele gordinen ende dat altemael ghelijck gheseyt is op soo cleenen breedte, als in eenen doel, hy sal bekennen dattet niet noodich en is, maer teghen reden, sulcken bolwerck gordine noch te willen * strijcken met cleyn gheschot, dat leeren, teetichappen, noch borstweeren des viants breken en can, noch over meurbrake met springhende puyn hem schade doen. Tis wel waer dattet hangheschot, in tijt des storms seer bequaem ende noodich is, tottet ghene int ghesicht comt, maer dat te willen ghebruicken tot de alder volcommenste strijckschoten der bolwerck gordinen, diemen om de redenen des 1^o punts ten grooten deele niet sien en can, daer oock ander grof gheschot eyghentlicker toe veroirdent is, ende om sulck misverstant de streken des grof gheschuts ghebreckich te trecken, cranckhouckighe bolwercken te veroirdenen, ende de stercke plomphouckighe te schuwen, ten schijnt in gheen reden ghegrondt.

4^e Punt, vande affchietinghe der schantsen, die door de viant
ande bolwerck gordine meughen gheleyt worden.

Materialem.

Natijc.

ETTE LICKE meynen dat soo de viant hem voor de bolwerck gordine beschant, om sich teghen de strijchoucken te bevrijden, datmen in sulcken ghevalle sijn schantien of borstweeren, met rechte strijckschoten der plomphouckighe bolwercken niet soo seer crancken een can als met scheeve, der rechthouckighe of scherphouckighe, maer de sake wel inghesien, is heel anders daer mede ghestelt, want een rechte strijckschote worpt de * stof der schants achterwaert wech, verspreyt die, de springhende sticken ende den deurvliegghenden cloot heschadighen den viant, ende can sulcke schants van daer * afghevaeght worden tot de gordine toe: maer de scheeve (die eyghentlick gheen strijckschote en is, dan om verstaen te worden sulcken naem heeft) streckende te wallewaert in, die worpt de springhende sticken meer teghen de bolwerck gordine an, daerom en connen soo wel niet verspreyt worden als anders, oock en is vanden deurvliegghenden cloot sulcken schade des viants niet te verwachten, om dat se of inde gordine blijft steken, ofte heur daer op vermaect.

Horizontalem.

*Pro terminatore
visus seu Hori-
sonte.*

Om t'welck noch opentlicker te verclaren, soo merckt dattet voor ghe-
meen reghel ghehouden wort, datmen de schantsen door * sichteindersche
schote veel meer beschadicht, dan met de ghene die van boven neerwaert
comt: Daerom de voorsijde der bolwerck gordine ghenomen sijnde als
* voor sichteinder, ende des viants borstweer als schants daer op, soo sal
de rechte strijckschote voor sichteindersche verstrecken, maer de scheeve,
voor de ghene die van boven neerwaert comt.

5^e Punt,

orillion, and those lying altogether as was said, in so small a width as a butt, he must confess that it is not needful, but against reason, yet to flank the curtain of such a bastion with small shot, which can neither break ladders, tools, nor the enemy's parapets, nor offend him with the debris that flies from a breach. It is true that hand firearms in time of an assault are very fitting and needful to be used against what is in sight, but to use them for the most perfect scouring shot to flank the curtain of a bastion a great part whereof we cannot see, for the reasons before shown in the 2nd point, for which purpose great ordnance is also more properly appointed, and through such misunderstanding to plan the range of great ordnance insufficiently, making weak-angled bastions and forsaking strong flat-angled ones, seems to be founded upon no reason.

4th Point, of the breaking with ordnance the redoubts that an enemy may make in approaching the curtain of a bastion

Some think that when an enemy entrenches himself before the curtain of a bastion to defend himself from the offence of the flank, that in such cases his redoubts or parapets cannot so well be damaged with straight flanking shot from flat-angled bastions as with skew shot from a right-angled or sharp-angled bastion, but the matter being well looked into, it will be found wholly otherwise: for a straight flanking shot throws the materials of the trench backwards and spreads them, the flying debris and the through-flying shot hurt the enemy, and such a trench may be scoured thence even unto the curtain: but the skew shot (which properly is no flanking shot, but to be understood bears this name) reaching towards the wall, throws the debris more up against the curtain of the bastion, and therefore cannot so well spread it as the other. Also, there is no such damage to an enemy to be expected from the through-flying shot, for it either sticks in the curtain, or else rebounds upon it.

Which to declare yet more plainly, note that it is held for a common rule that with a level or horizontal shot, a trench will be more damaged than with a shot that comes from above: Therefore, the foreside of the curtain of a bastion being taken as horizon, and the enemy's parapet as a redoubt upon it, then shall the straight flanking shot scour horizontally, but the skew like the one that comes from above.

5^e Punt, vande bescherminghe van deen bolwerck
gordine met dander.

SEGGEN noch, dat wanneer de voorhoucken der bolwercken niet plomp en sijn, dat aldan de twee gordinen van twee bolwercken neven een ligghende, malcander beter sien connen, daerom too een *strijckhouck met haer *schutsel neder ghevelt wierde, soo salmen van deen bolwerck gordine, dander beter connen sien ende beschermen: Hier op antwoorten, dat sulck ghedacht van sien hem niet en ghevought, na t'ghene daermē voornaemlick op behoort te letten, te weten op de *strijckkinghe, want van deen gordine der plomphouckighe bolwercken, canmen dander beter na de strijckkinghe sien, ende vervolgghens connen malcander beter beschermen, om de redenen van dies int voorgaende 4^e punt breeder verhaelt. Men soude hier noch meughen segghen, hadt ghy die punten na t'behoiren plomp ghetrocken, de viant en soude soo lichtelick tot *muerbrake niet ghetocht hebben, om daer over te stormen, ende het ander bolwerck daer ghy de beschermenis mede doen wilt, soude oock stercker ende verskerder sijn, om tot bescherminghe te meughen ghebruicken.

Flanc.
Orilium.

Nettoyement.

Breche.

6^e Punt, van storm met leeren ofte over muerbrake.

STORM gheschiet met leeren ofte over muerbrake: Soo veel die met leeren belangt (welcke somwijlen ghedaen wort, wanneer de viant vermoedt datmender gheē ghoele wacht en houdt, datter weynich volck opde sterckte is, of dier ghelijcke) alwaer met een rechte volcommen strijckschote, veel leeren met datter op is t'effens te neder connen ghevelt worden: In sulcken ghevalle en isser langs de bolwerck gordine dier scherpe bolwercken gheen volcommen strijckking, want vande groote gordine af, isser een groot deel der bolwerck gordine bedekt, ende onstrijckelick, soo wy int 2^e punt breeder verclaert hebben, ende uijt den *strijckhouck sijn de strijckschoten scheef ende onvolcommen: Inder voughen dat sulcke manier teghen storm met leeren onbequaem is.

Flanc.

Maer by aldien de storm over muerbrake gheschiet, soo canmen door rechte volcommen streken, met de springhende puyn, ende met deurvliegghende clooten, den viant veel meer beschadighen, dan met scheeuve onvolcommen strijckschoten, als van derghelijcke int wechschieten der viants schantfen breeder verhael ghedaen is, int voorgaende 4^e punt.

Angaende het voordeel dat eenighe rekenen, deur de groote uijstekkende plaets, diemen opde scherphouckighe of rechthouckighe bolwercken krijght, om aldaer catten te meughen legghen, die tusschen haer ende het borstweer des bolwerck, groote ruymte hebben: Hier teghen sal beweesen worden int volghende 13^e verschil vande catten, dat die groote

5th Point, of defending the curtain of one bastion with the curtain of the other

It is also said that when the corners of the bastions are not flat, that then the curtains of two nearest bastions can see each other the better; therefore, when the flank and the orillion are battered down, one will from one curtain of the bastion better see and defend the other: Hereunto it is answered that this opinion about the sight is not in agreement with what we ought specially to consider, to wit, the flanking, for from one curtain of a flat-angled bastion the other can be better seen flankwise, and consequently they can defend each other the better, for the reasons more extensively declared in the aforementioned 4th point. It might here be added: if you had drawn the corners so flat as they ought to be, the enemy could not so easily have made a breach through which to assault and the other bastion which you wanted to use as defence would be stronger and safer to be used for defence.

6th Point, of assailing with ladders or over the ruins of a breach

An assault is undertaken either with ladders or at a breach: As regards that with ladders (which is sometimes put into practice when an enemy suspects that there is a careless watch kept, that there are few soldiers in the fortress, or suchlike) where with one straight perfect flanking shot many ladders with all that is upon them can be overthrown at once, in such cases there is no perfect flanking along the curtain of these sharp bastions, for from the large curtain a great part of the curtain of the bastion lies hidden and unflanked, as we have further declared in the 2nd point, and from the flank the scouring shots are skew and imperfect, so that such manner of flanking is unfit against an assault with ladders.

But if an assault is made at a breach, one can with straight perfect shots, with the flying debris, and with through-flying bullets, offend the enemy much more than with skew, imperfect, flanking shots, of which in the battering down of the enemy's redoubts more has been said in the foregoing 4th point.

Concerning the advantage that some expect from the large projecting place obtained on the sharp-angled or rectangular bastion, by placing cavaliers upon it, which betwixt it and the parapet of the bastion have much space: Against this shall be demonstrated in the 13th difference concerning the cavaliers that that great space between is disadvantageous in that right-angled or sharp-angled

plaets daer tusschen beyden schadelick is. Inder voughen dat rechthouckige of scherpe bolwerckē, benevens datse meer stof behouven, ende costelicker vallen als ander, op veelderley wijze groot achterdeel veroirsaken.

Hier by mach noch dit gheseyt worden: Anghesien ghy self de groote gordine voor best bewaert acht, diens strijckschoten nochtans uijt den strijckhouck daer heel by ende langs henen strecken, over al even wijt daer af, waerom sal derghelicke strijckinghe langs de bolwerckx gordine quaet wesen? Ofse is v scheeve onvolmaecte strijcking der bolwerckx gordine de beste, waerom en brengdi niet derghelijcke beter manier op de groote gordine, makende de halven der bolwercken soo lanck, ofte yet anders daer toe doende, datmen sulck voordeel daer oock mach krijgen? Maer ghelijck v bekent is dat sulcx tot achterdeel der groote gordine soude ghedien, alsoo is anderen bekent, dattet tot achterdeel der bolwerckx gordine moet strecken.

De voorgaende redenen worden noch bevesticht door de ervaring, inde vermaerde sterckten die tot vericheyden plaetsen ghebouwt sijn: Als onder anderen Malta, een der voornaemste vestinghen des certbodem, daer veel an ghelegghen is, diemen onder de nieuwe rekenen mach, alsoose int iaer 1566 ontrent een iaer voor het Casteel van Antwerpen anhevanghen wiert, door rijpe beraetflaghinghe vande voornaemste * Boumeesters ende Crijgservaernen van Cristenrijk, welcke alle meeste voordeel forchvuldelick na trachtende, hebben; soo elck sien mach deur de ghedruckte formen daer af uijtgaende, de bolwerckx gordinen uijt de * strijckhoucken ghetrocken, om alsoo de plomphouckichste bolwercken te krijghen, met dander voordeelen daer uijt volghende, als boven verclaert is. Wy besluyten dan met de ervarenste, dat de alder plompste houcke, diemen na der * doorsichtighen reghel krijghen can, de beste manier van bolwercken maken, diemen na ghelegghentheyt der volcommen sterckten deses tijts, tot noch toe veroirdent heeft.

3^e VERSCHIL VAN RONDE

*of veelhouckighe bolwercken na de
rondtheyt streckende.*

SOMMIGHE hebben hun de ronde bolwercken laren bevallen, ettelicke twee cromme gordinen booghuys teghen malcander commende, ander veelhouckighe bolwercken, diens sijden * ghestrecken worden uijt verscheyden strijckhoucken die inde groote gordinen ghewrocht sijn, ghelijck de volghende form anwijst.

Nu anghe-

bastions (besides that they require more materials in their building and turn out costlier than other) in many ways cause great hindrance.

To this may yet be added: since you reckon the large curtain to be the best defended part, whose flanking shots scour close by and along the same equidistantly, why then should the like scouring all along the curtain of a bastion be wrong? Or if your skew and imperfect scouring of the curtain of a bastion be best, why then do you not bring up such better manner upon the large curtain, making the necks of the bastions so long, or doing something else unto it, that the like advantage may also be had there? But since you know that such a thing would be disadvantageous for the large curtain, so likewise it is known to others that it must be disadvantageous for the curtain of a bastion.

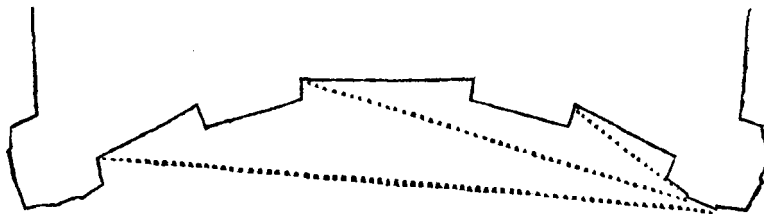
The above reasons are further confirmed by the experience in the most notable fortresses built in diverse places: As amongst others, Malta¹⁾, one of the most famous fortresses upon the earth, upon which much depends, which we may reckon amongst the new, because it was started in the year 1566, about one year before the Castle of Antwerp, with the ripe counsel of the best architects and most practised soldiers of Christianity, all of whom most carefully seeking after the most advantage. It has, as everyone can see from the printed figures issued about it, the curtains of the bastions drawn from the flanks, thus to obtain the flattest-angled bastions, with the other advantages ensuing therefrom as explained above. We conclude then with the most practised, that the flattest angles which (following the rule of perspective) we can have, make the best bastions, which according to the perfect fortresses of the present time, have been made so far.

3rd DIFFERENCE

Concerning round or polygonal bastions, bending roundways

Some have liked making round bastions, others two curved curtains bending inwards, each towards the other, others have polygonal bastions whose sides are flanked from several angles made in the large curtains, as the following figure shows.

¹⁾ At the end (last paragraph) of the 2nd Difference Stevin argues the advantage of the flattest possible bastions, the faces of which have been "drawn from the flanks". As an example he mentions the fortress of Malta, i.e. the capital La Valetta of this island, the fortification of which was begun in 1566, and he mentions incidentally the better-known "Castle" of Antwerp, the building of which was started in 1567. In addition, he refers to "the printed figures issued about it", by which he will certainly have meant the plates 35 and 7 in Speckle's *Architectura*, where on folios 85/86 and 17, respectively, the history of the building and the description of the two fortresses mentioned is dealt with. It is, however, doubtful whether Stevin wanted to set Antwerp as an example as well: for, the Citadel of Antwerp had no blunt, but sharp-angled bastions.



Nu anghesien dat de voorscreven form der bolwercken veelhouckich sijnde, na de rondtheyt streckt ende dat de ronde form, segghen sy, de sterckste is, om dat de stof haer na t'middel toe meer t'samen prangt als men se beschiet, soo moet die manier van bolwercken stercker wesen, als van twee rechte gordinen. Hier op wort gheantwoort, dat in sulck gemeen oordeel recht onderscheyt ghebreeft, want hoe wel den metser in overwelffelen de ronde of veelhouckige form verkiest, om bestfluytende boghen te maken; Hier teghen souct den timmerman sijn werck met corbeelen te verstijven, dat is eyghentlicker gheseyt, hy schouwet den veelhouck, ende tracht na den driehouck, welcke niet teghenstaende sy ter contrari onder de rechtlinighe formen de alder eenvoudichste is, nochtans vast staet, maer den vierhouck niet, den vijhouck noch min, ende vervolghens hoe des timmermans onghecorbeelde veelhouck meer sijden heeft, ende meer na de rondtheyt streckt, hoe sy slapper is. Inder voughen dat voor ghemeen reghel te segghen, de meesthouckighe formen die na de rondtheyt strecken de sterckste te wesen, ende dat slechtelick met ymants * achtbaerheyt te bevestighen, het schynt, ghemerct men contrari dadelicke voorbeelden can toonen, dat sulcke achtbaer personen rechte meyning niet wel ghetrossen en is, oft andersins, datmen de achtbaerheyt meer gheloof gheeft dan de reden. Daer valt dan voor het oordeel anghesien te worden de ghedaente des wercx, voorts na den eyfch van dien te besluyten, want wercken die van binnen hol sijn, ende van buyten over al anperssinghe krijghen, vereyffchen de rondtheyt, als steenen overwelffels van kelders, brugghen, kercken, en dierghelijcke, alwaer den booch self overal haer druckende ghewicht mede brenghende, de rondtheyt heeft daer t'meeeste voordeel, want alsoo het steenwerck des boochs van binnen cleender is dan van buijten, soo veroirsaeft die persinghe vaster sluytinghe der steenen in malcander. S'ghelijcks een bornput, waer teghen het eertrijck van buyten an allen sijden druckende, de ronde form is daer de bequaemste. Maer soomen (by voorbeelt gheseyt) de steenen back des bornputs stelde boven opt landt, ende van binnen met eerde vulde, alsoo dat de persinghe van binnen uijtwaert druckte, tis kennelick datmen daer in het eerste voordeel niet hebben en soude, want ghelijck die steenen deur persinghe van buyten innewaert (over-

Autorisaba.

Seeing that the aforesaid form of bastions with many sides approaches a roundness, and that the round figure, they say, is strongest, because the materials in it, when they are fired at, are wedged up together, towards the midst, therefore must that type of bastion be stronger than two straight curtains. Unto this is answered that in such common judgment good consideration is lacking, for although in vaults, the bricklayer chooses the round or polygonal form to make the best closing arches, yet the carpenter seeks to strengthen his work with corbels, that is, speaking more properly, he shuns many angles, and strives after the triangle, which notwithstanding, contrary to all the rectilinear figures, is the simplest, yet stands firm, but the square one does not, and the pentagon even less, and consequently the more sides the carpenter's uncorbelled many-angled work has, and approaches roundness, the weaker it is. So that to say as a common rule that the most-angled figures that approach a circle are the strongest and to confirm that poorly with any man's authority, since one can at once show examples to the contrary, it seems that such authoritative opinion is not well founded, or else that we give more credit to authority than to reason. There is then for the judgment to consider the shape of the work, and according to the nature of the work to enclose, for works that are hollow within, and upon the outside are compressed, require roundness, as stone vaults of cellars, bridges, churches, and such like, where the arch everywhere brings its pressing weight, there the roundness has most advantage: for since the brickwork of the arch is narrower within than without, it causes the weight there to press the stones to fit more closely. So likewise in a well, where all the earth upon the outside presses inwards, the round form is the fittest. But suppose (by way of example) that the stone reservoir of the well were built above ground, and its hollow filled with earth, so that the inner weight pressed outward, it is understood that then therein the first advantage were not to be had, for as stones through the thrusting from the outside to the inside (because they are broader

midts datse opde buytesijde meerder breede hebben) gheneycht sijn tot meerder sluyting: Alloo' sijns ter contrari deur persing van binnen uijte-waert, om datse opde binnesijde smalste sijn, tot meerder ontsluytinghe gheneycht. Daerom soo der bolwercken ghebruijck inhield, te moeten wederstaen een persinghe die van buijten over al daer teghen anquaem, soo soude de veelhouckighe, of ronde form tot dien einde wel stercker wesen, maer sulcke persinghe en wort niet op verwacht. Angaende de clooten die van buijten daer op gheschoten worden, dat en is gheen persinghe overal, te weten des aerts daermen ronde wercken omme maect, of behoort te maken; want ghelijck yemant met een breeckyfer, foolichtelick een gat maect inden muur van een rondt of veelhouckich bolwerck, als inden muur van een weynichouckich bolwerck, alsoo doet oock den gheschoten cloot opt een soo veel inbrake als opt ander. Daerom en moetmen om sulck wanen van voordeel, na gheen ronde noch veelhouckighe formen van bolwercken trachten, alsoot strijt teghen de punten, des wits, daer de sterckten deses tijts op ghegront staen, naemlick striickinghe, ende meeste begrip der plaets: Teghen de strijcking, overmidts dat ronde of veelsijdeghe bolwercken, tot haer bewaernis veel gheschots behouven, datmen andersins met weynich doen can: Teghen 'r meeste begrip, om dat de groote gordine een inwendighen bocht hebbende, daerom oock langher en costelicker sijnde, nochtans soo veel plaets verliest, alser begrepē soude sijn tusschen de cromme gordine, ende de linie recht-uijt ghetrocken. Het sy dan verre datmen na veelhouckighe bolwercken soude spooren, te meer dat soot meughelick waer, een sterckte te besluyten met strijckelicke bolwercken vooren heel plat sijnde, sonder houck (ghelijck van foodanighe gheseyt sal worden 'sijnder plaets, te weten int 2^e verschil des 7^{en} Hoofsticx) men soude se op sulcke wijze door *verkie-singhe behooren te maken. Hier eintlick noch by voughende, datter ghebreck ende de onbequaemheyt vande oude ronde bolwercken, eertijts goede strijckelicke bolwerken heeft leeren vinden, als int voorgaende 5^e Hoofsticx gheseyt is, sullent daer by laten, besluytende dat bolwercken met twee gantsche rechte gordinen, de beste form sijn diemen na den eyfch der sterckten deses tijts tot noch toe ghebruijckt heeft.

Elestionem.

*Ital. Rivellini.
Fr. Moineaux.*

4^e VERSCHIL VAN * AFGHE-scheyden bolwercken.

MEN heeft tot veel plaetsen, ghedeurende dese Nederlandtschen ende Franschen crijch, bolwercken buijten de groote gordine gheleyt, als eylandekens daer af ghescheyden, welke de Italianen *Rivellini* noemen, de Françoiten *Moineaux*, daer mē over een houten brugghe in comt. Het voordeel datter uijt verhoopt wort, is, dat de viant schoon sulcken bolwerck

on the outside) are apt to close better, so on the contrary, through pressure from the inside to the outside, because upon the inside they are narrowest, are apter to unclose. Thus, if it were necessary for bastions to withstand pressure all along their outsides, then would the round or many-angled figure for that purpose be stronger, but such pressure is not expected upon it¹⁾. Concerning the bullets that are shot from outside against it, they do not exert a pressure from everywhere, to wit of that nature for which one makes or should make round constructions, for as a man does as lightly make a hole with a pick axe in the wall of a round or polygonal bastion as in that of a bastion with few angles, so likewise a bullet makes as great a hole in one as in the other. Therefore we must not, for such a vain conceit of advantage seek either round or many-angled bastions, for it strives against the points of the scope whereupon the fortresses of the present time are based, namely flanking, and most enclosure. Against the flanking, because round or polygonal bastions have need of much ordnance to defend them, which in others may be done with little. Against most enclosure, because the large curtain having an inward bend, being therefore longer and costlier, yet loses so much ground or space as would be enclosed betwixt the crooked curtain and the line drawn straight. Be it far from us then that we should strive after polygonal bastions, the more so because if it were possible, we should rather seek to complete a fortress with flanking bastions wholly flat before, without a corner (of which shall be spoken in its place, to wit, in the 2nd difference of Chapter 7) we ought then to make them of that fashion by choice. Adding finally thereunto that the imperfections and defects in the old round bastions have taught us before to find well-flanked bastions, as has been said in Chapter 5, I say, for conclusion, that bastions with two whole straight curtains are of the best form that according to the nature of the fortresses of this time have hitherto been in use.

4th DIFFERENCE

Concerning ravelins or separated bastions

During the wars of the Low Countries and France, there have in many places bastions been laid outside the large curtains, separated from them like islands, which the Italians call *Rivellini*, and the French *Moineaux*, which are entered via a wooden bridge. The advantage that thereby is hoped for is that an enemy, having taken such a bastion, cannot yet immediately take the town, because there remains

¹⁾ This sentence is nicely composed and contains a convincing criticism on the often wrong opinion about the influence of artillery-fire on stone towers and masonry bastions.

bolwerck inghecreghen hebbende, soo en heeft hy daerom de Stadt niet, alsooder noch een diepte is, tusschen 'selve bolwerck ende de gordine.

De achterdeelen daer teghen sijn dese: Ten eersten dat sulcke bolwercken haer groote gordine niet soo volcomelick en * strijcken als de ghemeene, overmits sy verre daer af ligghen. Ten anderen, de belegherde en connen malcander in tijt des storms niet soo wel bystaen, om alle nootlicheyt of ende an te brengen, ende het spreken ende 'gheroep van malcander te hooren. Boven dien, als de viant de * bedeste wech in heeft, soo can hy lichtelick die houten brugghe af schieten, waer deur sy gantschelick van malcander ghescheyden sijn: Tis waer datmen in drooghe grachten, deur een overwelfde ganck onder de eerde vande sterckte int bolwerck mach commen, om alsoo gheen brugghe te behouven, doch en sijn daer mede dander onghevallen niet voorcommen, want het anbrenghen van alle nootlicheyt, ende om malcander metter haest by te staen, is alsoo noch ongherievigher. Inder voughen dat soodanighen bolwerck beter om winnen is als een ander, ende hoe wel de viant dan noch de Stadt niet en heeft, doch soo is hy meester vande gracht, of canse lichtelick worden: de stof des selfden bolwerck mach hem dienen, om de plaets tusschen het bolwerck ende de gordine te vullen. In somme, alsoomen ghemerckt heeft het meeste voordeel in afgescheyden bolwercken niet te wesen, sy worden tot ettelicke plaetsen verandert, ende als ghemeene bolwercken ande gordine ghewrocht: Volghende welcke meyning, wy en hebbense als by * verkiefinghe ande volcommen sterckten niet willen oirdenen: Doch daermen hem na ghelegentheyt der plaets moet voughen, mach sijn bescheyt hebben.

Rasent.

Corridor.

Election.

5^e VERSCHIL VAN RONDE

of cantighe * schutsels.

Oreillons.

De ghene die ronde schutsels begheeren, achten de ronde form voor stercker, ten anderen dat de springhende sticken van cantighe schutsels als men se beschiet, de belegherde meer beschadighen, ende de gracht meer vullen.

Soo veel de sterckheyt angaet, die in de ronde form meerder soude sijn als in dander, het bedencken mach daer op tweederley vallen, te weten van schieting recht daer op commende, om het heele werck te gronde te worpen, ofte sijdelingsche schieting, alleen om canten te breken: Soo veel het eerste belangt, daer teghen is verclaring ghedaen int voorgaende 3^e verschil, ende bethoont datmen om sulck vermoeden van voordeel gheen rondt werck en behoort te veroirdenen, dat andersins ghebreckich is. Angaende het ander bedencken, men moet bekennen dat cantighe houcken

a depth or ditch betwixt the same bastion and the curtain.

The disadvantages ensuing therefrom are these: first that such bastions cannot so perfectly flank the large curtain as the ordinary bastion, because they lie far from it. Secondly, the besieged cannot in time of an assault so well succour each other with all necessities, to and fro, or hear the cry and calling of each other so well. Furthermore, when an enemy has won the covered way, then he can easily shoot at and break the wooden bridge, by which the bastion is wholly cut off from the fortress. It is true that in dry ditches such a bastion may be entered by a vault underground, and therefore will need no bridge, yet other disadvantages are thus not prevented, for the bringing in of all necessities, and assisting each other rapidly become even more inconvenient. So that such a bastion is better to be won than another, and although an enemy then has not yet the town, yet he is master of the ditch or may easily be so: the material of the said bastion may help him to fill the ditch betwixt the bastion and the curtain. In all, seeing that the greatest advantage is not found to be in ravelins, so in several places they are changed, and as ordinary bastions connected to the curtains, following which opinion we have deliberately considered them not to belong to our regular fortresses. Yet, as a man must act according to the situation, he can take his decision.

5th DIFFERENCE Concerning round or angular orillions ¹⁾

They that desire round orillions, reckon the round form stronger, while the pieces flying from angular orillions during shelling do more offend the besieged and fill the ditch more.

Concerning the greater strength that is said to be in the round form in comparison with the other, the consideration thereof is two-fold, to wit, of shot that comes straight upon it, to beat the whole work to the ground, or shot coming sideways, only to break edges. Concerning the former, this has been explained before in the 3rd difference, which taught us that for such a conceit of benefit we should not make any round work, which in other respects is faulty. Concerning the other consideration, we must acknowledge that angular

¹⁾ This question: Orillions or Shoulders? which Stevin subjected to a detailed discussion, has also been studied attentively by his follower Coehorn; it is the only place in his *Nieuwe Vestingbouw* where he mentions Stevin by name. In the English translation by Thomas Savery of 1705, folio 9, the conclusion is: "And as sometimes we build with Orreillons, and sometimes with Shoulders, we should declare with *Stevin* for Oreillons for the same Reasons he gives: Because they leave no corner upon the Face, but round off so that the Bullets cannot so easily break them". Stevin too agreed with this, but he still concluded that "the angular orillions" pleased him best.

Tentier.

houcken van ter zijden lichtelicker ghebroken worden, dan uijterste zijden van ronde formen: Maer soomen neemt dattet rondt schutsel *machtelick int cantich bestaet, ende op sijn rondtheyt met die canten noch verdickt ende versterckt is, de sake sal een ander insien hebben. Angaende ymant hier teghen mocht voortbrenghe, datmen soo wel een cantich schutsel int ront bedencken mach, diens canten met rondtheyt verdickt sijn, als een rondt int cantich, diens rondtheyt met canten bedeckt is, de antwoort valt daer op, dat soomen se even lanck neemt, ghelijck de reden in sulcken ghevalle schijnt te vereytschen, soo sal het eerste plaets houden, het ander moet wijcken.

Tarapets.

Wat de verhingende der springhende stucken belangt, waer af noch maer te rekenen en is het verschil der stucken van cantighe en ronde schutsels: Hier op segtmen, dat ghenomen sulck verschil beemerckelick waer, dat de beleggerde met *borstweeren daer teghen bewaert sijn, soo wel als teghen de ghetrapte zijden der bosgaten, die ettelicke teghen het inslieren der clooten in plaets van even zijden veroirdenen, sonder sulcke springhende stucken te vreesen: Voort dat sulck cleen verschil, metgaders het cleen verschil der grachtvullinghe, welcke uijt deen meer soude meughen commen als uijt dander, altemael niet te bedien en heeft, verleen byde voordeelen die van cantighe schutsels commen: Als datse haer volmaecte form hebben, na den eyfch der strijckschoten: Datse beter den *strijckhouck bedecken, ende datter volcommender *strijckkinghe langs henen canghedaen worden: Waer by noch te overdencken valt, datmen deur het schuwen van sulcke rondtheyt, tot den constighen aert der strijckelicke sterckten deses tiits gherocht is, soo wy int, *Hoofsttick breeder verclaert hebben. Dese voordeelen teghen achterdeelen ouerleyt sijnde, soo hebben ons de cantighe schutsels best bevallen.

Flanc.
Nietoyement.6^e VERSCHIL OF DE BINNESIIDEOreillon.
Parallela.

*des *schutsels bequamer ghetrocken wort ewewij-
dich met de groote gordine, of niet.*

Flanc.

ETTELICKE willen de binnesijde des schutsels, als de lini *PI* inde 1^{re} form des 2^{en} Hoofsttick, ghetrocken hebben ewewijdich met de groote gordine *HK*, achtende den *strijckhouck alsoo beslotender ende beter bewaert te wesen, dan ofmen die van vooren wijder open stelde. Ander ter contrari willense scheef trecken, na den loop vant uijterste datmen sich voorstelt sijdeling te willen schieten, welck ghevoelen ons oock best bevalt om dese redenen: Tis seker, oft immer daer voor te houden, datmen metter buijtenbosgat niet alleenelick een strijckschote ewewijgt vande groote gordine en wil schieten, maer oock, alst den noot voordert,

orillions may sideways be more easily broken than the outsides of round forms. But if we assume that the round orillion greatly consists of corners and that in its roundness, it is thickened and strengthened with corners, the matter will then require another insight. If any man should allege against it that we might as well think an angular orillion to be a round orillion, whose corners are thickened or strengthened roundwise, as a round orillion to be cornered, whose roundness is covered with edges, the answer hereunto is that if we take them equally long, as reason in such a case requires, then the first must be maintained and the latter given up.

Concerning the damage that may be done by the flying pieces, in which connection we have only to reckon with the difference between round and angular orillions, unto this we say that if such a difference were appreciable, the besieged would be protected by the parapet as they are by the stepped sides of the embrasures which some make against the flying of bullets instead of even sides, without fear of the flying of such pieces. Moreover, that so small a difference, with also a so small one as that of the filling of the ditch, which might be greater for one than for the other, are things of no moment, compared with the advantages of angular orillions, which have their perfect shape required by the scouring shot. That they cover their flanks better, and may be more perfectly flanked all along, in addition to which it may also be considered that by avoiding such roundness one has arrived at the ingenious form of the flanking fortresses of the present time, as we have shown more extensively in chapter 5. These advantages having been compared with the drawbacks, angular orillions are preferred by us.

6th DIFFERENCE

Whether the inside of the orillions should be drawn parallel to the large curtain or not

Some want to have the inside of the orillion, as the line Pl in the first figure in Chapter 2, drawn parallel to the large curtain HK, thinking the flank thereby to lie more covered and better defended than if it were laid out wider before. Others on the contrary want to have it laid skewing to shoot sideways, to the outermost that might be, which idea pleases me best for these reasons. It is certain, or at least ought to be thought so, that from the outermost embrasure we would not only in the flank shoot a scouring shot parallel to the large curtain, but also, when need requires, more sideways outward to the curtain of the bastion

dert, meer terfijde waert uijt na de teghenoverstaende bolwerx gordine toe, lutrel of veel, daerom als men soo schiet, ende dat dan de binnefijde des schutfels ghetrocken is deur *l* ewewijdich met de groote gordine, soo moet tusschen de lini bescrevê vanden vlieghenden cloor, ende des schutfels houck *P*, een ledighe onghenvulde plaets wesen, soo groot als die schoensheyt veroirsaect: Nu of die ledighe plaets ghevult waer, sal daer mede den strijckhouck te meer ontdeckt sijn, blijvende des schutfels uijterste einde *l* op sijn selve plaets: neense niet met allen, maer het schutfel sal daer soo veel dicker en stercker wesen, ende sijn voorhouck *l* soo veel plomper ende beter hebben, als die vulling bybringt. Ofte tot noch meerder claecheit aldus gheseyt: Wanneer des schutfels binnefijde *P l*, afwijckt vande groote gordine, of men dan vande selve sijde soo veel stof afbrake, tot dat se ewewijdich waer met de voorschreuen groote gordine, soude daer mede den strijckhouck te beter bewaert sijn? Sonder twijffel neense, maer het schutfel soude soo veel ghedunt ende ghecranckt wesen, ende sijn voorhouck *l* van soo veel gheserpt, als die afgevallene stof veroirsaect. Wij besluiten dan, dat de binnefijde des schutfels met meerder voordeel ghetrocken wort, na den loop vande schoensche schietinghe diemen sich voorstelt te willen doen, dan ewewijdich vande groote gordine.

7^e VERSCHIL OPDE PLAETSEN

*des^e strijckhoucx ende i'ghene
daer in comt.*

Flanc

MEN heeft over een tijt, de onderplaets ende middelplaets des strijckhoucx met overwelfselen ghedeckt, om alsoo de boveplaets opt overwelfsel der middelplaets meerder ruymte te gheven, Vijt dese overwelfinghen sijn, soo de ervaringhe daer na leerde, ettelicke onghavallen ghevolgt, te weten, dat te wijle de viant die beschoot, soo en condemen daer onder, van wegghen de springhende stucken, niet bevrijt sijn: Ten anderen, soo spleten en braken de overwelfselen vande gewelt haers eyghens gheschots, in sulcker voughen, datmen daer boven noch daer onder versekert en was: Ten derden, soo wierden die plaetsen, als men daer uijt schoot, soo seer met vier en roock vervult, datmen niet en sach watmen dede, noch sonder groote bangheichet daer en conde blijven, veroirsakende verlies des ghehoirs ende ghesichts: Ende hoe wel tot dien einde lochtgaten ghemaect wierden, om den roock te vertrecken, noch en hielper niet. Om teghen sulck ongheval te voorsien, soo en heefmen daer na die plaetsen deen niet recht boven dander ghebouwt, maer de middelplaets, wat meer achterwaert dan de onderplaets, ende de boveplaets wat meer achterwaert dā de middelplaets, alsoo dat de plaetsen bo-

H

ven

opposite, little or much; therefore when we shoot so that the inner side of the orillion is drawn through I parallel to the large curtain, then there must be betwixt the line described by the flying bullet and the angle of the orillion P, an empty and unfilled place, so great as the skewing of the orillion is. Now, if that empty place were filled, should the flank thereby lie the more uncovered, the outermost corner or end of the orillion I remaining upon the same place? No, not at all, but the orillion will be there so much thicker and stronger, and its forecorner I be so much flatter and better, as the filling contributes. Or for better expressing, let it be thus said: when the inside of the orillion PI parts from the large curtain, if then we did break off so much of the materials of the said inside, until it were parallel to the large curtain, should therewith the flank be better defended? Without a doubt no, but the orillion would be so much thinner and weaker, and its forecorner I would be so much sharper, as the material dropped off caused it to be. We conclude then that the inside of the orillion may with more advantage be laid out agreeing to the flanking, to shoot sideways, than parallel to the large curtain.

7th DIFFERENCE

Concerning the places in the flank, and what pertains to it ¹⁾

It was a custom for a time to cover the lower and the middle place in the flank with vaults to give the upper place over the vault of the middle place more room. Out of these vaults, practice has taught us, several inconveniences have followed, to wit, that during the time that an enemy battered them, no one could be free or safe under these vaults from the flying stones. Furthermore, the vaults split and fractured under the force of their own ordnance, so that nobody was protected, either upon them or under them. Thirdly, the said places were so troubled by the fire and smoke of their own ordnance, that men did not see what they did, nor could any man without danger of losing hearing and sight tarry in them. And although vents were made, to the intent that the smoke might be drawn off, yet they were of no avail. To redress this inconvenience afterwards one place was built not right over the other, but the middle place more backwards than the lower place, and the upper place more backwards than the middle place,

¹⁾ The drawbacks of the vaults mentioned by Stevin (above the lower and middle places of the flanks) are also found with Marolois (*Stercken bouwing of Fortificatie*, fol. 96: Of Casemates); Brialmont confirms (Steichen, p. 114) that in Stevin's time no casemates were built any more, because of their defects, but that he himself realized the possibility of improvement, perhaps because he knew the so much better projects of Albert Dürer and his cannon-cellars.

ven open sijn sonder overwelfels, alleenlick wordender overwelfels gheleyt inden wal daer achter staende, ghelijck int 2⁵ punt der gronteyckening des 2^{en} Hoofsticx gheseyt is, om daer onder uijt reghen en inee, oock uijt de hitte der Sonne te moghen wesen, om t'gheschot, clooter, ende ander reetschappen daer toe dienende int drooghe te stellen.

Belanghende den steenen steygher, die ettelicke heel onbessloten ende bloot legghen, om vande bove plaets na de middelplaets te comen, die en schijnt niet sonder eenich peikel, want de viant gheroicht sijnde, of met ghewelt, of deur listighen anslach, inde selve middelplaets, soo can hy voort comen over den hooghen wal inde sterckte, sonder dat hem eenich ghebau belet: Daerom hebben wy inde voorscreven gronteyckening, den selven steygher met een muer afghesondert, alsoo dat de middelplaets met een deure vande boveplaets can ghescheyden sijn.

Cannonsiet.

Parapetto.

Angaende de * bosgaten der drie plaetsen, die heefsimen certijts alsoo ghemaect, dattet nauhte der selver quam ant buijtenste einde des * borstweers, voort na de binnensijde breeder en breeder.

Merluis.

Hier mede waren de belegherde wel beter beschermt voor het inslieren van des viants clooten, dan te nu sijn, met bosgaten ter contrari buijten wijst ende binnen nauht: Maer wederom daer teghen, soo vielen op sulcke wijze de buijtenste canten der * tanden seer dunne, ende t'gheschot daer op goede vating hebbende, wierden lichtelick afghelechten, ende de gaten terstont seer vermeerderd. Ten anderen soo braken de tanden, van wegghen der belegherden eyghen gheschot, deur den slach des ontficken buscruijs, t'welck deur die nauwe plaets moest vliegghen. Om dit onghewal te voorkomen, soo pastemen daer na het nauhte der bosgaten opt middel des borstweers: Maer alle voordeel teghen achterdeel, deur veel ervinghen overleydt sijnde, soo wort nu oirboirst gheacht de nauhte sijde teenemael opde binnecant des borstweers te legghen, opde manier als inde gronteyckeninge der 2^e ende 3^e form des 2^{en} Hoofsticx ghedaen is.

8^e VERSCHIL VAN RECHTE

en cromme groote gordinen.

1^e VOORBEELT.

Flan.

ETTELICKE hebben gheacht, dat soomen met de * strijchoucken een groote rechte gordine wilde beschermen vande stormen des viants, dat een strijchouck met schieten dander strijchouck, gheschot, of bolwerck te groote schade soude doen. Om teghen twelck te voorsien, sy gheven de groote gordine int middel een uijtwendighe bocht, alsoo dat elcken helft comme inde lini, daer de bolwerck gordine op ghetrocken is, als inde form hier onder, alwaer elckē helft der gordine een strijchouck alsoo bedeckt, datmen van een tot dander niet sien en can.

Hier

leaving the said three places open overhead without vaults, vaults only being made in the walls behind them, as is said in the 25th point of the ground plan in Chapter 2, to the intent within these vaults to protect ordnance, shot and other implements appurtenant to the ordnance, from rain, snow and heat of the sun.

Concerning the stone stairs, which some do lay wholly open, to go from the upper place into the middle place, it seems to be not without danger: for an enemy getting unto the middle place, either by force or surprise, may then by that stair come unto the top of the rampart, without hindrance of any building. Therefore I have in the aforesaid ground plan separated the same stair with a wall, so that the middle place may be separated by a door from the upper place.

Concerning the embrasures in the three places, heretofore they were made so that the narrowest of them was set at the outermost edge of the parapet and thence inward they were made broader and broader.

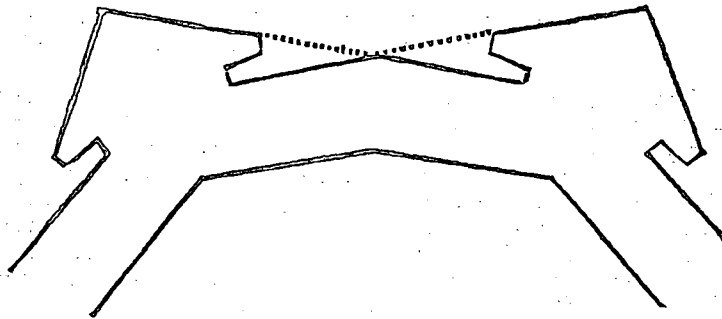
With these embrasures the besieged were better protected against the enemy's bullets than they are now with embrasures that are widest without and narrowest within. But on the other hand, the outsides of the merlons thereby became very thin and the enemy's shot taking good hold upon them, they were easy to shoot off, and the embrasures immediately were made much wider. Furthermore, these merlons were also broken by the defendants' own ordnance through the explosion of the fired powder, which must fly through that narrow hole. To avoid which inconvenience, afterwards the narrowest places of these embrasures were placed in the middle of the parapet, but all the advantages and disadvantages being diligently considered through much practice, it is now found that the fittest place to make the narrowest part of the embrasures is on the inner edge of the parapet, after the manner of the ground plan in Figures 2 and 3 of Chapter 2.

8th DIFFERENCE

Concerning straight and bent large curtains

1st EXAMPLE

Some have thought that if one wanted to defend a large curtain by a flank from scaling and assaulting, that the one flank would with its shot greatly offend the other flank, artillery and bastion opposite. To prevent this they give the large curtain a bend in the midst, such that each half is laid out upon the same line that the curtain of the bastion is framed upon, as in the figure following, in which each half of the curtain covers a flank, so that one flank cannot be seen from the other.



Hier teghen wort wederom gheseyt, dat elke halve gordine aldus maer van een sijde *ghestrecken en can worden, daer sy anders haer strijking van beyden sijden crijcht, daerom een strijckhouck door de viant ter neder ghevelt sijnde, soo blijft een halve gordine onbeschermt. *Nettoyé.*

Ten anderen, soo ist een eyghenschap in alle groote gordine die maer van een sijde ghestrecken en wort, datter een plaets tot voordeel des viants bedect ende onbeschietelick blijft: Om welke plaets te beschrijven, soo neemt door t'ghedacht twee *oneindelicke platten, het een streckende langs de afdakinge des borstweers vande groote gordine, het ander langs de afdakinghe vant borstweer des strijckhouck, want de plaets, welke voor den strijckhonck tusschen die platten begrepen is, en can tot gheen oirt int ghesicht comen, vande ghene die langs de afdakinghe der borstweeren siet, ende vervolghens al wat in dien houck tusschen de selve platten staet, is verborghen: Inder voughen dat de viant soo wel ter eender sijde onder den strijckhouck, als ter ander sijde inde groote gordine, metter handt sal meughen graven en breken na sijn wille, sonder vande belegherde verhindert te worden. Ende by aldienmen door t'ghedacht noch sulcken *plat treckt, langs de afdakinge vant borstweer ten einde des schutsels, men sal daer onder tusschen de platten oock derghelijcke onbeschietelicke plaets crijghen. *Plana infrita.*

Ten 3^{en}, soo de viant sonder *muerbrake de groote gordine met leeren bestoimt, in sulcken gevalle schietmen nijt de strijckhoucken met keyen ende ketengheschot, t'welck grooter inoort der vianden doet, sonder bolwercken te beschadighen. *Breche.*

Ten 4^{en}, by aldien de storm over muerbrake ghedaen wort, soo schietmen vrielick met grof gheschut in die afgevalen steenen, om met de springhende sticken onder de viant meerder schade te doen, ende dat sonder de bolwercken te breken, want de clooten inde puyn commende, of sy blijvender in steken, of verliesender haer cracht op, of nemen een onteker spronck.

Against this it is said that each half of the large curtain can be defended or scoured from one flank or side only, because otherwise it would be scoured from both sides; therefore, when one flank is ruined by an enemy, one half of the large curtain remains unflanked.

Furthermore, it is a property of all large curtains that are scoured but from one side, that one place remains for the profit of the enemy covered and shot-free. To describe this place, I take by supposition two infinite planes, one stretching along the shelving of the parapet of the large curtain, the other along the shelving of the parapet in the flank, for the place before the flank included betwixt the two planes can by no means come into sight for those that look along the shelvings of the parapets, and therefore all that stands in the corner betwixt those two planes is safe, in that the enemy, upon one side under the flank, as well as upon the other side under the large curtain, may with hands dig and break at his pleasure, without hindrance of the besieged. And if a plane were drawn along the shelving of the parapet at the end of the orillion, there would likewise, betwixt the plane and the curtain, the like protected place be found.

Thirdly ¹⁾, if an enemy should assault the large curtain with ladders, without a breach, in such cases we shoot from the flank stones and chain shot, which effect great murder amongst the enemies, without damaging bastions.

Fourthly, if an assault is made over the debris of a breach, we may freely shoot amongst those ruins with great shot to offend an enemy more with the flying stones, without breaking the bastions, for the shot landing in the rubbish either remains there, or loses its force in it, or rebounds uncertainly.

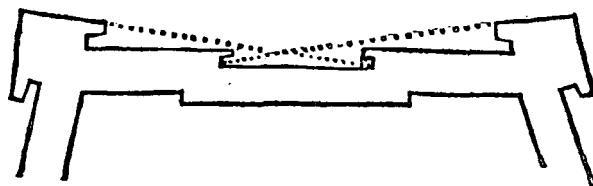
¹⁾ With points 3, 4 and 5 Stevin wants to demonstrate that, if one only uses good ammunition (in this case stones or chain-balls) and shoots carefully, the chance that one hits from one flank the one opposite, is not great. The assertion in point 5, that an assault only seldom occurs, is indeed characteristic of his time.

Ten 5^{en}, stormen ghebueren selden, ende en gheduren soo langhe niet, dat de bolwercken daerentusschen soo groote schade lijden, of t'prouffijt en is veel meerder, datter comt uijt de gheduerighe vreesse, die de viant belet hem tusschen sulcke twee strijckhouckē tot den storm te begheven.

2^e VOORBEELT.

Fluys.
Nateyck.

SOMMIGHE hebben de gordine tusschen twee bolwercken in drien gheb.oken, het middelste deel innewaert gheleyt, ende daer an twee *strijckhoucken ghebrocht, uijt welcke niet alleen dat middelste deel, maer oock de bolwerck gordinen volcommelick *ghestreken worden, als hier onder, achtende daer mede de gordine meerder sterckte, ende beter bewaernis te hebben.



Hier op segmen dat een van beyden, te weten, of de twee bolwercken staen van malcander soo verre, dat elcx gheschot de gantsche groote gordine niet strijcken en can, ofte soo na dat daer gheen ghebreck af en is. By aldien sy soo verre staen, soo is elck gordijndeel dat nevens het bolwerck light, alleenelick bewaert met een strijchouck, te weten met dien daer an gheraect, want dander strijchouck is te verre, ende vanden strijchouck des middelsten deels en cant niet ghesien noch gestreken worden. Inder voughen dat de viant een strijchouck des bolwerck ghebroken hebbende, soo blijft het gordijndeel daer an staende onbeschermt. Of andersins een strijchouck des middelsten deels der gordine ghebroken wesende, soo blijft een bolwerck gordine onghestreken, overmidts het ander bolwerck te wijt daer af is. Maer by aldien de twee bolwercken malcander na ghenouch staen om de heele gordine daer tusschen ligghende, oock om deen des anders bolwerck gordine te connen strijcken, soo sijn de twee strijchoucken des middelsten deels daer onnodich, want can het gheschot van deen strijchouck des bolwerck, sijn cracht doen tot ant einde der gordine tusschen de bolwercken, ende tot ant einde der bolwerck gordine, met meerder reden salt sijn cracht connen doen opt middelste derdendeel. T'welck anghemerckt, sulcke gordinen worden met grooter costen meer vercrant, want het gheschot can grooter *muerbrake ende schade doen, op de canten der *schutselen van ghebroken gordinen,

Breche.
Oreilant.

Fifthly, assaults happen seldom and do not last so long that the bastions in so short a time are damaged, but the profit that proceeds from an enemy's fear to put himself betwixt two flanks in going to an assault is far greater.

2nd EXAMPLE 1)

Some have divided the curtain betwixt two bastions into three parts, laying the middle part drawn inward, and made two flanks to it, from which not only the same middle part, but also the curtains of the bastions are perfectly flanked, as in the following figure, considering thereby the curtain to be stronger and better defended.

Hereunto we say that either the two bastions stand so far apart that the ordnance in each of the bastions cannot scour the whole curtain, or else stands so near that there is no need of it. If they stand so far apart, then either part of the curtain next to a bastion is defended by one flank only, namely by the one on that side, for the other flank is too far from it, and from the flank in the middle part it can neither be seen nor scoured, so that the enemy having broken one flank of the bastion, that part of the curtain next to it remains undefended. Or else, one flank of the middle part of the curtain being broken, then there remains one curtain of the bastion unflanked, because the other bastion is too far from it. But if the two bastions stand near enough together to scour the entire curtain betwixt them, and also the curtain of each other's bastion, then there is no need of the flanks in the middle part, for if the shot from one flank of the bastion can scour the whole curtain to the end, and the curtain of the bastion throughout, with much more reason it may make its force felt upon the middlemost third part. Which considered, such a curtain is with greater cost more weakened, for the ordnance can make a greater breach and do more damage to the edges of the orillions of broken curtains than to a whole, straight and even curtain.

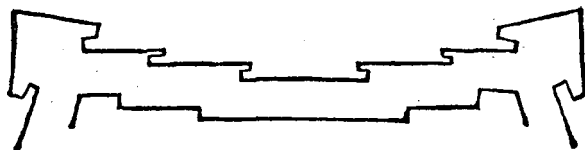
¹⁾ In these three examples Stevin describes the "ordre renforcé" as it appears from Mallet's *Travaux de Mars*, Dutch edition 1672, 2nd volume, pp. 205-212; this manner, ascribed both to Spaniards and Italians, is said still to occur e.g. in *Le Dessin ou la perspective militaire*, by the Jesuit father Bourdin, published in Paris in 1655, but was probably much older, because also contemporaries of Stevin, like Adriaan Anthonisz, already applied it. That Brialmont wants to understand by this method the inward broken curtains in the 7th Chapter, 2nd Difference, must be due to an error.

nen, dan op heel rechte ende even. Ten anderé sijne van cleender begrip.

Ten 3^{en}, de houcken der bolwercken commen aldus scherper oft onplomper te wesen, daerinnen hem deur ghemeene reghel voor wachten moet.

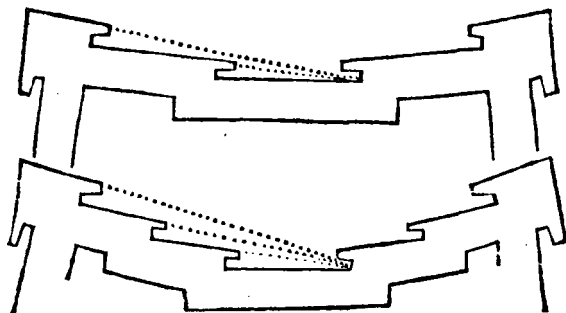
3^e VOORBEELT.

ANDER en hebben de groote gordine niet alleenlick in drien ghe-
deelt alfooren, maer wel in vijven, ghelijck hier onder: Welcke
manier uijt de bovescreven redenen noch ergher gheacht wort dan die
des 2^{en} voorbeelts, als wesende van slimmer bewaernis, minder begrip,
van noch scherper of onplomper ende crancker bolwerckhoucken, ende
boven dien alles streckende tot meerder onnutte costen.



4^e VOORBEELT.

DAER na bemerct sijnde de bovescrevè faute des 2^{en} ende 3^{en} voor-
beelts, te weten datmen uijt yder * strijckhouck dander gordijn-
stucken niet sien en conde, men heeft de deelen scheef ghetrocken, ende
voor malcander strijckelicker gheselt, als hier onder. *Plano.*



Waer op gheseyt wort, sulcke verbeteringhe andersins meerder verer-
gheringhe te veroitsaken, als dat de houcken der bolwercken alsoo noch
scherper ofte onplomper vallen: Boven dien datmen met veel costelicke
wallen noch weynigher plaets begript. Wy besluyten dan dat een gantche

Furthermore they enclose less ground.

Thirdly, the angles of the bastions in this manner are sharper, or less flat, which by the common rule we must avoid.

3rd EXAMPLE

Some have not only divided the large curtain into three parts as before, but into five, as shown below, which manner owing to the reasons described before may be esteemed even worse than that in the 2nd Example, as being of less defence, enclosing less ground, having sharper and weaker angles of bastions and because it is found to give rise to greater and unnecessary cost.

4th EXAMPLE

After the faults in the second and third examples had been found, to wit, that out of every flank the other part of the curtain could not be seen, the said parts were drawn askew, and set flanking as hereunder.

Whereupon it is said that such improvements in other respects make it much worse, for the bastions become even much sharper. Furthermore, with much more cost of wall, we shall enclose less ground. We conclude then, that one whole,

rechte groote gordine tusschen twee bolwercken, de bequaemste manier is diemen inde volcommen sterckten tot noch toe ghebruijkt heeft.

9^e VERSCHIL VANDE DICKTE

*der leeghe gordine, ende de breedte
des ganck daer achter.*

Le raser.

Planct.

*Plana Horizontalia.
Strada cepta.*

*Horizontem seu
Terminatorum
visus.*

Nettoyer.

Planct.

De *strijcking die in alle volcommen sterckte vereyscht wort, is tweederhande, d'eene langs staende vlacken, als der caden en gordinen vande buytsijde ende binnessijde des grachts, daer eyghentlick t'geschot der *strijchoucken toe veroirident is: Dander langs ligghende *sichteinderische vlacken, als des velts ende der afdakinghen van boorstweer der *bedekte wech, diens volcommenste strijckinghe vande leeghe gordine gheschiet, om alsoo meer vianden te connen ombrenghen, oock om sijn schantsen lichtelicker te moghen braken, dan met gheschot dat van hooghe comt, deur dien de stof der schantsen aldus meer verspreyt, ende dat den deurvliegghenden cloot hem meer beschadighen mach. Daerom sterckten die den *sichteinder niet volcommelick strijcken en connen, haer ghebreeft een goet deel der volmaetheyt: Soodanighe sijne diens borstweeren der leeghe gordine een steenen nuerken is, twee of drie voeten dick, met bosgaten daer in, deur welcke men met muschetten ende handroeren schiet: Voort een smalle ganck daer achter van 5 of 6 voeten breed. De reden van haer ghebreck is dese: Ten eersten datmen op sulcke onder gordinen gheen grof gheschut bruijcken en mach om den sichteinder te *strijcken, overmits den ganck te smal is, oock met afvallende walbrake haest vervult wort. Ten anderen, dat soodanich steenen borstweeren, teghen des viants grof gheschot niet dueren en can, oock dat de springhende puyn de beleggerde groot achterdeel doet, hun belettende, soo wel cleen als groot gheschut daer te moghen besighen. Om sulck ongheval te schuwen, ende het bovescreven voordeel te ghenutten, soo hebben wy inde teyckening der volcommen sterckte, ghevolght het ghevoelen der ghere die t'borstweer der leeghe gordine, soo dick veroirdenen als het borstweer der bovegordine, met een ganck breed 20 voeten, wesende noch inden hooghen wal tot de behoerlike plaetsen, overwelsfels om t'gheschot sijn deysing in te nemen. Ende by aldienmen beneven t'ghene boven gheseyt is, noch insiet, dat der *strijchoucken leegste plaetsen, als by ghemeene reghel, het grootste gheschot vereyschen, soo is daer uijt oock te verstaen, datmen sijn rekening behoort te maken, opde leeghe gordine niet alleenslick soo groot gheschut te moeten ghebruijcken als opde bovegordine, maer een grooter, ende vervolgghens de reden te willen, dat het werck der selve leeghe gordine daer na angheteydt wort.

Sommi-

straight curtain betwixt two bastions is the best manner that hitherto has been used in regular fortresses.

9th DIFFERENCE

Concerning the thickness of the lower wall or curtain and
the width of the way upon it behind the parapet

The flanking or scouring, which is required in all regular fortresses, is of two sorts: one all along vertical planes, as the banks and curtains of the outside and inside of the ditch, for which the artillery in the flank is properly appointed. The other along planes which are horizontal and flat, as the field and the shelving of the parapet of the covered way, whose perfect scouring is from the lower curtain, to kill more enemies and to break his trenches more easily than with shot that comes from the higher wall, because the materials of the trenches with such a shot scatter more, and the throughflying shots do more harm. Therefore, fortresses that cannot perfectly scour the level line, are lacking a good part of their perfection. So likewise are they that have upon the lower curtain small stone parapets, 2 or 3 feet thick, with embrasures in them, out of which muskets and pistols may be used, and besides have behind the parapet a small narrow way of 5 or 6 feet broad. The reasons of their imperfections are these: first, that upon such a lower curtain no great ordnance can be used to scour the level line, because the way is too narrow, and will be quickly filled with the debris of a breach. Secondly, that such stone parapets cannot withstand the enemy's great ordnance; also, that the flying stones hinder the defendants there to use either great or small shot. To avoid that mischief, and to enjoy the benefit before spoken of, I have in the plotting of a regular fortress followed the opinion of those who appoint the parapet of the lower curtain to be as thick as the parapet of the higher curtain with a way 20 feet broad, while in the upper wall are vaults at certain necessary places for the ordnance to recoil into. And if, besides what has been said above, we also see that the lower places in the flank, as by common rule, require the greatest ordnance, so is thereby also to be understood that we must make our reckoning upon the lower curtain, to use not only such great ordnance as upon the higher, but much greater, and according to that reason the work upon the lower wall must be handled.

Sommighe wel verstaende de noodicheyt van dit strijcken des sichteinders, veroirdenen seker manier van strijchoucken, anden punt des borstweers vande bedecte wech die teghen over 't middel der groote gordine comt, om van daer sijdeling des viants schantsen opde afdakinghe ende opt velt te beschieten: Maer de leeghe gordine na 't behoiren weerbaer veroirdent sijnde, sy is daer toe veel bequamer, want de viant ligghende opde afdakinghe teghen over den houck eens bolwerck, soo en ismen hem vande gordine des selfden houck niet alleen veel naerder, als van soodanighen strijchouck, maer boven dien breeckmen hem sijn schantsen met meerder verskertheyt ende gerief der belegherde: Oock wanneer men sulcke uijtwendighe strijchoucken verlaten moet, soo ghediense tot groot achterdeel der sterckte.

Wat de coorde belangt, die gheemeenlick tot cyraet der leeghe gordine boven het * beschoeyfel der selve ghewrocht wort, de ghene die segghen datse daer gheen coorde en souden begheeren, en bevalien my int selve niet qualick.

10° VERSCHIL OFT OIRBOIR

is de twee sijden der * bedecte wech, als

* cabeschoeyfel, ende het borstweer,

na de * strijcking te trecken.

Strada coperta.

Centra scarpa.

Elasticuerment.

WANNEER de cade inde grontteyckeninghe uijt de middelplaets ghetrocken is, soo sijn eenighe van meyning, datmen 't beschoeyfel der selve cade uijt de onderplaets niet strijcken en can om sijn schoensheys wille, achtende men soude het selve beschoeyfel, om volcommelick te menighen ghestreken worden, moeten teyckenen met eenighe verbreydende trecken die uijt den strijchouck commen, 't welck altoot moeyelick ende ongheschickt ghebou soude veroirsaken, te weten beschoeyfelen ant een einde veel dicker als ant ander, sy en willen hun ande volcommen strijcking niet verbinden. Hier op seggh ick, dat hy die met * doorsichtighe spiegeling, overlegt de ghedaente des 21^{en} punts der grontteyckening, sal verstaen dat de * bosgaten der onderplaets in sulcker voughen gheleyt sijn, datse 't beschoeyfel overal eenvaerdigher dickte sijnde, heel volcommelick sien en strijcken, commende nochtans de twee uijterste bosgaten wyder van malsander te ligghen, dan de bosgaten der middelplaets, alsoo datter noch een derde bosgat int middel comt, uijt oirsaeck dattet borstweer vande onderplaets vermeerderd, om het afwijcken des schutsels.

Perspectiva contemplatione.

Cannonares.

Hier af dan gheen noot wesende, ende anghesien de viant het borstweer der bedecte wech, ende het cabeschoeyfel moet hebben, eer hy tot de bolwercken of groote gordinen can gheraken, soo ist billich het selve borstweer

Some, well understanding the needfulness of this scouring upon the horizontal or level line, ordain certain manner of flanks in the angle of the parapet of the covered way over against the midst of the large curtain, to the intent thence to shoot sideways upon the enemy's trenches in the shelving of the parapet and in the fields. But the lower wall being made as it ought to be, is thereto much fitter, for the enemy entrenched in or upon the shelving of the said parapet over against the corner of a bastion, is then not only much nearer to the curtain of this corner than to such a flank, but, moreover, with more certainty one breaks his trenches, and eases the besieged. Also, when such outward flanks must be abandoned, they are a great disadvantage to the fortress.

Concerning the cordon ¹⁾ commonly made to decorate the lower wall above the scarping of the same I am rather pleased with the opinion of those who say that they do not want cordons there.

10th DIFFERENCE

Whether it be fit to lay the two sides of the covered way, to wit,
the parapet of the same and the counterscarp,
in the direction of the flank scouring

When the outside of the ditch in the ground plan is drawn from the middle place, then some who think that the counterscarp cannot be scoured from the lower place, because of the scarping of the same, thinking that for its more perfect scouring it should be fashioned by certain widening lines drawn from the flank, which would cause it to be both a troublesome and unsuitable building, to wit, of broader scarping at one end than at the other, will not bind themselves to perfect flanking. Hereunto I say that he who with perspective theory well considers the shape of point 22 of the ground plan, will understand that the embrasures in the lower place are laid out in such a manner that the counterscarp, being equally wide everywhere, may be seen and perfectly scoured from them; the two outermost embrasures in the lower place, however, lie wider apart than the embrasures in the middle place, so that betwixt these two a third embrasure is made, for the deviation of the orillion makes the parapet of the lower place larger.

These then not being needful, and since an enemy must first possess the parapet of the covered way, and have the counterscarp, before he can come unto the bastions or large curtains, therefore it is reasonable that the said parapet

¹⁾ Instead of the better English word "border", the term "cordon" from the translation of 1604 has been maintained, because this is still in use in architecture. The final remark indicates that Stevin was no artist like Vauban.

*Plan.**Instrumenta.*

borstweer ende beschoeyfel, om hem daer veel verhindering te connen doen, opt meeste voordeel te trecken, dat is na de volcommen strijckschoten uijt den *strijchouck commende, ghelijck inde 1^e form des 2^{en} Hoofsticx ghedaen is, want dat schantsen ende *reetschappen die de viant daer op brenght, alsoo bequaemlicker connen ghebroken worden, dan door onvolcommen scheeve strijckschoten, sulcx is ghenouch te verstaen uijt de volcommen strijcking der bolwercx gordinen daer int 2^e verschil breeder af ghesyt is, voornaemlick int 4^e punt des selfden verschils. Ten anderen, soo dickmal de viant hem verstout inde gracht te commen, t'sy om te stormen, ofte andersins daer na sijn voordeel te trachten, soo en can hy daer niet in gheraken, noch weder daer uijt vertrecken, dan over de *bedecte wech: Daerom als haer borstweer ende *cabelchoeyfel na de strijcking niet ghetrocken en sijn, soo isser een groot voordeel versien, ende sulcx te willen laten daerment doen can, het strijt teghen t'ghemeen ghevoelen daer int 3^e Hoofsticx af gheseyt is.

*Chemin couvert.**Contrascarpa.*

Angaende dat de bedecte wech aldus byde houcken als *c* breeder valt, dan byde punten als *d*, sulcx comt beneven de bovescreven voordeelen noch wel te pas, om de weggen in te legghen, daermen door boven opde afdakinge comt, wantmen alsoo opde bedecte wech noch breetheyt ghenouch houden mach.

*Oortken.**Rafte.*

Belanghende de breetheyt des grachts, welke aldus voor t'middel der groote gordine smalder valt, dan als men de cade treckt ewewijdich met de bolwercx gordine, ofte noch wijder voor de *schutsels dan voor den bolwercx houck: Hier op seghtmen, dat alsoo het middel der groote gordine, die van beyden sijden *ghestrecken wort, de onwinnelickste plaets is, ende dat boven dien de gracht daer veel breeder valt dan voor de schutsels, welke nademacl sy maer van een sijde ghestrecken en worden crancker sijn, soo ist onnodich de gracht daer noch wijder te trecken, ende daerom caden te veroirdenen met onvolcommen strijcking.

*Plan.**Breke.*

Angaende dat de gracht voor de bolwercx punt aldus ten alder breesten comt, dat vereyscht oock de reden, ghemerckt de sterckte an die punten ten alder crancksten is, om verscheyden redenen: Ten eersten overmits elcke haer sijde alleenelick van een *strijchouck ghestrecken wort: Ten anderen dat de gordinen daer ten alder wijtsten vande strijchoucken sijn, waer deur des viants schantsen an dien oort alder weynichts vande strijchoucken connen beschadicht worden: Ten derden, dat de gordinen der bolwercken deur sijdelincse schieting, lichtelicker *muerbrake connen krijghen ande punten der bolwercken, dan op ander plaetsen: Ten vierden, dat de viant om de voorscreven redenen, an die punten alder bequaemlicx de gracht can vullen, daerom datmen se tot die plaets ten nausten treckt, daerse de meeste wijde behouft, ende ten wijtsten daerse ten nausten mach wesen, het is den viant onnoodelick voordeel gheghe-

and counterscarp should be laid out to most advantage, to cause him most hindrance, that is that it may be perfectly scoured with shot from the flank, as is shown in the first figure of Chapter 2, because trenches and instruments that the enemy brings upon them may thus be more easily broken than with imperfect skew-scouring shot, as is easily understood by the perfect scouring of the curtains of the bastion, of which more is said in the 2nd difference, specially in point 4. Moreover, as often as the enemy makes bold to come into a ditch, whether it be for an assault or otherwise to seek his advantage, he can neither get into it, nor get out again, but over the covered way. Therefore, when the parapet in it and the counterscarp are not scouringly drawn, then is a great advantage overlooked, and to leave such undone, when it may be done, is to strive against the common feeling of which is spoken in the 5th Chapter.

Concerning the covered way, which in the corners at c is broader than at point d, besides the advantages before spoken of, it stands in good stead to make the ways to pass upon the shelving, for by that means there will be width enough left upon the covered way.

As for the width of the ditch, which is thus narrower in the midst of the large curtain than when the outside of the ditch is taken equidistant with the curtain of the bastion or broader before the orillion than before the point of the bastion: thereupon I say that the midst of the large curtain, which is flanked upon both sides, is the most difficult place to be won, and furthermore that the ditch before it falls out much broader than at the orillions, which, because they are flanked but upon one side, are weaker, therefore it is not needful there to make the ditch broader and thereby to make counterscarps with imperfect flanking.

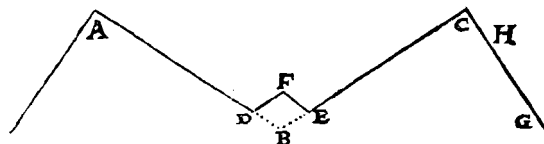
As the ditch before the point of the bastion is thus laid out broadest, reason would it should be so, because the fortress at these points is weakest for many reasons¹⁾. First because each side of it is scoured but from one flank only. Secondly, because the curtains of the bastions are there furthest from the flanks, owing to which the enemy's trenches at that part can be least offended by the flanks. Thirdly, because the curtains of the bastions by sideways battering may be more easily breached at the points than at any other place. Fourthly, because the enemy, for the reasons alleged before, at these points can more easily fill the ditch, wherefore to draw them narrowest where they require their greatest width, and widest where they should be narrowest, is giving an enemy a needless advantage, which in many ways tends to the disadvantage of the besieged.

¹⁾ Here Stevin clearly shows the disadvantages of the Old-Dutch system with earthen wall, which hold much less for his "envelope" or reveted low wall with the locally wider ditch in front of it.

ghegheven, dat op veelderley wijze tot achterdeel der belegherde strekt.

Sommighe der ghene die de * cabeschoeyfelen, ende de borstweeren der bedecte wech na de strijcking niet en trecken, nochtans wel verstaende den grooten noot die se lijden moeten, wanneer de viant hem daer beschanft, veroordenen op de buytesijde des grachts voor den punt des cabeschoeyfels die teghenover t'middel der groote gordine comt, verscheyden * borstweeren met haer * bosgaten, om de selve cabeschoeyfelen ende borstweeren der bedecte wech van dien oirt an weder sijden te strijcken: Maer ghemerckt sulcx uijt de strijchoucken bequaemlicker can ghedaen worden, met daer by te ghenutten al dander vervolghende voordeelen die boven verhaelt sijn, soo ist onnoodich buijten de sterckte nieuwe besonder ghebouwen te legghen, diemen boven al dander voorscreven achterdeelen, van verkeerde wijtheit der grachten en bedecte wegghen, niet dan met grooter moeyte, cost, ongherief, ende onsekerheyt beschermen noch behouden en can, welcke eintlick, wanneermen die verlaten moet, tot groot voordeel des viants strecken.

Ettelicke legghen int borstweer der bedectewech teghenover t'middel der groote gordine, een * inham met haer bosgaten, om de * afdakinghe, ghelijck sy segghen, an beyden oirten sijdeling te moghen beschieten: T'welck tot dien einde onnoodich schijnt, ghemerckt datmen vant een heel borstweer, des anders borstweers afdakinghe sijdeling beschieten can, sonder inham. Om t'selve by voorbeeld verstaenlicker te verclaren, soo laet ABC het borstweer der bedecte wech beteecken, waer af B de punt is die teghenover t'middel der groote gordine comt. Nu ghenomen datmen de linien AB ende CB niet heel rechtuijt en trekt, maer alleenecliek tot D ende E, van daer af na F, alsoo dattet borstweer der bedecte wech nu sy A D F E C, hebbende een inham D F E, om over t'borstweer D F, te moghen schieten ter sijdewaertuijt langs de * afdakinghe van A D, ende over het borstweer E F, ter sijdewaertuijt langs de afdakinghe van E C, legghende tot dien einde bosgaten inde borstweeren D F ende E F.



Hier op segtmen, dat als t'selve borstweer sonder inham waer, alleenecliek vande twee rechte linien AB ende BC, dat de belogherde dan soo wel sijdeling schieten over t'borstweer B E, langs de afdakinghe van D A, ofte B A, als sy anders doen over het deel D F: S'ghelijcx soo wel over BD, langs

Some of those who do not draw the counterscarp and the parapet of the covered way scouringwise, notwithstanding the great need they have of them is well understood, when the enemy entrenches himself therein, do ordain upon the counterscarp of the ditch, at the point over against the midst of the large curtain, various parapets with embrasures in them to scour thence the said counterscarp and parapets of the covered way on both sides. But seeing that it may be better performed from the flanks, therewith enjoying all the other advantages mentioned before, it is unnecessary to make outside the fortress new special buildings, which above all the other aforesaid disadvantages of wrong width of ditches and covered ways, cannot but with great labour, cost, inconvenience and uncertainty be kept and defended, which, when they must finally be abandoned, tend to the great advantage of the enemy.

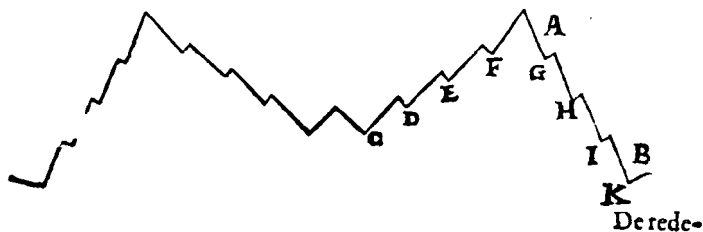
Some lay in the parapet of the covered way over against the midst of the large curtain a recess with embrasures in it, as they say, to scour the shelving from it upon both sides, which to that purpose seems needless, seeing that from one whole parapet the other shelving of the parapet may be scoured sideways, without the recess. To express the same more plainly by example let ABC signify the parapet upon the covered way, of which B is the point which comes over against the midst of the large curtain. Now suppose that we do not draw the lines AB and CB wholly straight, but only to D and E and thence to F, so that the parapet of the covered way now is ADFEC, making the recess GFE to shoot over the parapet DF sideways along the bank AD and over the parapet EF sideways along EC, making to this purpose embrasures in the parapets DF and EF.

Against this we say that if the same parapet were without a recess, only of the two straight lines AB and BC, that the defendants would then shoot sidelong over the parapet BE along the bank DA or BA as they would otherwise do over the part DF. Likewise over BD along the shelving BC as otherwise over EF, so that

B D, langs de afdakinghe van B C, als anders over E F. Inder voughen dat dien inham tot sulcken einde gheen voordeel en doet. Maer soomen de sake wilde nemen, dat opde bedeste wech C G gheen verweerdens en waren, om t'borstweer aldaer als borstweer te ghebruycken, altoo dat de viant hem verstoute te commen boven opt borstweer ter plaets van H, in sulcken ghevalle soude den inham D F E bare gheven, want de belegherde staende voor t'borstweer D F, om te schietem langs de afdakinghe van D A, souden van achter met den houck E beschut sijn voor den viant wefende ter voorscreven plaets van H. Maer de belegherde, welke tot dien einde stonden voor t'borstweer B E, souden voor dē viant an H bloot sijn, ende inden rugghe of sijdeling gheschoten worden. Hier op valt wederom te segghen, Soomen wil nemen, dat de viant hem vervoordert te staen ter plaets van H, opden bovecant des borstweers, sonder t'gheschot te vreesen dat vande bolwercken ende gordinen can commen, soo moetmen met een toelaten, dat hy oock sal durven commen in een van foodanighe inhammen daer hy sijn meeste voordeel merct, want de wegghen eensdeels daer toe bereyt ligghen, ten anderen een borstweer van 4 of $4\frac{1}{2}$ voeten hooch, is licht om affspringhen: Als by ghelijcknis, de viant hem vervoughende inden inham D F E, sal beyde de houcken D ende E tot schutsels ghebruijcken, om van daer met voordeel te beschieren de belegherde dieder sijn opde bedeste wegghen E C ende D A. Angaende ymant hier teghen segghen mocht, datmen van binnen de sterckte den viant niet toelaten en soude in dien inham te blijven: Hier op antwortmen, dat sulcx soo ghenomen, men sal sich met een moeten voorstellen, datmen hem vande selve sterckte niet ghedooghen en sal, opt voorscreven borstweer te staen. Twelck overleyt sijnde, dien inham soude, oock in dat ansien, soo wel tot achterdeel als tot voordeel strecken.

Angaende dat eenige diē inham met manier vā strijckhouckē verstercken, om van daer den viant met grof geschut opde afdakinge sijn schantsen te brekē, t'selve schijnt tot dien einde onnoodich, ende in ander ansien schadelick, gemerckt sulcx vande leeghe gordine bequamelicker ghedaen wort, als breeder verclaert is by t'einde des voorgaenden 9^m verschils.

Ander sijnder die int borstweer niet alleen dien inham en maken als vooren gheseyt is, maer teyckenen noch elck lanck borstweer in form van een heughel, met vier neusen als hier onder.



the recess has no advantage. But if we suppose that upon the covered way CG there were no defenders to use the parapet there as parapet, so that the enemy made bold to come upon the shelving or parapet at H, in such a case would the recess DEF be advantageous, for the defendants standing before the parapet DF to shoot along the bank DA would be protected behind by the corner E against the enemy at the aforesaid place H. But the defendants, who to this end would stand before the parapet BE, would be exposed to the enemy at H and be shot sideways, or upon their backs. To this again may be said: if we suppose that the enemy will venture to abide at the place H at the top of the parapet, without fear of the shot that may be fired from bastions and curtains, we must then grant that he will also be so bold as to come into one of those recesses where he sees his greatest advantage, for the means to come into them lie partly ready; besides, a parapet 4 feet or $4\frac{1}{2}$ feet high is easy enough to leap down. As for example, the enemy thrusting himself into the elbow DFE may use the two corners D and E for defence, for thence he may safely shoot at the defendants that are in the covered ways EC and DA. Concerning that which any man can say against it, that from within the fortress the enemy should not be suffered to stay in one of those elbows; hereunto we answer that, be it so understood, we must therewith also understand that he will not be suffered from the fortress to abide at the parapet, which being considered, the elbow would also in this respect tend to a disadvantage as well as to an advantage.

Concerning that some do strengthen these elbows in manner of flanks, thence with great ordnance to break the enemy's trenches upon the shelving, the same seems to that end not needful, and in another respect harmful, considering the same may better be done from the lower curtain: as is shown in more detail at the end of the preceding 9th difference.

There are others that do not only make in the parapet the elbow spoken of before, but make each long parapet in the shape of a saw with many teeth as hereunder.

De redenen van voordeel ende achterdeel, sijn hier af ghenouchsaem de selve, die wy hier boven vanden inham verhaelt hebben, want of men stelt sich voor, dat den viant hem sal verstouten te commen opt borstweert A B, om van daer te ontvrien den bedeckten wech C D E F, of dat hy 't selve niet en sal durven bestaen: doet hijt, soo sal hy met een, om noch meerder voordeel te hebben, durven commen vant borstweert opde bedeckte wech, ende ghebruijcken de neusen G H I K met soo grooten voordeel, als de belegherde de neusen C D E F doen. Maer darf hy opt borstweert A B niet verschijnen, soo en behoofstmen daer teghen de neusen C D E F tot gheen deckfels te veroirdenen. Tis oock te weten dat die heughels om uijt de * strijckhoucken ghestreken te worden, meerder openheyt des * schutfels vereysschen, waer deur de bosgaten blooter staen, ende uijt het velt souden connen beschoten worden. Voor besluijt, wy alle achterdeel teghen voordeel overleggende, ons heeft inde voorgaende teykening des 2^{en} Hoofsticx, beter bevallen de manier der ghene die elcke sijde der bedeckte wech rechtuijt trecken, sonder inham ofte heughelneusen, oock strijckelick uijt de strijckhoucken.

Flanc.
Oreillon.

11^e VERSCHIL OFT BETER IS

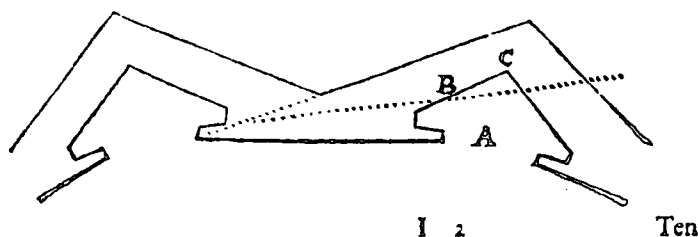
*het * buijtebosgat der middelplaets opde * bedeckte wech te connen ghebruijct worden, of niet.*

Canoniere exto-
rieure au pres
l'oreillon.
Chemin couvert.

By aldien, als sommighe willen, het * schutfel soo wijt open ghestelt wort, datmen door het buijtebosgat der middelplaets can * strijcken het borstweert der bedeckte wech, ghelijck inde 1^e form des 2^{en} Hoofsticx ghedaen is, soo sal de viant vande bedeckte wech als hy die heeft, wederom dat buijtebosgat connē breken. Maer trekmen het schutfel soo nauwe toe, dattet buijtebosgat bedeckt blijft metter nevenstande bolwerck A, alsoo dattet vande bedeckte wech nergens ghesien en wort, ghelijck hier onder, soo en can de viant sulcken bosgat niet breken. Inder voughen datter te overlegghen valt welck nutter waer, den * strijckhouck beter bedekt, sonder het buijtenste gheschot opde bedeckte wech te connen ghebruijcken, ofte den strijckhouck blooter te stellen, ende dat gheschor daer te meughen besighen.

Oreillon.
Nestoyer.

Flanc.



The reasons of the advantage and disadvantage hereof are the same that we have alleged before of the elbow; for whether we say that the enemy will venture to come upon the parapet AB, thence to scour the parapet CDEF, or that he dare not attempt it: if he does it, he will at once for his greater advantage come from the parapet unto the covered way, and use the teeth GHIK with such great advantage as the defendant uses the teeth CDEF. But if an enemy dare not show himself upon the parapet AB, then these teeth need not be made for cover. It is also to be understood that to scour the saws from the flanks, the orillions of the bastions must be laid out wider, by which means the embrasures lie more open and exposed, to be shot at from the field. To conclude, comparing all the advantages and the disadvantages, we have in the plan spoken of before in Chapter 2 better liked the manner of those who draw each side of the parapet of the covered way straight without an elbow or saw teeth and also scoured from the flank.

11th DIFFERENCE

Whether it is better that the outermost embrasure of the middle place in the flank should be fashioned to scour the covered way, or not

If, as some want it, the orillion were made so wide open that from the outermost embrasure in the middle place, a man might scour the parapet of the covered way, as shown in the 1st figure in Chapter 2, then an enemy, having reached the covered way, may thence break the embrasure. But if we draw the orillion so near the curtain that the outermost embrasure stands covered with the bastion A over against it, so that from the covered way it can be seen on no side, as hereunder, then the enemy cannot break such an embrasure; so that it is to be considered which were more convenient, to cover the flank better, without using the outermost ordnance upon the covered way, or to lay the flank more open, and to use that ordnance upon the covered way.

Instrumenta.

Ten eersten mochtmen segghen, anghesien t'gheschot inde strijckhoucken veroirdent is, soo wel om te breken schantlen en * reetschappen des viants opde bedecte wech, als inde gracht, soo vereyscht de reden datmen t'gheschot des strijckhoucx daer altemael ghebruijckt, datmender bequaemlick gebruijcken can. Hier op antwoortmen, dat wanneer het buijtebosgat altoo bedect is metter schutsel ter eender, ende het nevenstaende bolwerck ter ander sijde, soo en macht van buijten niet beschadicht worden, daerom al waer de reste des strijckhoucx heel ter neder gheschoten, soo houdmen dat buijtebosgat alijr versleert, teghen een storm die de viant soude moghen anvanghen. Hier teghen wort wederom gheseyt, dat ghelijck het schutsel den viant belet, het buijtebosgat te meughen breken, alsoo beletet oock de belegherde t'selve ter noot te moghen befighen op het bolwerck deel B C: Inder voughen dattet binnebosgat ghebroken sijnde, soo sal hy t'selve deel BC vrielijck moghen bestormen, sonder van dat bewaerde buijtebosgat hindernis te krijghen, daerom wat helpt een heel ongebroken bosgat te moghen behouden, daermen den viant gheen schade mede doen en can? Hier benevens machmen noch dit segghen: Haddemen metter buijtebosgat, soo wel als metter binnebosgat, de bedecte wech connen strijcken, ende dattet een stick het ander gheholpen hadde, misschien dat de viant die bedecte wech voor hem niet versterckt noch behouden en soude hebben, noch vervolghens middel ghecreghen, om tot storm te gheraken. Voor besluyt, wy achterdeel teghen voordeel overlegghende, oock gedenckende dat de viant de bedecte wech niet hebbende, de strijckhoucken gheen besonder schade doen en can, overmits hy te verre daer af moet ligghen: Dat noch daer benevens het buijtebosgat R der boveplaats inde 3^e form des 1^{en} Hoofsticx, oock het bosgat datmen ter plaats van S inde selve form legghen mach, sulcke twee bedeckte bosgaten sijn, soo beviel ons beter de manniere der voorgaende grontteyckening inde 1^e form, alwaer het borstweer der bedeckte wech, ende het * cabeschoeyfel, uijt des strijckhoucx buytesijde P ghetrocken sijn, ende het buijtebosgat daer na veroirdent: Oock sonder t'selve buijtebosgat wijder het velt te connen ontdekken, als sommighe willen, die daerom den strijckhouck noch wijder openen, want daer toe eyghentlicker dient het gheschot opde gordinen ende * catten liggende.

*Contrasfari.**Cavaglieri.*12^e VERSCHIL OF DE VOLCOMMEN*La raspi.*

* *strijckinghe vande bolwerck leeghe gordine, beter ghe-
daen wort uijt het binnebosgat der middelplaats,
of uijt het binnebosgat der boveplaats.*

By aldienmen des bolwerck leeghe gordine, treckt, ghelijck sommighe willen, uijt het binnebosgat der middelplaats, soo en canmen
deur

First one might say, since the ordnance in the flank is ordained to break the enemy's trenches and tools upon the covered way as well as in the ditch, reason would that we should use the ordnance in the flank there altogether where we may most suitably offend an enemy. Hereupon we answer, that when the outermost embrasure is covered by the orillion upon one side, and a bastion standing against it upon the other side, then it cannot outwardly be damaged; therefore, if the rest of the flank were broken, yet the outermost embrasure would remain to resist an assault which the enemy might attempt. Against this again it is said that as the orillion hinders the enemy from breaking the outermost gunhole, it also prevents the defendants in their need from using it at the part of the bastion BC, so that the inner embrasures being broken, the enemy can freely without offence of the unbroken outermost embrasure, assault the part BC. Therefore, what is the use of keeping one embrasure unbroken, wherewith we can do an enemy no harm? Besides, we might yet say this: If we could with the outermost as well as with the innermost embrasure have scoured the covered way, and that the one piece had helped the other, perhaps the enemy would not have strengthened himself in it, nor held the covered way, nor consequently have acquired means to come to the assault. For conclusion, weighing advantage against disadvantage, also remembering that the enemy, not having the covered way, can do the flanks no special damage, because he must lie too far from them, that besides the outermost embrasure R of the upper place, in the 3rd figure of Chapter 2, also the embrasure that may be made at the place S in the same figure, are two such covered holes, the manner of ground planning in the 1st figure pleased us better, wherein the parapet of the covered way and the counterscarp are laid out upon the outside of the flank P and the outermost embrasure framed accordingly: Also without the said embrasure being able to cover the field better, as some wish it, who therefore lay out the striking angle even wider, for this is more properly the function of the ordnance upon the curtains and cavaliers.

12th DIFFERENCE

Whether the perfect flanking of the lower curtain of a bastion
may be better performed out of the innermost embrasure of the middle place,
or out of the innermost embrasure of the upper place

If we draw the lower curtain of a bastion, as some would have it, from

deur het binnebosgat der boveplaets, die leeghe gordine niet sien noch strijcken. Hier teghen valt wederom te seggen, dat soomen de selve gordine treckt uijt het binnebosgat der boveplaets, dat die strijckinghe van hooghe nederwaert dalende, niet soo volcommelick langs de heele gordine en can strecken, ghelijckse doet commende uijt de middelplaets die op de selfde hooghe light. Ten anderen en can aldan de middelplaets die gordine oock niet volcommelick strijcken: Inder vougen datse gheen volmaecte strijcking hebben en sal. Ten derden soomen de strijcking van boven treckt, dat maect onplomphouckigher bolwercken, twelckmen deurgheemeene reghel schuwen moet. Ten vierden, soo can doch even wel de bolwerck leeghe gordine, uijt twee bosgaten der boveplaets, als P Q inde 3^e form des 2^{en} Hoofsticx, ghestreken worden. Dese voordelen ende achterdeelen teghen malcander overleydt, soo heeft ons best bevallen, de volcommen strijcking der bolwerck leeghe gordine uijt het binnebosgat der middelplaets te trecken: Twelck de natuerlicke ghedaente der form oock schynt te vereytschen, soomen insiet dat de hooghe ende leeghe gordinen, ghenouchsaem twee sterckten sijn, deen boven dander ligghe, die elck uijt haer eyghen binnebosgat, haer eyghen bolwerck gordinen begheeren ghetrocken te hebben.

13^e VERSCHIL VANDE * CATTEN.

Causgiers.

Hoe wel vande catten gheen goede strijcking opt velt en gheschiet, deur dien het gheschot van hooghe comt, nochtans soo wort haer dienst seer nut ende noodich geacht, overmits datmen beneven de *stijck- *Le flanquer.* king van dander plaetsen, noch hoogher gheschot heeft om den viant achter sijn schantfen te ontdekken, oock om hem te bedwynghen dat hy niet grooter moeyte, cost, ende tijtverlies, hoogher schantfen moet opwerpen, waer in de * Boumeesters ghenouchsaem met malcander overcom- *Architelli.* men, maer vande bequaemste plaets der catten, daer af is t'verschil: Want catten die boven opt middel der groote gordine liggen, beschoten sijnde, de vallende stucken vullen de gracht seer: Maer brengtmense om hier reghen te voorsien, meer achter den wal, soo en canmen van daer, segghen sy, gheen bolwerck gordine sien noch beschermen. Dit wiert tot ander plaetsen ghebetert, met de bolwerck sijden te trecken na de catten toe, alsoo datse daer af * ghestreken mochten worden, twelck in dat ansien wel goet *Rafex.* was, maer wederom quaet, dat de bolwerck gordinen aldan van malcanders *stijckhoucken gheen volcommelicke strijcking en cregghen, dat bo- *Flancs.* ven dien de voorhoucken der bolwercken scherper of onplomper vielen: Ettelicke hebbense tot noch ander plaetsen gheleyt, als boven op den hals ofte inganck des bolwerck: Sommighe op elcke sijde des inganck een: Ander voor den inganck, doch vant bolwerck verscheyden. Maer elck int besonder overleyt wese, men bevint in yder sijn gebreken. Onder

the inner embrasure in the middle place, then we can from the inner embrasure of the upper place neither see nor scour the same lower curtain. Against this may be said again that if we draw the same curtain from the inner embrasure of the upper place, that the scouring from above downward cannot so perfectly flank the whole curtain as it does coming from the middle place that lies at equal height with the curtain. Secondly, the middle place cannot then perfectly scour the curtain, so that it will not have a perfect flank. Thirdly, if we draw the scouring from above, it makes sharp-angled bastions, which by the common rule we must avoid. Fourthly, the lower curtain of the bastion can equally well be flanked out of two embrasures in the upper place, as P, Q in the 3rd Figure in Chapter 2. These advantages and disadvantages being weighed against each other, we have preferred drawing the lower curtain of the bastion for better flanking from the inner embrasure in the middle place, which the natural quality of the form also seems to require, seeing that the higher and lower curtains are two sufficient fortresses, the one lying above the other¹⁾, which require to have their own bastion-curtains drawn from their own inner embrasures.

13th DIFFERENCE Concerning the cavaliers

Although from the cavaliers no good scouring of the field can be performed, because the shot comes from above, yet their service is thought very useful and necessary, because besides the scouring and flanking of other places, we have higher ordnance to discover an enemy behind his trenches; also to compel him to throw up higher trenches, with greater labour, cost and loss of time, wherein the master builders well enough agree. But as regards the fittest place for the cavaliers there is a difference: for when cavaliers that lie upon the middle of the large curtain are battered, the debris falls down and fills the ditch. But if to prevent this, they are laid more backwards within the wall, then they cannot thence, it is said, either see or scour the curtain of a bastion. This was mended in other places by drawing the curtains of the bastions to the cavaliers, so that from them they might be defended, which in that respect was good, but otherwise bad, because the curtains were then not perfectly scoured from the flanks of the bastions; besides, the forepoints of the bastions fell out sharper or less flat. Some have laid them upon other places, as above upon the gorge or entrance of the bastion. Some have made one upon either side of the entrance: Others have made one before the entrance, separated from the bastion. But each of them separately considered, is found to have its particular drawbacks.

¹⁾ This conclusion: "two fortresses, the one lying above the other. . ." becomes especially clear if one consults Brialmont's plate I, or Dijksterhuis's, page 380.

allen soo heeft my best befallen, de manier der ghene diefe opt bolwerck legghen, na de wijfe die der int 2^e Hoofstlick verclaert is.

Parapetti. Angaende eenighe hun laten voorstaen, dat de plaets der cattedaer te cleen soude vallen, men seght daer tegen dat eyghentlick ondersouck van dies, sekerheyt der sake can gheven, t'welck is, datmen den vloer boven op de cattedaer tusschen haer * borstweeren 80 voeten (men soude met veel min connen ghedoen) breed bevint, welcke berekent worden inde sijden des selhoucx daer de sterckte op gheteykent is, als de twee deelen der twee sijden B C, B G, begrepen tusschen t'punt B, ende het borstweer der cattedaer, diemen elck 40 voeten lanck bevint, de uijterste voorsijden vanden vloer sijn noch langher, weseende boven dien daer voeten de borstweeren met * beschoeyfelen dick na t'behooren, ende de beneden plaetsen ende ghanghen ruijm na den eysch.

Scarpe. Maer want ettelicke soo seer trachten na groote plaets, tusschen de cattedaer ende des bolwercx * bovecrans, soo moeten wy daer af wat breeder seggen: De ervaring heeft gheleert, als kennelick is, datmen de plaets tusschen de leeghe bolwercx gordine ende den wal der hooghe bolwercx gordine daer achter liggende, niet soo wijd en moet nemen als men wel can, maer slechts een wech soo breed, als noodich is tot de deysing des gheschots, ende de afvallinghe der * walbrake: T'welck oock in reden ghegront is, want seer groote plaets, soude den viant, wanneer hy daer op gheraect, tot voordeel itrecken; als * stof verleenen om hem daer te beschanisen, ende gheleghentheyt om daer op met grooter menichte van volck voorder storm an te vanghen: Want wilt ghy opt bolwerck groote plaets maken om veel beschermers haer te moghen verweeren, ghy maectse met eene voor de viant, om v met veel bevechters te moghen bestormen, t'welck onnoodich is, ghemerckt sy deur den hooghen wal voor hemlieden staende, niet loopen en connen. Ia de viant wetende dat hy gheen gheleghentheyt hebben en soude, om daer te moghen blijven, bevint hem ghenootsaect oock walbrake inde bovegordine te moeten schieten, eer hy hem tot stormen begheeft. Daerom wort die leeghe gordijnganck vande * Boumeesters deur ghemene reghel, met goede reden alsoo smal ghetrocken als gheseyt is, op datmen den viant daer sulcken voordeel niet en gheve, maer datmen hem ter contrari, uijt de nevenstaende * strijchoucken ende catten vande smalle gordijnganck mach strijcken, vant een einde totter ander. Sulcx dan den rechtē eysch weseende vande ganck achter een leeghe gordine, ende gemerckt dat de bovecrans des bolwercx daer een cattedaer comt, oock een leeghe gordine is, int anlien der cattens gordine, soo vereycht den ganck achter die bovecrans derghelijcke form ende ghestalt te hebben, op dat den viant genootsaect sy inde cattedaer oock walbrake te moeten schieten, eer hy hem tot stormen begheeft, ende om dander voordeelen te krijghen, ende achterdeelen te schuwen, die boven verhaelt sijn.

Om

Amongst all, I like best the manner of those that lay them upon the bastions, as has been declared in Chapter 2.

Concerning that some imagine that the place for the cavalier would fall out too small, we say against it that the examination thereof can give certainty of the matter, which is that we find the floor of the cavalier betwixt the two parapets to be 80 feet broad (it might be much narrower), which are marked in the sides of the hexagon whereupon the fortress is drawn; as the two parts of the two sides BC and BG, containing betwixt B and the parapet of the cavalier, which are found each to be 40 feet long; the outermost foresides of the floor are even longer, having besides before them parapets and scarps, as thick as they ought to be, and the lower places and ways as broad as is required.

But since some do greatly seek after much room betwixt the cavalier and the garland of the bastion, we must speak thereof somewhat more. Practice has taught, as is well-known, that the room betwixt the lower curtain of the bastion and the wall of the higher curtain, lying behind it, must not be taken so broad as is possible, but only a way so broad as is necessary for the recoil of the ordnance, and the falling of the debris of a breach, which is founded upon reason, for a very large place there would benefit the enemy, if he should attain thereunto, as to afford him matter to entrench himself there, and the advantage to assemble many soldiers thence to assail further. For if you want to make great room upon a bastion for many defenders to fight upon, you make it also for the enemy to assail you with many fighting hands, which is not needful, since they cannot run through the high wall that stands before them. Yea, the enemy, knowing that he would have no means to abide there, finds himself forced to shoot a breach in the upper curtain before he attacks. Therefore the lower wall-way, by a common rule and with great reason, is by master builders laid out so narrow as has been said, thus not to give the enemy there such advantage, but that on the contrary he may be scoured out of the near-by flanks and cavaliers of the narrow way from one end to the other. Such then being the true requirement of the lower wall-way and noting that behind the garland of the bastion a cavalier is made, that wall, in respect of the cavalier, being a lower wall, it is necessary that the way behind it should have the like form and breadth, to force the enemy to batter the cavalier before he goes to the assault, to attain the other advantages and avoid the disadvantages mentioned before.

Om t'welck noch opentlicker te verclaren, ghenomen datter een bolwerck sy, alleenlick (ghelijckmen tot veel plaetsen vindt) met een gordine, welke, alsooder gheen ander gordine en is daermens teghen verlijken mach, noch hooghe noch leeghe gordine eyghentlick gheseyt en can worden. Op dit bolwerck wilmen tot beter bewaernis noch een hooghe brengen: De vraghe is wat breede datmen bequaemlicx laten sal, tusschen die hooghe ende het borstweer des bolwerckx? De antwoort soude met goede reden dusdanich menghen sijn: Anghesien de gordine van dese hooghe, de hooghe gordine sal wesen, ende de gordine des bolwerckx dier nu is de leeghe, soo salmen die hooghe gordine trecken, ghelijck de ervaring in ander hooghe en leeghe gordinen leert goet te wesen, dat is met en strijckelicke ganck tusschen beyden, soo breed als ghenouch is voor het deysen des gheschots, ende de afghevalen walbrake. Angaende ymant hier op mach segghen: Anghesien die hooghe, vant bolwerck niet voort geleydt en wort opde groote gordine, soo en salt gheen bovegordine wesen, maer een catte, ende willende daerom die hooghe een ander form gheven, wie en siet niet dat hy hem selven bedriecht met de namen, sonder te letten opde sake.

Maer op dat ick alle partyeghe noch met *strickreden begheghen, ende tot *teghenspreuck brenghe, soo laet andermael een bolwerck sijn alsvoorren hebbende alleenlick een gordine, t'welckmen begheert te verstercken, met daer op een hooghe van eerde na t'meeeste voordeel te veroirdenen: Dese hooghe suldi leggen of verre vant *borstweer der bolwerckx gordine, ofte daer heel by, alsoo dat den vloer des bolwerckx daer mede bicans vervult wort: Ligtse verre, ghy noemtse catte, ligtse by, ghy heetse bovegordine. Nu van dese twee manieren en can maer een de beste sijn, welke segdi die te wesen? Soo ghy hier antwoort dattet deerste is, te weten de hooghe die verre vande bolwerckx gordine light, waerom dan en veroirdent ghy niet alsoo by *verkiefing alle bolwercken, ghemerckt het meeste voordeel over al ghesocht wort? waerom raedt ghy elders ter contrari tot een onbequaem, te weten tot bolwercken met bovegordinen, welke na veyghen seggen soogoet niet en sijn? Maer soo ghy hier antwoort dat dander wijse de beste is, te weten de hooghe byde bolwerckx gordine ghebrocht, waerom segdi elders ter contrari hoogden verre vande gordine beter te wesen? Tot hier toe is gheseyt vande plaets tusschen de catte ende het borstweer daer voor.

Angaende noch by mocht ghebrocht worden, dat de afvallende *stof, als men de catte beschiet, beletten soude de boveplaets des *strijchouc te moghen ghebruycken: Hier teghen segmen, dat de boveplaets niet meer noots vande afvallende stucken der catte en verwacht, dan de middelplaets vande afvallende stucken des hooghen wals, want daer is soo groote ruymte tusschen de *tanden der boveplaets, ende het *beschoeyfel der catte,

Dilemmat.

Contradictionem.

Parapetto.

Electioem.

Materia.

Flanc.

Merlens.

Scarpa.

To explain this even better, suppose that there is a bastion with only one curtain (as we find in many places), which, having no other curtain with which it may be compared, can be called neither higher nor lower curtain. Upon this bastion we will, for more defence, yet bring another height. The question is, what width should we leave best betwixt that height and the parapet of the bastion? The answer with good reason may be this: seeing that the curtain of this height will be the higher curtain and the curtain of the bastion that now is the lower, then we must draw the higher curtain, as practice teaches us to be good, in other higher and lower curtains, that is with a scoured way in between, so broad as is sufficient for the recoil of the ordnance, and the debris of the breach. Concerning what any man may say against it: since that height upon the bastion is not laid forward along the large curtain, it shall not be reckoned to be a higher curtain, but a cavalier, and wanting therefore to give that height another form, who does not see that he deceives himself with the name without consideration of the matter?

But in order to bring dilemmas before all parties, and bring them to contradiction, suppose once again, as before, that there is a bastion that has only one curtain which we desire to strengthen, with a raised height of earth upon it, at the most advantageous place. This height you must either lay far from the parapet of the curtain of the bastion or very near it, so that the floor of the bastion will be almost filled therewith. If it lies far off, you call it a cavalier, if you lay it near, you call it higher curtain. Now of these two sorts one can be but best; which do you say it is? If you answer here that it is the first, to wit the height that lies far from the curtain, why then do not you ordain all bastions by preference to be so, seeing that most advantage is sought everywhere? Why do you recommend then in another place the contrary, at an unfit place, to wit, bastions with higher curtains, which according to your own saying are not so good? But if you answer here that the other manner is best, to wit, the height near the curtain, why then do you say in another place on the contrary that a height far from the curtain is best? Hitherto has been spoken of that way or place betwixt the cavalier and the parapet before it.

Concerning what might hereunto be added, that the debris or matter falling from a breach in the cavalier might hinder the use of the upper place in the flank, we say that the upper place in the flank does not expect more trouble from the broken earth falling from a breach than the middle place from the earth falling from the upper wall, for there is so much room betwixt the merlons of the upper place and the scarping of the cavalier as betwixt the other merlon

*Rejer.**Strada coperta.**Ital. Retirati.
Fran. Retraites
of retrenchemens.
Girlanda.**Eract.*

catte, als tusschen dander tant ende den wal daer achter staende. Hier af dan gheen noot wefende, soo sullen wy de voordeelen verhalen uijt sulcke gheleghentheyten der catten spruytende. Ten eersten connen se, daer liggende, de groote gordinen hooghe en leeghe van weder sijden * strijcken. Ten anderen meughen sy self van haer nevenstaende strichoucken ghestreken worden. Ten derden, want se den viant daer naerder ligghen, soo ontdecken se hem veel meer achter sijn schantfen, die hy op de * bedekte wech of inde gracht mocht opwerpen, dan of se op eenighe van d'ander plaetsen stonden. Ten vierden, sy en verminderen daer het begrip der sterckte niet, ghelijck se achter de wallen doen. Ten vijften en strecken se daer tot soo groote cost niet, als achter de wallen, overmits dat se (op dat ick soo segghe) wel half ghemaect sijn eermen se beghint, deur dien het bolwerck sijn hoochde van selfs mede brengt. Ten seften, nade-mael de bolwercken, diens gordinen maer van over een sijde ghestreken en worden, crancker sijn dan de groote gordine, om dat men se van weder sijden strijcken can, soo ist oirboirder de cranckste plaetsen met de catten te verstercken. Ten seveden sijne daer bequaemer, om alst noot is * ver-treckwallen te legghen (soo noemen wy der Italianen *retirati*, ende der Françoisen *retraites*, of *retrenchemens*) want de * bovercrans of bolwerck gordine door de viant te neder ghevelt sijnde, soo en behouft men, om sich te verstercken, niet een halve maen oft ander form te legghen, soo lanck als de * muerbrake, ghelijck men doet in bolwercken daer gheen catte op en is, maer aleenelick twee wallekens, ofte borstweerkens, over de breedte des wechs, tusschen de catte ende beyde de einden der muerbrake, met een diepe put daer voor, quellende daer beneven den viant, met van boven de catte af te worpen vier, brandende tacken, siedende peck, en dierghelijcke, waer af hy om de smalheyt des wechs hem niet wel bevrijden en can. Ten laetsten, soomen beneven al dese voordeelen noch overdencken, dat de behoorlicke plaets vande torens der oude sterckten, was ten deele buijten de mueren te steken, ende dat nu de catten genouchsaem in plaets van sulcke torens comen, soo schijnt de nateurlicke reden te vereytschen, dat se in dierghelijcke ghestalt behoiren gheleyt te worden, al-soo ten deele buijten de groote gordine stekende.

14^e VERSCHIL VANDE POORTEN.

SOMMIGHE willen dat de poorten beschermt worden met eyghen bolwercken, ende verscheyden stercke ghebouwen: T'welck ander segghen onnoodich te wesen, want alsoomen niet en verneemt, dat sterckten diemen sterckten heeten mach, deur poorten met ghewelt inghenomen worden, dat die groote beschutselen onnoodighe costen sijn, door welke altemet der sterckten nateurlicke form mismaect wort, waer uijt oock in ander ansien somwijlen achterdeel volgt: Willen daerom, dat-

men se

and the wall standing behind it. Hereof then being no doubt, we will declare the advantages that proceed from the placing of the cavaliers. First, lying there they may scour the higher and lower curtains from both sides. Secondly, they can be scoured themselves from the flanks standing against them. Thirdly, the nearer the enemy lies, the better he may be discovered behind his trenches, which he throws up in the covered way or in the ditch or in any other place. Fourthly, they do not there lessen the circuit of the place, as they do when they lie behind the wall. Fifthly, they cost there not so much as when they are laid more inwardly, because (as I say) they are there half made before they are begun, because the bastion brings a height with itself. Sixthly, since the bastions whose curtains are scoured but from one side are weaker than the large curtains because they are flanked on both sides, therefore it is fit to strengthen the weakest places with the cavaliers. Seventhly, they are there more necessary when need requires to make retranchments¹⁾ (thus we mention the Italian *retirati* and the French *retraites* or *retranchements*) for, the curtains of a bastion being overthrown by an enemy, we need not make a half moon or some other fashioned trench as long as the breach, to strengthen ourselves against an enemy, as we do in bastions where there is no cavalier, but only make two small walls or parapets, across the way betwixt the cavalier and the ends of the breach with a deep hole in front, and besides troubling the enemy by casting from the cavalier burning branches, boiling pitch, and such like, from which, because of the narrowness of the way, he cannot free himself. Lastly, if besides all these advantages we remember that the fittest place for the towers in the old fortresses was partly outside the walls, and that the cavaliers now come well enough in the place of those towers²⁾, it seems that natural reason requires that they should be laid in the same manner, i.e. partly outside the large curtain.

14th DIFFERENCE Concerning the gates

Some want to have the gates defended with particular bastions and various strong buildings. Which others say not to be necessary, for if we do not mean that fortresses (which we may term to be fortresses) are by their gates taken by force, so we say that those great covertures are unnecessary costs, by which the natural form of fortresses is often misshapen, by means whereof, also in another respect, disadvantages sometimes follow. Therefore they would that they should

¹⁾ Like elsewhere, Stevin gives here a good example of the defence of fortresses, namely by means of retranchments, the name of which existed already with the Italians as "*retirati*" and with the French as "*retraites*" or "*retranchements*".

²⁾ This final remark about the cavaliers, which just like the towers of the old fortresses protrude outside the wall, is still characteristic of Stevin's sense of the past.

menſe ſlechtelick legghen ſal int middel der groote gordine, ofte anders inſe ſelve gordine byden *ſtrijckhouck, alſoo datſe door het *ſchutſel ghenouch bedekt ſy: Voort datmen ſal brenghen een cromme brugghen, ſtreckende om het ſchutſel na de *bedekte wech toe. Wy hebben int 2^e Hoofſtick deerſte meyning gevolght alwaer de poorte int middel der groote gordine gheleyt is, ende ſoo wel het ghewelf der poorte onder de wallen, als de brugghen over de gracht, heel rechtuijt veroident ſijn. De redenen waer deur men acht ſulcx het meelte voordel te weſen ſijn tweederley, d'eene de ſterckte, dander de *ſtrijckinge, daermen als na voornaemlick wit in deſe *ſtof het oogh op behoort te hebben: De ſterckte is hier in ghelegghen: Ghemerckt dat ten einde des ghewelfs een ſtercken wal light, met haer borſtweeren ende boſgaten daer in, ſoo iſt daer voor te houden, dat al ſtonde d'eerſte doore E F inde 4^e form des 2^{en} Hoofſtickx wijs open, ende dat de brugge al bereyt laghe, om tot ſijn wille daer over te loopen (ick laet varen dat de ghebruyck inhoudt, wanneermen den viant ſiet ghereeſchap maken om een poorte te beſchieten, datmen valbrugghen optreckt, brugghen af breekt, poorten toe ſluijt, die van binnen met eerde vult en dierghelijcke) noch en ſoude de viant, wetende hoet van binnen gheſtelt is; hem niet vervoorderen daer in te comen, want de tweede deure ter plaets van K, en can door grof gheſchut niet beſchadicht worden, hy ſoude daer ſtaen voor een ſtercke wal met haer *borſtweer ende boſgaten, in veel meerder perikel dan voor den buijte-
wal, connende *gheſtreken worden tottet einde der brugghen toe. Derghelijcke voordeel heeft deſe ſtrijckinge teghen de liſtighe anſlaghen des viants, die een poorte onvoorſiens metter haſt wil overweldighen, ſoo wel int afwijcken als int ancomen.

Flanz.
Orsiden.

Corridor.

Le nettoyen.
Materia.Parapetto.
Raſt.

Poorten die buijten haer mueren uijſteken, met pilaerwercken ende ander coſtelick cyraet, en achten ettelicke (die my daer in wel bevallen) niet oirboir, ſegghende goede vaſticheyt der ſterckten beſte cyraet te weſen, want ſulcke uijſteckſelen beletten de volcommen ſtrijckinge der gordinen, ſy connen int ſtormen den viant tot beſchutſel verſtrecken.

15^e VERSCHIL VANDE *STEVNSTIILEN.

AL S M E N de ſteunſtylen anden muer dunder maect dan na de walſijde, ghelijcke int 3^e Hoofſtick gheteyckent ſijn, ſoo houdt den muer ende den eerden wal inde ghedeuricheyt beter tſamen, maer daer teghen iſt meerder achterdeel, ſegghen ander, wanner de muer van buyten deurſchoten wort, want het gat dan tuiſſchen twee ſteunſtylen wyder ſijnde na de gracht toe, als na den wal, ſoo is de eerde tuiſſchen beyden ligghende, meer ghenegen om af te vallen, dan of ter contrari die plaets na de gracht ſijde engher waer, ende na den wal toe wijder, dat is met ſteunſtylen dicker ande muer, ende dunder na den wal. Maer als ſy in

Freyten of Pila-
ren achter an
ghewurckt.
Ital. Sperruth.
Frans. Contro-
forts.

K

ſulcker

be laid, if need be, in the midst of the large curtain or else at the flank in the same curtain, so that they may be sufficiently covered by the orillion. Moreover that the bridge should be made bent around the orillion to the covered way. We have in Chapter 2 followed the first opinion, where the gate is laid in the midst of the large curtain, and the vault of the gate under the wall, as well as the bridge across the ditch are laid out straight. The reasons why this is thought to be most advantageous are of two sorts, one of the strength, the other of the flanking, because we must have an eye for the special scope of this matter: The strength consists herein: seeing that at the end of the vault lies a strong wall, with its parapets and embrasures in it, then it should be considered that if the first gate EF in Figure 4 of Chapter 2 stood wide open, and the draw-bridge down for an enemy at his pleasure to enter (I exclude that the custom is when we see an enemy ready to batter a gate that we draw up bridges, demolish bridges, shut the gates, fill them within with earth, and such like) yet the enemy would not presume to come in, knowing what defence is within the gate, for the second gate at the place of K cannot be offended by the enemy's great ordnance; he would stand there before a strong wall with its parapet and embrasures in much more danger than before the outermost wall, which may scour the bridge unto the very end. Such an advantage has this scouring against a wily enemy who would surprise a gate in going off as well as in coming on.

Gates that project outside the wall, with pillars and other costly garnishing, some esteem (as I do) not to be advantageous, saying that good assurance in a fortress is the best garnishing, for such projections hinder the perfect scouring of the curtains, and they may provide cover to the assailing enemy.

15th DIFFERENCE Concerning the counterforts ¹⁾

When we make the buttresses thinner at the wall than at the rampart, as they are plotted in Chapter 3, then the wall and the rampart hold more firmly together when they are battered, but others say it is a disadvantage, for when the wall is battered from the outside, the hole betwixt two counterforts being wider towards the ditch than towards the rampart, the earth will be more ready to drop out than if the place next to the ditch were narrower, and the place next to the rampart wider, that is, the counterforts thickest at the wall and thinnest at the

¹⁾ About the buttresses Stevin gives various theories, among which the one of no protecting wall at all: "good earth can resist better than stone, but only it should be walled for longer continuance".

fulcker voughen ghemaeckt sijn, soo en strecker niet tot sulcken geduericheyt, want soo den muer gheneycht is te hellen na deen sijde, ofte den wal na dander, de eerde tusschen beyden en houdtse dan niet soo seer t'samen. Ettelicke makense van vooren en achter even dick. Sommige om beyde de voorscreven ongevallen te voorkomen, makense int middel dunst, waer deur deen helft vande eerde tusschen twee steunstielen, den wal ende den muer t'samen houdt, dander helft crycht na de gracht toe meerder nauicheyt, om de eerde aldaer (den muer afgheschoten sijnde) beter by een te houden. Noch sijnder ander die achten, datmen de wallen niet en bemuert, ofte en behoort te bemueren, in meyning dat steen het grof gheschut beter can teghen staen dan eerde, alsoo ter contrari goede eerde beter teghenstant doet dan steen, maer datse alleenelick bemuert worden, om den wal langher in gheduericheyt te houden datse niet en vervalle: In welck an sien soo en behoort ons voornemen niet te wesen, de ontmuerde eerde te verstercken met steunstielen die na de grachtsijde breeder sijn, maer ter contrari smalder, ende volghende sulcke meyning, wy hebbense alsoo gheteykent int voorscreven 3^e Hoofstuck: Sy die deur ervaringhe of vernuftighe redenen ander wijze voort beter kennen, meughen die te wercke stellen.

*Ital. Sortite.
Franc. Sorties ou
Faussez portes.
Holl. d. Afsval.
Strada coperta.*

16^e VERSCHIL VANDE* *heymelicke uijtganghen.*

ALSOODER cerijts opde cade gheen * bedeckte wech en lach, soo waren de heymelicke uijtganghen van cleyenen dienst, inder voughen dat een of twee voor een groote sterckte ghenouch was: Maer de bedeckte weggen daer na inde ghebruyck commende, soo wordender tot de sterckten die een bedeckte wech hebben, an elck bolwerck twee geleyt. Ettelicke hebben de uijrcomst ofte de deure des heymelicken uijtganx, ghebrocht in des strijckhoucx onderplaats, ende om daer te gheraken, maecten wenteltrappen binnen inde bolwerken. Ander en maken gheen trappen, maer, t'welck an ettelicke beter bevalt (voornaemlijck tot sterckten met drooghe grachten) neerdalende ghanghen sonder trappen, om daer over met peerden te meughen commen: En hebben oock de deure niet ghestelt inde onderplaats, maer bequamelicker daer buyten ande binnelijde des * schutsels, ghelijck int 2^e Hoofstucks 28^e punt der grontteykening, oock met de 5^e form verclaert is.

Orcillen.

17^e VERSCHIL VANDE* *moortcuylen.*

Casematte.

ETTELICKE willen dat inde gracht tusschen twee bolwercken een leeghe dunne muer sal wesen, met veel bosgaten daer in, die na allen sijden

rampart. But if they are made after that manner, then they are not so strong, for if the wall is readier to heel one way, and the rampart another, the earth betwixt does not hold them so well together. Some make them both before and behind equally thick. Some, to prevent the aforesaid mishaps, make them in the middle thinnest, whereby one half of the earth betwixt two counterforts holds the rampart and the wall together, the other half towards the ditch having there more narrowness to keep the earth (when the wall has been battered) better together. There are others who think that the ramparts should not be faced with a wall, and others that we ought to wall them, because stone can better resist great ordnance than earth, whereas on the contrary, good earth can offer better resistance than stone, but only that they should be walled for longer continuance, that they may not fall: In consideration whereof it must not be our intention to strengthen unwalled earth with counterforts which next to the ditch are broadest, but contrarily are narrowest, and following that opinion, we have plotted them so in the afore-said 3rd Chapter. Those who by experience or ingenious reasons know the other method to be better, may set it awork.

16th DIFFERENCE Concerning secret sallies

When heretofore upon the outside of the ditch no covered way was made¹⁾, then the secret sallies were of little service, so that one or two in a great fortress were enough. But covered ways afterwards coming into use, in fortresses that have a covered way two sallies are made in every bastion. Some laid the exit or door of the sally in the lower place in the flank, and to come to it made a winding stair within the bastion. Others make no stairs but, what some like better (especially for fortresses with dry ditches), ways descending without stairs, to pass across with horses, and have not set the doors in the lower place, but more fitly outside, upon the inside of the orillion, as has been explained in the 2nd Chapter, point 28 of the ground plan, and also in Figure 5.

17th DIFFERENCE Concerning murdering places or casemates

Some would have in the ditch betwixt two bastions a low thin wall with many embrasures in it, to scour on every side. Against which is said again: first, that

¹⁾ Stevin's remark that formerly the fortresses had no covered way and so were much more exposed, is important.

lijden strecken. Waer teghen wederom gheseyt wort: Ten eersten dat die muer soude beletten het * beschoyfel des leeghen wals te meughen ghe- *Scarpa.*
 strecken worden van haer nevenstaende * strijckhoucken: Ten anderen, *Flancs.*
 datmen de viant daer uijt met gheen groot gheschot en can beletten liet opwerpen der schantsen inde gracht. Ten derden, dat de afvallende stucken der beschoten gordine, den ghenen verhinderen soude die achter den selven muer stonden. Ander begheeren een moortcuyl ten einde des * schultsels, als voor de sijde *Orillon.* *lm* inde 1^e form des 2^{en} Hoofsticx, de welke oock cleen ende cranck sijnde, daermen gheen groot gheschut in ghebruycken en can, soo worden se om de voorgaende redenen van ettelicke veracht. Ander, die my best ghevalen, willen moortcuylen gheleyt hebben inde houcken der caden, teghen over de punten ter bolwercken, als ter plaets van *b*, segghende die aldaer best beschermt te sijn, ende datmen den viant van dien oort met minder swaericheyt een tijt lanck soude meughen beschadighen, want inde gracht commende, hy soude ghequeelt worden van achter ende van vooren.

Sy verstaen oock datmen de selve moortcuylen niet seer sterck noch grooten sal maken, op datmen die, soomen se verlaten moeste, te lichtelicker mach affschieten, sonder de gracht seer daer mede te vullen, oock op dat de springhende stucken den viant seer mochten beschadighen. Willen oock datter vande selve houcken af tot den voorhouck des tegenoverstaende bolwerck toe, ende van daer voort tot inde sterckte, overwelselen sullen ligghen inde eerde onder den gront des grachts, om daer langs henen uijt de sterckte na die moortcuylen bedectelick te moghen gaen en keeren.

Doch alsoo dese moortcuylen gheen wesentlicke deelen der stercke en schijnen, maer alleenelick souden meughen gheleyt worden ten tijde van oirloghe, tot sulcke plaets ende van sulcke ghedaente als de voorkommende nootlicheyt vereyscht, soo en hebben wy de selve inde teykeninghe des 2^{en} Hoofsticx niet bescreven, gheuoouchtende dese vermaninghe daer af ghedaen te wesen.

7^e HOOFSTICK, VAN

*sommighe * verschillen der onvolkommen sterckten, te *Quæstionibus.*
 weten diemen veroirdenen moet na gelegentheyt
 der plaetsen, ende ander omstandighen.*

Wy hebben hier vooren bescreven de manier des ghebous van een sterckte met haer volkommen leden, na de wijze deses tijts, mergaders een Hoofsticx vande voornaemste verschillen die der op foodanighe volkommen sterckten vallen meughen.

that wall would hinder the scouring of the scarp of the lower wall from the flanks. Secondly that we cannot thence with great ordnance prevent the enemy from throwing up trenches in the ditch. Thirdly, that the debris of the battered curtain would be a hindrance to those who stood behind the wall. Others want a casemate at the end of the orillion ¹⁾, as before the side *lm* in the first figure of Chapter 2, which being also small and weak, no great ordnance can be used in it; therefore some do not appreciate them for the reasons mentioned before. Others, whom I like best, want to have casemates laid in the corners of the ditches over against the points of the bastions ²⁾, as in the place b, saying that they are there best defended, and that we might thence, for a time, with less danger, offend an enemy, for, entering into the ditch he would be troubled both before and behind.

They are also of opinion that those casemates should neither be made strong nor great, that when they must be abandoned they may be more easily demolished, without much filling of the ditch, and that also the flying stones may offend the enemy. They also want that from the said corners of the ditch, unto the corner of the bastion opposite, and thence forward into the fortress, vaults be made in the bottom of the ditch underground, to go and return throughout covered, out of the fortress into the casemates.

But as these casemates seem to be no essential parts of the fortress, but are only to be made in time of war, at such places and of such form as need requires, therefore I have in the planning in the 2nd Chapter made no show thereof, esteeming this warning to serve its purpose.

CHAPTER 7

Of certain deviations from irregular fortresses, to wit,
of those which must be planned according to the situation of the
places and other circumstances

We have so far described the manner of the building of a fortress with its regular lines according to the manner of the present time, together with a chapter on the main differences that may occur with respect to such regular fortresses. But because it often happens that the situation of the place and other

¹⁾ Among the casemates which Stevin rejects are those at the end of the orillions; an example of this from later times can still be seen in the only ravelin left at Bergen op Zoom, a design by Coehorn.

²⁾ The casemates finally recommended by Stevin are the "counterscarp caponiers", the advantages of which he describes extensively. Brialmont (Steichen, p. 115) praises the genius of this construction when he writes: "Cette idée, aussi ingénieuse que féconde, fut généralisée avec le plus grand succès par Coehorn et appliquée ensuite dans la plupart des systèmes modernes".

Maer want het dickwils ghebeurt, dat de gheleghentheyte der plaets ende ander omstandighen, niet toe en laten alles te maken ghelijckmen wil, ende datmen bedwonghen wort hem na wat anders te ghevougen, soo sullen wy in dit Hoofstuck soodanighe verschillen vergaren.

1^o VERSCHIL VAN HALVE BOLWERCKEN.

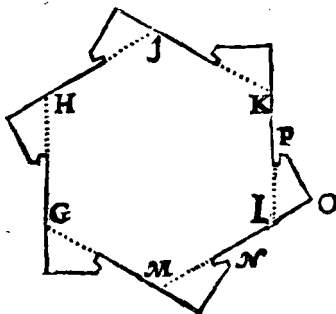
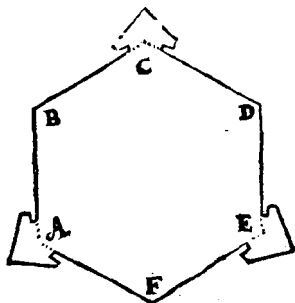
*Hexagonū aquila-
lancrum castrum
avculo inscriptu-
bile.
Nathyer.*

Tarsapeto.

*Canmen: r. d.
Cavaglien.*

Rafte.

GHENOMEN datter te maken sy een selhouckige evesijdeghe schantse of sterckte * int ront beschrijvelick, waer afmen besloten heeft om seker redenen, elke groote gordine alleenelick vā een sijde te willen * strijcken: Vraghe wat daer toe bequamer waer, drie heele bolwercken, als ghestelt sijn opden selhouck A B C D E F, ofte ses halve, als opden selhouck G H I K L M? (wy noemensē halve bolwercken, overmidts dat N O anghelien wesende voor een heele rechte groote gordine, soo is de reste O P alleenelick den helft van een heel bolwerck) De halve bevallen my beter om verscheiden redenen: Ten eersten, dat haer voorhoucken plomper of onscherper connen vallen, dan vande heele: Of maectmensē evescherp, soo sullen de halve bolwerckx gordinen van veel naerder plaets der groote gordine connen ghestreken worden. Ten anderen, soo connen de half bolwerckx gordinen veel strijckelicker staen, om datmen niet soo seer schoens over het * borstweer der groote gordine en moet schieten, uijt welke groote schoensheyt quade beschermnis voight, oock onbequame gheleghentheyte om * bosgaten in te brenghen. Ten derden canmen opde halfen der halve bolwercken meerder ruymte cryghen, om * catten of hoogden op te legghen. Hier machmen noch by vougen, dat halve bolw rcken haer op onevenhouckighe formen beter schicken dan heele, welverstaende wanneermen na het bovescreven voornemen, elke groote gordine maer van een sijde * strijcken en wil: Als by gelijcknis, drie heele bolwercken sijn op een vijf houck te veel, overmidts sy teghen het voornemen, een groote gordine van beyden sijden strijcken, maer twee heele sijn te luttel, want daer blijft een groote gordine ongestreken.



MERCT.

circumstances do not allow men to make what they will, and that they are compelled to adapt themselves to something else, therefore I will in this chapter collect such differences.

1st DIFFERENCE
Concerning half bastions

Suppose that there were to be made a hexagonal, equal-sided redoubt or fortress, to be described in a circle, whereof, it is agreed for certain reasons, each large curtain shall be flanked but upon one side. The question is, which for this purpose is fitter, three whole bastions, as are set upon the hexagon ABCDEF or six half ones, as upon the hexagon GHIKLM? (I call them half bastions, because NO being taken for a whole straight large curtain, the rest OP is only half of a bastion). The half bastions please me better for various reasons: First because the forecorners may be shaped flatter than the corners of the whole bastions. Or if we make them equally sharp, the curtains of the half bastion can be scoured from a much nearer place in the large curtain. Secondly, the curtains of the half bastion may be easier to flank, because we need not shoot so much skew over the parapet of the large curtain, of which great skewing can proceed but little defence, and no advantage of making embrasures. Thirdly, in the necks of the half bastions more room may be found to lay cavaliers or heights. To this may be added that half bastions fit better upon unequal-angled figures than whole ones, well understanding when we will, according to the former intention, have each large curtain flanked but upon one side. As for example, three whole bastions upon a pentagon are too many, because contrary to the intention, they flank one large curtain both ways, but two whole bastions are insufficient, for one large curtain would remain unflanked.

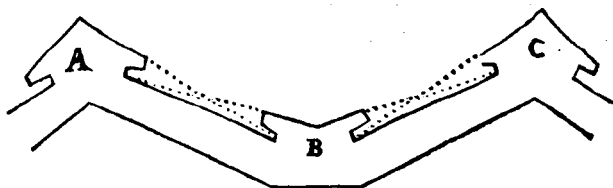
M E R C T.

A LLE sterckte diens groote gordine maer van over een sijde * ghe- Netoyd.
 streken en wort, r'sy uijt den * strijckhouck van een half ofte heel Flanc.
 bolwerck, en is niet wel bewaert: Eenfdeels deur dien noch schutsels
 gordine, noch bolwerck gordine goede bescherminghe en crijcht van ouer
 de groote gordine, om de afdakinghens wille van haer * borstweer, ghe- Parapette.
 lijck breeder verclaert is des 6^{en} Hoofsticx 2^e verschils 2^e punt: Ten an-
 deren, dat de groote gordine self oock een onbeschermden houck heeft,
 alsoo wy bewesen hebben in des 6^{en} Hoofsticx 3^e verschils 1^e voorbeelts
 ander punt.

2^e VERSCHIL VAN VERSTERCKINGHE
 der wallen met inwendighe houcken.

1^e VOORBEELT.

L AET ABC een wal sijn, met een inwendighe bocht int middel
 ter plaets van B, als hier onder.



Na desen crommen houck neem ick datmen sich ghevoughen moet,
 om een bolwerck daer op te brenghen ten besten oirboire. Ick seggh dat
 foodanighe inwendighe bochten, een ghelegghentheyf hebben om stercker
 bolwercken op te connen maken (ghelijck het bolwerck B een daer af is)
 dan eenighe ander *evesijdeghe form int ront beschrijvelick, oock stercker Aequilatera
 formae crurulo
 in angustibus.
 dan op rechte wallen, beter ist bolwerck B, dan een der twee A C, ende
 dat om twee merckelicke redenen. Ten eersten, de heele voorsijde des
 bolwerck B, wort ghesien ende beschermt van elck nevenstaende bol-
 werck A en C, twelek de selve bolwercken A, C, niet ghebeuten en mach,
 want elcke haer voorgordine maer van een sijde * ghetreken en can wor- Rasie.
 den. Ten tweeden altoo het bolwerck B gheen uijstekenden houck en
 heeft als dander, soen cander gheen uijstekenden houck wech gescho-
 ten noch beschadicht worden.

NOTE

All fortresses whose large curtains are flanked but upon one side, whether it be with a half or a whole bastion, are not well defended. Partly, because neither the curtain of the orillion, nor the curtain of the bastion can be well defended from the large curtain, because of the shelving of the parapet, as is more extensively declared in Chapter 6, 2nd difference, 2nd point. Secondly, because the large curtain itself has an undefended corner, as we have shown in Chapter 6, 8th difference, 1st example, 2nd point.

2nd DIFFERENCE

Concerning strengthening walls with re-entering angles

Example 1 ¹⁾)

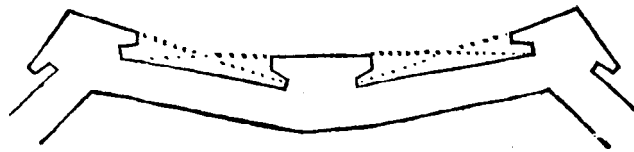
Let ABC be a wall with a re-entering angle in the midst, at the place B as hereunder.

According to this angle I suppose that a bastion must be constructed at most convenience. I say that such re-entering angles give a better opportunity to make stronger bastions upon (whereof bastion B is one) than any other equilateral figure described in a circle, yea stronger than upon straight walls; bastion B is better than any of the two A C, and that for two special reasons. First, the whole foreshore of bastion B is seen and defended from either bastion A or C beside it, which cannot happen to the same bastions A, C, for either of their front curtains can be flanked but upon one side. Secondly, since bastion B has no projecting corner, as the other, no projecting corner can be shot off or damaged.

¹⁾ For this construction with re-entering curtain see also Tartaglia, Pl. III; Maggi-Castriotto, p. 52; Lorini, p. 159; Pasino and other Italian authors.

2^e VOORBEELT.*Du flancquet.**Platta forma.*

ENDE om den ghemeenen aert * des strijckens noch volcommelicker te verclaren, soo merckt, dat wanneer de bocht in sulcker ghestalt light, datmen de voorsijde des bolwercx heel rechthuyt mach trecken, ghelijck dese tweede * platteform anwijst (ghelijck oock binnen Malta het bolwerck van *S. Barbara* is, volghende de ghedruete formen daer af nijtgaende) sulcke ghedaente is de aldersterckste dieder in bolwercken vallen mach, want de heele voorgordine can van beyden sijden volcommelick ghestreken worden. Daerom dat ettelicke meughen meynen, het middeiste bolwerck gheen form te hebben na bolwercx eysch, om datter vooren gheen vijftstekenden houck en is, het schijnt datse meer letten opde ghewoonte, dan opde reden die de ghewoonte maect.

*Elevation.*

Maer al ist dat wy hier gheseyt hebben, dat dese form des bolwercx de aldersterckste is dieder in bolwerckē vallen mach, soo en is daer by nochtans niet te verstaen, datmen se door * verkiefsinghe maken sal, ter plaats daermen de wallen na sijn wille teyckent, want om sulcke stercker form, souden ander bolwercken te crancker, als scherphouckigher ofte onplomphouckigher moeten wesen, twelck gheen voordeel en waer, overmidts den ervaren viant de stercker plaetsen laet berusten, ende de cranckste overvalt. Ten anderen soo begrijpmen niet meer wals min plaats.

3^e VOORBEELT.

Ital. A forbici.
Fran Entaille.
Nerroyant.

DER wallen inwendighe houcken scharp ofte onplomp genouch sijnde, connen oock versterckt worden sonder bolwercken, te weten met * inwendighe strijckhoucken deur het borstweer der gordine inden wal ghewrocht, als hier onder de twee strijckhoucken A, B, * strijckende deen des anders groote gordine, ende bolwercx gordine. De Italianen noemen sulcke manier der versterckinghe *à forbici* de Françoisen en *tenaille* dat soo veel te segghen is als tanghewijs, of opde manier van tanghen.

Dese

EXAMPLE 2

And to express the common quality of flanking more fully, it can be observed that when the bend lies in such a manner that we may draw the foreside of the bastion straight, as this second ground plan shows (as in Malta the bastion of St. Barbara ¹⁾, as in the printed figures thereof is shown), such a form is the strongest that can be in bastions, for the whole curtain may be perfectly scoured from the flanks upon both sides. Therefore, those who might think that the middle bastion has no shape as required by a bastion, because it has no projecting corner, it seems that they heed more the custom than the reasons that make the custom.

But although it be as we have said that this form of bastion is the strongest that may be, yet thereby is not to be understood that we should make them in a place where one may draw the walls according to one's own will, because, for such a stronger shape, other bastions should be made weaker, as more sharp-angled or less flat-angled, which were no advantage, because the practised enemy suffers the stronger places to rest, and falls upon the weaker. Moreover in this way with more circuit of wall less ground is included.

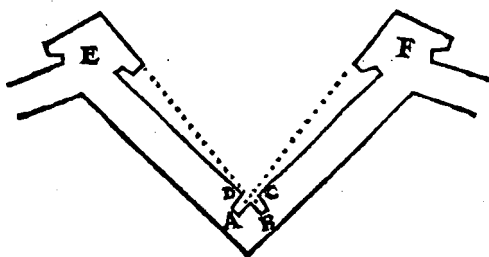
EXAMPLE 3 ²⁾

The re-entering angles of walls, being sharp enough, may be strengthened without bastions: to wit, with inward flanks wrought through the parapets of the curtains in the wall, as hereunder the two flanks A, B, the one flanking the large curtain and the curtain of the bastion of the other. The Italians name such manner of strengthening *à forbici*, the French *en tenaille*, that is to say, after the fashion of tongs. These inward flanks are vaulted by some, but noting the disadvantages

¹⁾ For the flat bastion St. Barbara of the fortress La Valetta in Malta see also note 1 p. 145.

²⁾ Here and on the following page, with figure, Stevin gives his solution for a tenail or tenailed front (see also note 1 p. 205).

STERCTENBOVWING.



Dese inwendighe strijckhoucken worden by eenighe overwelft, maer ghemerct de ghebreken : van dander overwelfde strijckhoucken ; daer int 7^e verschil des 6^{en} Hoofsticx afgheseyt is, soo en connen dese daer niet af bevrijt sijn.

Der wallen seer plompe inwendighe houcken, en sijn tot de versterckkinghe met * inwendighe strijckhoucken niet soo bequaem als dander, *Aforbici.* om dat de houcken ghelijck C en D, verstrekkende voor *schutsels, aldan *Oreillons.* te scherp ende cranck vallen, daerom machmender oirboirlicker een bolwerck legghen nade manier des 1^{en} ofte 2^{en} voorbeelts.

Hoe wel dese manier van versterckkinghe een goet ghelaet heeft, ende bequaem can wesen daer de noot dringt, nochtans en moet men se, als sommighe willen, by * verkiesing niet veroirdenen, ter plaets daermen sijn *Elefionem.* vrijhey heeft, want by aldien datter een rechte gordine laghe vant bolwerck E totter bolwerck F, sy soude voor de selve bolwercken plomper houcken connen veroirfaken : Ten anderen van minder cost sijn dan dese twee : Ende ten derden meerder plaets begriipen.

3^e VERSCHIL VAN VERSTERCKINGHE der Wallen, met uytwendighe houcken.

1^e VOORBEELT.

WANNEERMEN hem ghevoughen moet na uytwendighe houcken, soo connen de * spreghelinghen daer af verscheyden vallen, *Contemplationes.* na gheleghenthey van haer scherpte ofie plompheyt, met ander omstandighen. By aldien den houck als A B C soo plomp of onscherp waer, datmender een bequaem bolwerck voor conde legghen, diens voorhouck als D plomp of onscherp ghenouch soude vallen, ende dar boven dien de langde der gordinen A E, C F, sulck bolwerck daer vereyschte, soo waert beier daer een te brenghen dan gheen, om drie merckelicke redenen.

Ten

of the other vaulted flanks, which are described in the 7th difference of Chapter 6, they cannot thereof be free.

The very flat angles of re-entering walls are not so easily made strong with inward flanks, as the others, because the angles C and D, standing in place of orillions, fall out then too sharp and weak; therefore we had better make there a bastion as in examples 1 and 2.

Although this manner of fortification looks satisfactory, and may be fit in case of need, yet we must not, as some would have us, make it by choice in a place where one has full freedom, for if there lay a straight curtain from bastion E to bastion F, it would cause the same bastion to have flatter angles. Secondly, it would be of less cost than these two, and thirdly it would enclose more ground.

3rd DIFFERENCE

Concerning strengthening walls with salient angles

Example 1

When we must have salient angles, the consideration thereof may turn out to be diverse, according to the condition of their sharpness or flatness, with other circumstances. If the angle, as ABC, were so flat that we might lay a suitable bastion before it, whose forepoint, as D, would fall out flat enough and that furthermore the length of the curtains AE, CF, required there such a bastion, it were then better to make there one than none, for three notable reasons.

Natooyen.

Ten eersten soo connen de gordinen tusschen twee bolwerckē als A E, C F, elck van twee sijden * ghestreken worden, daerse sonder het bolwerck B D, elck maer van een sijde strijckin- ghe en cryghen.

Planct.

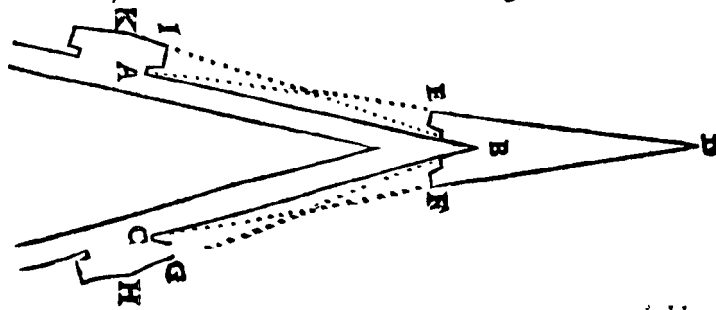
Cannoniers.

Ten anderen can- men de twee bol-

werckxgordinen G H, I K uijt * strijckhoecken strijcken, daerse anders soudē moeten ghestreken worden uijt eenighe plaetse der gordine, tusschen A E ende tusschen C F, welcke strijckin- g so goet niet en is, soo wel deur dien datmen om de afdakinghe der groote gordinens wille, de bolwerckx gordine ten deele niet sien en can, als datter schoens deur de groote gordine gheen bequame * borsgaten gheleyt en connen worden, als breeder verclaert is in des 6^{en} Hoofsticx 2^e verschils 2^e punt, oock in des 6^e Hoofsticx 8^e verschils 1^e voorbeelts ander punt. Ten derden, als men de bolwerckx gordinen G H, I K, strijckt uijt het middel, ofte uijt eenich ander punt der groote gordinen A E, C F, soo moeten die bolwerckx gor- dinen na dat middel of ander punt ghetrocken worden, waer deur de bolwerckx houcken H ende K, oock te scherper of onplomper vallen, en- de vervolgens te crancker sijn.

2^e VOORBEELT.Planes &
Orizont.

LAET nu den uijtwendighen houck A B C veel scherper sijn dan de voorgaende: Om opden welken een bolwerck te brenghen, diens * strijckhoucken ende schutsels haer noodighe breedte ende dicte



hebben,

First, by that means the curtains between two bastions as AE, CF, can be flanked each from two sides, whereas without the bastion BD each can be scoured but from one side. Secondly, the two curtains of the bastions GH, IK can be scoured from flanks, because otherwise they must be flanked out of some place in the curtain AE and the curtain CF, which flanking is not so good, because, for the shelving of the parapet of the large curtain, we cannot see part of the curtain of the bastion, and also because obliquely in the large curtain there cannot any convenient embrasures be made for that purpose, as is better shown in Chapter 6, 2nd difference, 2nd point; also in the said Chapter, 8th difference, 1st example, 2nd point. Thirdly, when we flank the curtains of the bastions GH, IK, from the midst or from any other point in the large curtains AE, CF, then those bastion-curtains must be drawn to that midst, or other point, by which the angles of the bastions H and K are too sharp and consequently weaker.

Example 2

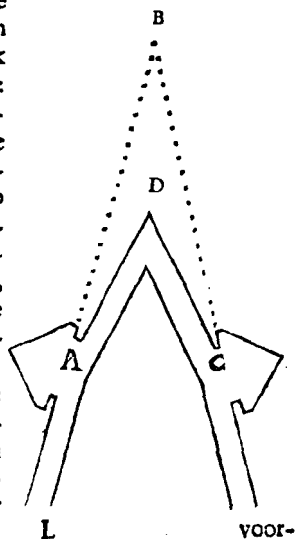
If the salient angle ABC is much sharper than the former, upon which to frame a bastion whose flanks and orillions have their necessary breadth and

hebben, soo valt den voorhouck als D veel te scherp, inder voughen datie niet alleen van ter sijden metter tijt en soude connen omme gheschoten worden: maer men soudele om haer dunheys wille, elcke mael wei deur en weer deur schieten: la sy en soude om die schoensheyt der * beschoey- *Scarpes.* felen haer behoorlicke hooghde niet connen cryghen. Het can oock ghebeuren, dat de twee linien E D, ende F D (soomen de strijckhoucken ende schutsels haer behoorlicke breedte en dichte gheeft) met malcander * eve- *Parallele.* wydich loopen, ofte hoe voordr ghetrocken hoe veel te meer van malcander wijcken: In sulcken ghevalle en cander opden houck B gheen oirboirlick bolwerck gheleyt worden. Twelck soo wesende, ende daer beneven besloten sijnde, datmen den wal of den houck A B C niet veranderen en wil, het waer beter den houck B, die onscherper is dan den houck D, sonder bolwerck te laten, dan daer op soo ghebreckighen bolwerck te brenghen, treckende dander twee bolwerck gordinen G H, I K, strijckelick uytreenich punt tusschen A B ende tusschen C B: Want hoe wel de gordinen tusschen C F ende A E, andersins van weder sijden ghestreken worden, soo cryghtmen (boven voorscreven ghebreck vande scherphuyt des bolwerck) twee gordinen als F D, E D, soo buyter maten lanck, dattet gheschor van C, tottet einde D misschien niet bequamelick en soude connen draghen.

3^e VOORBEELT.

MAER by aldien den houck B mach vercort worden, soo sijnder verscheyden manieren van verbeteringhe. Ten eersten den houck die te vooren stont an B, ghebrocht sijnde ter plaets van D, als hier nevens, soo is den houck A D C, veel beter dan den houck A B C, om die te laten sonder bolwerck: Ofte by aldien den houck D plomp ghenouch waer, om daer op een bolwerck te legghen, als int 1^e voorbeelt ghedaen is, welverstaende soot de plaets toelaet, dat is, soo de groote gordinen niet te cort en vallen, ende dat de drie bolwercken niet al te na malcander en quamē, twelck veroirsaken mocht, niet alleen groote cost om weynich wals te bewaren, maer oock scherphouckighe quade bolwercken.

Soomen de drie voorscreven bolwercken als A, C, ende rghene datmen an D wil hebben, al even sterck begheerde (ghelijckmen oock behoorde te doen, ten waer dat de omlyghende plaetsen het een bolwerck meer



thickness, the forepoint D falls out much too sharp, so that not only it could be shot down from aside in course of time, but it might because of its thinness with every shot be shot through and through, yea it could not for the obliqueness of the scarp, or wall, attain to the height it should do. It may also happen that the two lines ED and FD (if we give the flanks and orillions their necessary breadth and thickness) run parallel, or even how further forth they were drawn out, the further they diverge. In such a case, upon the angle B there can no fit bastion be laid. Which so being, and concluding that we will not alter the wall, nor the angle ABC, it were better to leave the angle B, which is flatter than D, without a bastion than to make such a faulty bastion upon it, drawing the curtains of the two bastions GH, IK to be flanked from a point between AB and CB. For although the curtains between CF and AE are otherwise flanked on both sides, yet (besides the above disadvantage of sharpness of angle) two curtains as FD, ED fall out so extremely long that the ordnance at C would not conveniently carry unto D.

Example 3

But if the angle B may be shortened, then there are diverse manners of improvement. First the angle that stood before at B, being brought as is seen here unto D, then the angle ADC is much better than the angle ABC to be left without a bastion. Or if the angle D were flat enough to set a bastion upon, as is shown in example 1, to wit, if the place would permit, that is, if the large curtains were not too short, and the three bastions were not too near each other, which might cause, not only great cost to defend a little part of wall, but also poor, sharp-angled bastions.

If we desire to have the three bastions, as A, C and the one we intend at D to be alike strong (as we ought to do, unless the grounds about the place did give the one bastion more advantage than the other) we should bring

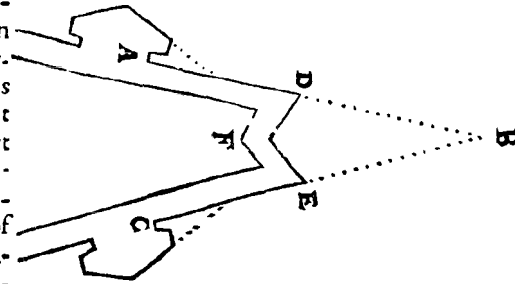
voordeel gaven alst ander) men soude metter punt D soo na A C moeten comen, tot dat haer voorhoucken al even groot vielen, want neenit ghy eenich bolwerck plomper, een ander sal moeten te scherper vallen, welck achterdeel waer: Boven dien soo sijn drie evenhouckige bolwercken van meeste begrijp, wel verstaende grootheyt der vlacken * everedenlick ghe-nomen na langde der wallen.

Proportionale.

4^e VOORBEELT.

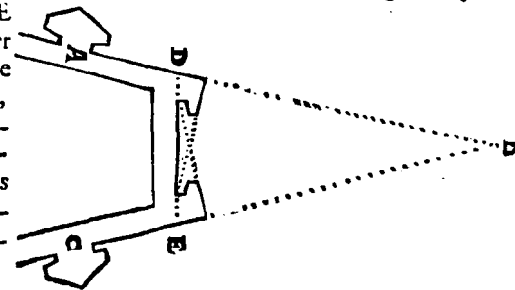
Noch canmen den scherpen houck ABC, bequamelick veranderen in twee evegroote plompe of onscherper houcken, als hier nevens de twee honcken D E, veroitsakende den inwendighen houck F, welke met *inwendige strijckhoucken versterckt can worden, na de manier des 2^{en} voorbeelts vant 2^e verschil. Voort machmen de houcken D, E, laten sonder bolwercken, of daer op heele of halve bolwercken brengen, na gheleghentheyte vande langde der gordinen ende ander omstandighen.

En tenaille.



5^e VOORBEELT.

Andersins machmen den houck ABC noch vercorten met een rechte lini DE, makende daer mede twee evegroote plomphoucken als ADE ende CED, daer op legghende twee heele bolwercken, soot de gheleghentheyte der omstandighen lyden wil, dies niet twee halve bolwercken als hier nevens.



6^e VOOR-

point D so near unto AC until the forecorners fall out equal, for if you take one bastion flatter, the other must be sharper, which were a disadvantage. Furthermore, three equiangular bastions are of most enclosure, to wit, the size of the planes being taken proportional to the length of the walls.

Example 4 ¹⁾)

The sharp angle ABC may yet conveniently be altered into two equal flat or unsharp angles, as shown here by the two angles D and E causing the re-entering angle F, which with inward flanks may be strengthened after the manner of example 2, in the 2nd difference. Furthermore, we may leave the two angles D, E without bastions or make upon them whole or half bastions as the length of the curtain and other circumstances will permit.

Example 5 ²⁾)

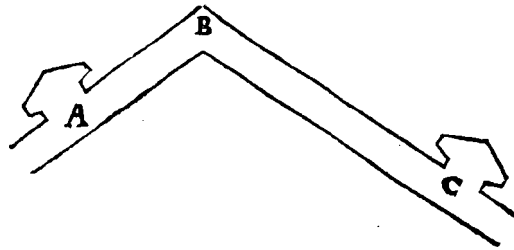
Or else, we may shorten the angle ABC with a straight line DE, making therewith two equal flat angles as ADE and CED, making upon them two whole bastions if circumstances permit; if not, two half bastions, as in shown here.

¹⁾ This figure again represents a tenail, but of a simpler form than that represented on folio 75.

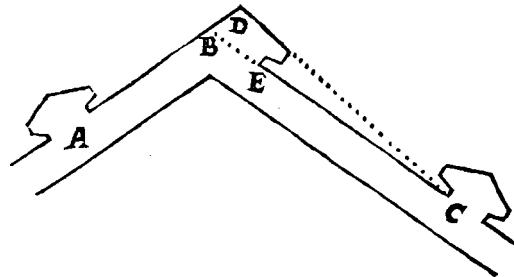
²⁾ This figure gives the solution in the form of a horn-work, but not as a horn-work by itself; Stevin was no advocate of this and other outworks and also rejected the ravelins (for this see also Brialmont, Steichen pp. 115 and 116 with the notes).

6^e VOORBEELT.

GHENOMEN datter een wal sy, hebbende een uijtwendighen houck A B C, met twee bolwercken A C: Doch alsoo dattet bolwerck A, te na light den houck B, ende het bolwerck C, te verre vanden selven houck B, daerom soudemen op B wel begheeren een bolwerck te legghen, alsoo dat de gordine B C verkorte, ende van beyde sijden mochte *ghestrecken worden: Maer dat bolwerck daer ligghende, soo sal de gordine A B die nu niet lanck ghenouch en is, dan noch corter wesen. *Natye.*



Om dese twee ongevallen t'samen te voorkomen, men soude op den houck B, bequamelick meughen brenghen een half bolwerck als hier onder, want daer mede verlangt de gordine A B van B tot D, ende dander gordine B C verkort van B tot E.



7 VOORBEELT.

By aldien datter erghens een bolwerck te legghen waer voor een oude wal ofte poorte, ghelijck tot veel plaetsen ghebeurt, soo behoortmen acht te nemen op de nevenstaende uijtsteekselen ofte houcken, sooder eenighe sijn, des wals, ende trecken de voorsijden des bol-

Example 6

Suppose there be a wall that has a salient angle ABC, with two bastions A, C, such that bastion A lies too near angle B and bastion C too far from angle B; therefore at B one would have a bastion made, so that it might shorten the curtain BC and might be scoured upon both sides. But that bastion having been laid there, then shall the curtain AB, which is now not long enough, even be shorter.

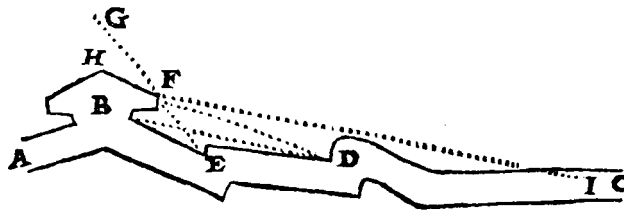
To prevent these two inconveniences together, we might upon the angle B fitly place a half bastion as hereunder, for therewith does curtain AB lengthen from B unto D and the other curtain BC shorten from B to E.

Example 7

If there were a bastion to be made before an old wall or gate, as happens in many places, then we must consider the near projections or corners, if there be any, in the wall, and draw the foresides of the bastion from such a projection

wercx op foodanighen uijsteeckfel, daer de selve sijden bequamelicx of meughen ghestreken worden, doch den voorhouck haer behoerlike plompheyt cryghende. Laet by ghelijcknis A B C een wal sijn, daer een bolwerck voor moet gheleyt worden ter plaets van B, welke wal heeft twee uijsteeckfelen D E: Ghenomen nu dattet uijsteeckfel E soo na B staet, dat om de bolwercx gordine daer uijt te trecken, sy soude moeten comen van E tot G, t'welck al te scherphouckighen bolwerck soude maken: Ghenomen oock dat I daer af te verre ende buyter schote light: Maer het uijsteeckfel D, light, neem ick, in bequame langde van B, ende Haer lini D H maect een goeden plompen bolwercx houck. In sulcken ghevalle ist beter de bolwercx gordine F H, van het uijsteeckfel D strijckelick te trecken, dan van eenighe ander plaets, want beneven dattet punt I te verre is, soo en cander schoens over het borstwee gheen goede besichermis comen, als breeder verclaert is in des 6^m Hoofsticx 2^e verschils 2^e punt. Maer int uijsteeckfel D, machmen, soomen wil, een bequaem en *strijckhouck leggen, *met bosgaten daer doormen de bolwercx gordine F H, tot den gront toe strijcken can.

Flanc.
Cannoniers.



4^e VERSCHIL VAN DER RIVIEREN

*oft vaerden bequaemste in ende uijtcomst,
inde grachten der sterckten.*

Chemins couverts.

WANTTET tot veel plaetsen ghebeurt, datter op deen sijde der sterckten rivieren of vaerden inden gracht comen, ende op een ander sijde wederom daer uijt loopen, soo isser verschil van haer bequaemste uijt ende incomst. Sommighe sijn gheleyt teghenover de houcken der bolwercken, als hier onder de vaerden A, B, teghen over de houcken der bolwercken C, D. Maer de *bedeckte weggen (wel verstaende der stercken diese hebben) worden daer mede ghebloot ende ontvrijt: Want eenen staende ter plaets van E, F, G, of H, siet de bedeckte weggen I, K, L, M, van t'beghin totten einde toe: Daerom de viant tot sulcke plaetsen als E, F, G, H, of inde rechte linien daer deur ghetrocken als N O, schantsen ghecre-

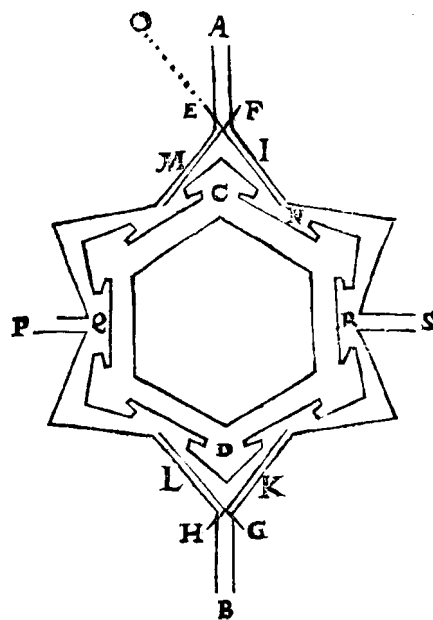
that the same sides may be more conveniently flanked thence, but the forepoint acquiring the flatness it ought to have. For example, let ABC be a wall before which a bastion must be laid at the place B, which wall has two projections D and E: Suppose that the projection E stands so near B that to draw the curtain of the bastion thence, it must lie upon the line from F to G, which would make too sharp-angled a bastion. Suppose also that point I lies too far away and out of shot. But the projection D, I take it, lies in a fit place from B and the line DH makes a good flat angle of a bastion. In such a case it is better to draw the curtain of the bastion FH to be scoured from the projection D than from any other place, for besides the point I being too far, can there no good defence be made obliquely over the parapet, as is better expressed in Chapter 6, 2nd difference, 2nd point. But in the projection D we may, if we will, make a convenient flank, with embrasures, out of which the curtain of the bastion FH may be scoured to the ground.

4th DIFFERENCE

Concerning the most fitted entrance and exit of rivers and canals
into the ditches of the fortresses

Since it happens in many places that upon one side of a fortress there come into the ditch rivers or water-courses, which pass out again at the other side of the fortress, there is a question of the fittest outgoing and incoming of the same. Some are laid over against the corners of the bastions as hereunder the water-courses A, B over against the angles of the bastions C, D. But the covered ways (to wit of the fortresses that have them) therewith are laid open and stand unguarded. For, one standing at the place E, F, G or H, sees the covered ways I, K, L, M, from the beginning unto the end. Therefore the enemy at such places, as E, F, G, H, or in the straight lines drawn through them, as NO,

ghecreghen hebbende, soo en sullen de belegherde die bedecte weggen tot haer voordeel niet connen ghebruijcken: Ia man voor man gherekent, soo isser meerder voordeel ende sekerheyt ter plaets van E, of inde lini E O, dan opde bedecte wech I, want by E, ofte inde lini E O, heeftmen het velt om wijt en breed te verlooopen, maer opden smallen wech I, machmen * gheftreken worden vant een einde des wechs tottet ander, *Nettys.* sonder datmen inde breedte verlooopen can. Om dit ongheval te voorkomen, soo veroirdenen ander de uijt ende incomst der vaerden, bequaemlicker teghenover het middel der groote gordine, als de vaerden ter plaets van P Q ende R S.



Merckt wijder, dat by aldien het incommende water sijn oirspronck uijt hooghe landen hadde, alsoo datter met reghen en snee hooghe vloeden maeckte, die veel modder, sant, ende anwas mede brenghen, ende dat daer benevens de menichte des waters, verleken byde grootheyt des grachts, soo cleen waer, datter inde grachten gheen merckelicke stroom en maeckte, om die in gheduerighe diepte te houden, maer datter ter contrari die vervulde: In sulcken ghevalle ist goet, het stroomken met een

having made trenches, the besieged then cannot use the covered ways for their profit. Yea, reckoning man for man, there is more advantage and safety at the place E or in the line EO than in the covered way at I, for at E or in the line EO, one can run away in the field wide and broad, but upon the narrow way I the besieged can be scoured from one end unto the other, and cannot help themselves by any breadth of ground. To prevent this disadvantage, others are of opinion that the incoming and outgoing of water courses can be laid fitter opposite the midst of the large curtain, as the water courses at PQ and RS.

Further note that if the incoming water course had its source in high grounds, so that with rain and snow it made high floods, which bring with them much mud, sand and silting-up, and that, besides, the quantity of the water, compared with the size of the ditch, were so small that in the ditch there was no current to keep it at constant depth, but that contrarily it did fill it: In such a case it is good to pass it through the fortress with a conduit across the ditch, thus to

waterleyder over de gracht deur de sterckte te brenghen, om alsoo die geduerighe vervullinghe te schuwen. Maer den stroom soo groot ende sterck sijnde, datse al mede sleept watser inbrengt, ende de gracht in ghe-
durighe diepte houdt, soo en ist niet noodich die door sulcken waterley-
der te doen loopen.

Angaende ymant achten mocht, dat de plaets van dit vijfde verschil, soo wel soude schicken int voorgaende 6^e Hoofstuck, byde verschillen der volcommen sterckten, als int dit 7^e Hoofstuck bijde verschillen der onvolcommen: Hier op valt te bedencken, dat wy inde boveteven volcommen sterckte namen drooghe grachten, om voorbeelt te gheven van strijckhoucken met drie plaetsen, diens leegste den gront des grachts strijct, daerom heeft ons dit voorbeelt hier eyghentlicker ghedocht.

Flancs.

5^e VERSCHIL VAN HINDERLICHE
*hoogden die buyten de sterckten
moeten blijven.*

ALSSER buyten de plaets daermen een sterckte begheert, eenighe hinderlicke hooghe light, diemen om seker onghelighentheyten binnen de sterckte niet en wil vervaten, soo is de meyning van sommighe dattet onboir waer, teghenover die hinderlicke hooghe een bolwerck te brenghen: Ander willen het middel der groote gordine daer voor ghepact hebben, segghende die stercker te wesen dan het bolwerck, uijt oir-
saeck datse bewaert is met twee *strijckhoucken, daer elcke bolwerck gordine maer met een beschermten wort, t'welck sijn reden heeft: Maer by aldien op het bolwerck een hooghe *catte laghe, na de manier hier bo-
ven int 2^e Hoofstuck verclaert, om daer mede over die hinderlicke hooghe te meughen *heerschen, sulcx soude d'eerste meyning eenich voordeel gheven.

Flancs.

Catagiere.

*In verdorven
tael siet men
dormieren.*

TOT hier toe hebben wy gheseyt van halve bolwercken, van versterckinghe der wallen met inwendighe, oock met uijtwendighe houcken, vande uijt ende incomst der rivieren inde grachten, oock van hinderlicke hoogden die buyten de sterckten moeten blijven: Wat de rechte belangt, te weten daermen om ander beletselen de ghemeene reg-
ghelen vande volcommen sterckten niet volghen en mach, daer salmen men met een woort gheseyt, t'volmaeckste soo na commen als men can, soo veel *strijckelick stellende tot voordeel der sterckte, ende soo veel be-
deckende tot achterdeel des viants, als deur de omstandighen meughedick is. Doch alsoo dit alte ghemeen antwoort schynt, men mocht noch berheeren de manier ende verclaringhe hoemen van elck int besonder doen sal: Hier op segghmen, dat de form der plaetsen daermen de vol-
commen

Restoyable.

avoid the continual silting-up. But if the stream is so great and strong that it carries along with it that which it brings in, and that it keeps the ditch at constant depth, then it is not needful to cause it to run through such a water-leader.

If one should think that this fourth ¹⁾ difference might as well have been raised in the 6th Chapter among the questions of regular fortresses, as in this 7th Chapter among the questions of irregular fortresses, it is to be considered here that in the aforesaid regular fortress, we spoke of dry ditches ²⁾, to give an example of flanks with three places, whose lowest scours the bottom of the ditch: therefore, we have thought this example to be more proper here.

5th DIFFERENCE

Concerning inconvenient heights which must remain
outside the fortresses

If outside a place which we want to fortify there lies any inconvenient height which we do not want to include within the fortress, the opinion of some is that it were fit over against that troublesome height to lay a bastion. Some would have the midst of a large curtain placed before it, saying that it is stronger than a bastion, because it is defended by two flanks, whereas the curtain of a bastion is defended but by one, which has its reason. But if upon the bastion a cavalier were laid, as in the manner of building specified before in the 2nd Chapter, thence to dominate the said height, it would mean some advantage for the first opinion.

Hitherto ³⁾ we have spoken of half bastions, of the strengthening of walls with re-entering and also salient angles, of the outgoing and incoming of rivers into the ditches, also of awkward heights which must remain outside the fortresses: What concerns the rest, to wit, if because of other hindrances we cannot follow the common rules of regular fortresses, in these cases, to say it in one word, we should make them as regular as we can, with so much flanking of the fortress for its profit, and so much covering for the disadvantage of the enemy, as circumstances will give leave. Yet, as this seems too common an answer; we might desire an explanation of the manner how everything should be particularly handled. To this it may be said that the shape of the places whereupon we can make the regular fortresses is simple, but the diverse shapes of the others are,

¹⁾ The original text gives "fifth", which must be "fourth" (difference).

²⁾ We also mentioned Stevin's dry ditches in regular fortresses and striking angles with three places in note 3 on p. 125.

³⁾ Linking up with the first two paragraphs of folio 83 Stevin gives here a separate argumentation, which at the same time forms an introduction to a detailed explanation about the geology of his time, preceding the Differences 6—10. This argumentation contains among other things the curious remark about the desirability that somebody should collect various plans of fortresses with a review in good Dutch, so not in terms like "counterscarps, flanking, sapping". Dijksterhuis also stresses this lively passage in his book on Stevin, page 234.

commen sterckten op maken can, eenvoudich is, maer de verscheyden formen van dander, sijn, soo te segghen, sonder einde, daerom sulcx te beghinnen, het waer genouchsaem een oneindelick werck anghewangen. Wel soude my dit ghefallen, datmen by een vergaerde, de attheykeningen die door ettelicke uijtghegheven sijn, van verscheyden soodanighe wesentlicke sterckten, diemen tot sommighe plaetsen dadelick ghemaect vindt, met Neerduytsche verclaringhe van t'ghene daer in na de wijze deses tijts welghedaen, ofte ghebreckich is: Maer ick vreesende of den Drucker de papieren eintlick den Apotekers tot peperhuijckens moest vercoopen, als niet wetende hoe langhe de Neerlanders liever sullen segghen ghelijck papegaeyen, *contercherpen*, *flanckeren*, *Zapperen*, dan als menschen met kennis der *sake*, *cabeschoeyfels*, *strijcken*, *graven*, hebbe mijn aerbeydt, ende des Burgmeesters de Grootens voorder onkosten ghespaert, daer hy ten ghemeenen oirboire meer dan middelmatich toe gheueycht is.

Latende sulcx dan berusten tot, soor lucken wil, een andermael, sullen in plaets van soodanighe besonder voorbeelden, ettelicke *ghemeene verscheillen stellen vande voordeelen ende achterdeelen in verscheyden ghelegentheden der plaetsen, daermen sterckten op bouwen wil, als platte, berchachtighe, drooghe, waterighe landen, en dierghelijcke, maer sonder te besluijten welcke ghelegentheden de oirboirste sijn, want * meen teghen is van weder sijden soo veelderhande, dattet oirdeel daer af duyster ghenouch vallen soude. Tprouffijt datmen uijt dese onbesloten verscheillen rapen mach, is dit: De ghene die vande ghelegentheden der sterckten wil spreken, of * strijden, ofte die erghens een sterckte begheeren te veroidenen, vinden hier int corte by een vergaert, voordeelen ende achterdeelen die daer op loopen, oock t'ghene voor het bouwen oirboirlick mach overleyt worden, ende dat na de meining der * schrijvers, die nu tertijs de ervarenste in die * itof gheacht worden, uijt wercke ick de selve verscheillen int corte versaeint hebbe.

Generales quaestiones.

Pro & contra.

Argumentari.

Autorum.

Materia.

Wy sullen dan eerst beghinnen vande sterckten op even platte landen, maer want de selve tweederley sijn, sommighe op de hooghden, welcke haer evenheyt (ick spreke van seer ghelijcke * stichteindersche evenheyt) somwijlen door eenich onbekent gheval hebben, ander die haer evenheyt criighen inde leegghden, deur de rivieren, ende dat vande laetste soorte hier t'voornemen is te scrijven, soo sal ick eerst de manier van haer anwastinghe verclaren, op dat deur kennis van dien, der * Bouwmeesters meyninghen, ende soodanich landts eyghenschappen tot dese sake dienende, te beter bekend meughen sijn.

Horizontalis planitie.

Architectura.

Het is te weten dattet reghenwater, ende noch meer het ghedoejde sneewater, met grooter overvloet vande hooghden na de leegghden valt, van

so to say, infinite. Therefore, to begin it were to take in hand an endless work. It would please me well if one collected the drawings that some have published, of diverse such actually existing fortresses, which are found ready in some places, and having a Dutch explanation of all that is good and bad performed in them, according to the manner of the present time. But I, fearing that the printer might at last sell the papers to the apothecary for pepper bags, as not knowing how long the Dutch will, like parrots, rather say *conterscherpen*, *flanckeren*, *zapperen*, than as men with knowledge of the matter, *cabeschoeysels*, *strijcken*, *graven*, have spared my labour, and Burgomaster de Grootens ¹⁾ further expenses whereunto he is inclined more than can reasonably be expected, for the benefit of the community.

Leaving it then for a while until ²⁾, if it will so happen, another time, we shall instead of such special examples put several common questions of the advantages and disadvantages of the diverse sites and situations of the places whereupon we will build fortresses, as plains, hills, dry and watery lands, without concluding which are the best, for there are so many pros and cons upon either side, that the judgment thereof would fall out dark enough. The profit that we may get out of these undecided questions is this: Those who want to speak or argue of the situation of the fortresses, or who desire to make a fortress anywhere, will find herein briefly gathered together the advantages and disadvantages inherent therein, also that which for the building must be fitly considered, and that according to the opinion of the authors who at this day are considered the most practised in this matter, out of which ³⁾ I have briefly collected the said differences.

We will first begin with the fortresses upon plain even grounds, but because the same are of two sorts, some upon high grounds, which have their evenness (I speak of horizontal evenness) sometimes through an unknown reason, others that get their evenness in low grounds, by means of rivers, and since it is my intention here to speak of those of the last sort, therefore I will first declare the manner of accretion of these low grounds, to the intent that by knowledge thereof, the master builders' opinions and the properties of the said land serving to this end, may be better known.

It is to be understood that the rain water, and even more the thawed snow water falls down in great quantities to the low grounds, and thence continually

¹⁾ For Stevin's personal friend and co-worker Johan Hugo Cornets de Groot, Grotius' father and burgomaster of Delft from 1591-1595, see for example Dijksterhuis, pp. 9, 130, 191, 201, etc.; A. Romein-Verschoor, *Vaderland in de verte*, Amsterdam, 1948, p. 17 ff.

²⁾ The beginning of the paragraph suggests that in the future such a collection of drawings or documentation will be realized. This may have been connected with Stevin's intention, which he cherished then already, one day to write a larger work about fortification. That he had this intention at least later on appears from the Dedication to the States General of his *New Manner of Fortification by means of pivotted Sluices* on December 21st, 1617; also quoted by Brialmont (Steichen, pp. 133, 134 with note 26: *Traité complet de fortification*).

³⁾ See Erratum, folio 91: "wercke" must be "welcke".

van daer eindlick na de rivieren, daer in mede brenghende eerde, cley, modder ende sulcke stof als van die beighen ende hoghe landen afghe-spoelt wort: Ende want dat dick water der rivieren hem seer verliest, om den grooten overvloed dier dan afcomt, soo loopt over de leeghe landen die daer nevens ligghen: Opde selve int breede commende, het verliest sijn sterke stroom diert inde nauwe rivier hadde inder voughen datter daer ghenouch als stille staende, sijn cleyghe moddenighe stof synckt te gronde, ende het water daer na al sachkens weder vertreckende, soo wordet landt voor dat mael van soo veel verhooght. Dese anwassinghe gheschiedt tot twee plaetsen, d'ene inde inhammen die hier en daer nevens de rivier ligghen, d'ander ant einde der rivier daerse inde Zee ofte int wijde comt, want het rivierwater daer oock sijn sterke stroom verlietende, laetter sijn dicke stof te gronde syncken. Altoo is Hollandt (daermen alle ander der ghelijcke by verstaen mach) ghewassen ant einde des Rhijns, deur de stof die den Rhijn van boven af brenghet: Alsoo is mer lanckheyt van tijt, het eertijck boven in Duytslandt deur reghen en snee wechghespoelt, inder voughen datter eintlick tot veel plaetsen niet dan harde dorre steenroeten, als de Alpes, ghebleven en sijn, van welke afgheespoelde stof, Hollandt, met dander inhammen nevens den Rhijn ligghende, haer anwas ghecreghen hebben, ende noch iaerlicx cryghen. Ende gelijk den Rhijn groot sijnde, uijt groote landen commende, grooten anwas maect, alloo sietmen metter daet de cleene rivierkens, ia fonteynen diens ghemeen water nau een voet breet en is, haer anwas kens voortbrenghen, groot na ghelegghentheyt der landen, diens affspoelinghe mer reghen en sneewater daer deur loopt. Vijt sulcke fonteinkens is in dese sake veel te leeren, want ghelijckmen deur cleyne gheschilderde clooten, diemen draeyt en keert daermen se hebben wil, bequamelick gheraect tot kennis vande ghedaente des grooten * Weereltcloots, alsoo comten deur cleine fonteinkens (diens stroomkens wy keeren en wenden soo wyse begheeren, ende ons voor * reetenschappen verstrecken, daer mede wy hier schuyringhe maken, ghinder een santplaetken doen wassen, elders modder vergaren en dierghelijcke) lichtelick tot kennis vande ghedaenten ende eyghenschappen der groote stroomen.

Sphaera mundi.

Instrumentis.

Maer om noch wat breeder van Hollandt te segghen, soo is te weten, dat doen eertijts den Rhijn deur Leyden voorby het huijs te Bretten in Zee liep, soo was doen den grooten Hollantschen anwas ant einde des Rhijns tot dier plaets, alsoo dattet selve huijs ettelicke mijlen van Zee lach. Maer doen daer na deur groote storm voor den Rhijn (ghelijck sulcx tot veel ander plaetsen ghebeurt) verstopping van een santplaet quam, alsoo datse by Vtrecht na de Lecke toe keerde, uijtlopende door t'gat ten Briele ende Goedereede, soo is van dien tijt af tot nu toe, den grooten Hollantschen anwas tot dien oirt gheweest, soo overvloedich, datter

towards the rivers, bringing with it earth, clay, mud, and such matter, as is scoured from the hills and high grounds. And because such water greatly raises the rivers, because of the great abundance that then descends, it floods the low land that lies next to it. Since the same water has a much greater breadth than it had in the narrow rivers, it loses the strength of its current which it had in the narrow river, so that it remains there almost stagnant, the earthy, muddy, clayey matter in it sinks unto the bottom, and the water afterwards thence running away softly, the land is this time so much heightened. This silting-up occurs in two places; one in the bays that lie here and there along the river, the other at the end of the river, where it runs into the sea, or becomes broad, for the river water, there also losing its strong current, suffers its matter to sink to the bottom. So has Holland (by which one may understand all other suchlike ground) grown upon the end of the Rhine, through the materials that the Rhine brings from the higher grounds. So also has the earth from above in Germany, in the course of time, by rain and snow, been scoured or rinsed away, so that at last in many places, nothing is left but bare hard rock (as in the Alps), of which eroded matter, Holland with other similar grounds, lying near the Rhine, has obtained its accretion and is yearly increasing. And as the Rhine, being great, coming out of large countries, makes great growth, so we see actually the small rivers and fountains whose common water stream is not above a foot broad, bring forth their little accretions, to an amount depending on the situation of the lands whose scourings with rain water and snow run through them. Out of such fountains in this matter is much to be learned, for as we, with small painted globes, which we turn and wind as we desire, easily attain unto the knowledge of the shape of the earth, we may similarly by small riverlets (whose streams we may turn and wind as we want, and provide us with instruments, making in one place scouring, in another place a sand shelf to grow, in another place collecting mud and the like) easily attain to the knowledge of the qualities and properties of great streams.

But to speak somewhat more of Holland, it is to be understood that heretofore, when the Rhine did run through Leyden into the sea at the house at Bretten¹⁾, then was the great increase and growth of Holland at the end of the Rhine as far as that place, so that the same house lay various miles from the sea. But when after that through great storms before the Rhine (as happens in many other places) a stopping or damming by means of a mud flat occurred, so that at Utrecht it turned towards the Leck, running out into the sea by the mouth at Brielle and Goederede, so has from that time until now, the great growth of Holland at that place been so abundant that at certain places there is high land,

¹⁾ By the "house at Bretten" Stevin meant the Brittenburg, for which we refer, not only to the book of Dijksterhuis, p. 172, but also inter alia to Byvanck, *Nederland in den Romeinschen Tijd*, Leyden 1944, II, 420 and figure 88, the picture published in 1567 or 1568 by Ortelius and which Stevin must have known; furthermore to Holwerda, *Afbeeldingen van de Brittenburg* and *De Rijnvesting van Karel de Grote*, both articles in *Archaeological Communications from the National Museum of Antiquities at Leyden*, 1927; finally to Fockema Andreae, Renaud and Pelinck, *Kastelen, ridderhofsteden en buitenplaatsen in Rijnland*, 1952, p. 25, where Holwerda's catastrophe theory is rejected, just as Beekman in his work *De Wateren van Nederland*, The Hague, 1948, page 117 (under Lek), rejects the obstruction of the mouth of the Rhine near Katwijk by drifting of dune sand. (Cf. Stevin, folios 84-85.)

datter tot ettelicke plaetsen hooge landen sijn, soo wel bedijckte als onbedijckte, daermen noch binnen menschen ghedencken met groote schepen voer. Ende dat anghewassen landt by t'huijs te Bretten ligghende, daer na sijn ghewoonelick onderhoudt van anghebrochte stof niet meer hebbende, is deur t'gheduerich schueren der Zee weder afghespoelt, alsoo dat den gront van t'selve huijs nu buyten t'duyns licht. Voort sulcken anwas alser comt ant einde des Rhijnsdeels ten Biele in Zee loopende, dergelijcken anwas isser oock ant einde des Rhijnsdeels by Campen inde Zuyderzee commende, t'welckmen daer de Yssel noemt: Inder voughen dat de Zuyderzee met lanckheyt van tijt, sooder gheen verandering van stroom en comt, teenemael landt sal worden, ghelijck eertijts gheweest heeft, deur t'welck den Rhijn sal loopen, ghelijckse nu door t'lant van Overijssel doet, ende de Zuyderzee vol sijnde, soo sal den anwas dan (midts datter als boven geseyt is, geen verloop vā stroom en comt, of met groote storm nieuwe deurbrake der duynen en geschiet) voortgaē buyten Texel ende Vlielant, want hoewel de buytezee daer nu wint, dat en sal niet gebeuren, als t'einde des Rhijns, dat overal sijne anwas mede brengt, daer sal gecommen wesen: Ende die sulcx niet toe en staen, dat comt deur ghebreck van kennis der oirsaken, want soo langhe alser stof van boven afcomt, ende datter landt daer vermindert, soo moet elders vermeerderen. Dit is den oirspronck vant roetsel des eertrijcx daer Aristoteles af vermaent, t'welck gelijk dander *beghinselen sijn geduerighe beweghinghe heeft, landt wordende daert eertijts Zee was (ghelijck de Zee schelpen dat betuyghen, die verre van Zee int eertrijck ghevonden worden) ende in Zee veranderende, daert voormael landt gheweest heeft. Angaende eenighe riuieren of fonteynen, die tusschen haer oirspronck ende de Zee, niet dan deur cluppen en steenighe gront en loopen, dat die ten einde daerse in Zee commen gheen anwas en brenghen, maer datmen daer ter contrari groote diepte vint, als tusschen de cluppen van Noorweghen ende dierghelijcke plaetsen, dat is in nateurlicke bekende reden ghegront, want als al de stof der hooge landen die nu anwas maecken, deur reghen en snee teenemael sal wechghespoelt sijn, ende dat de Alpes inde Zee sulen staen, ghelijck nu de cluppen van Noorweghen doen, soo sal daer dan derghelijcke ghebeuren. Wy soudē hier af noch veel menighen verhalen, als hoe ende waerom tot sommighe plaetsen niet dan sant en vergaert, tot ettelicke keyen en steen, tot ander weycke modder, elders harde cley, met de omstandighen van dien: Maer angesien datter ghenouch geseyt is, voor soo veel de sake der sterckte vereyscht, wy sullent daer by laten.

Aldus dan verclaert wesende de manier der anwassinghe vande leeghe landen, soo sijn daer uijt dese haer ghemeene eyghenschappen deur de oirsaken bekendt: Als datse onbedeyct wesende, met de hoochste vloedē onder water moeten ligghen, te weten met die hoochste vloedē, welcke

walled in as well as unwalled, where within the memory of men, they passed with large ships. And that new land, which lies near the house at *Bretten*, no longer having its usual growth of alluvial matter wherewith it was maintained, has through the continual fretting of the sea been washed away again, so that at this day all the grounds belonging to the house lie on the outside of the dunes. Furthermore, such a growth as occurs at the end of the branch of the Rhine, running into the sea at Brielle, the like growth is there also at the end of that part of the Rhine that runs at Campen into the Zuyderzee, which there is called the IJssel, so that the Zuyderzee in course of time (if there comes no change of current) will altogether become land, as it once was, through which the Rhine will run, as it does now through the land of Overijssel: and when the Zuyderzee is full, then (if there comes no altering or change of current as aforesaid, or with great storm a new breach should occur in the dunes) will the growth go forward beyond Texel and Vlielant, for although the sea there is now winning, this will not happen when the end of the Rhine, which brings its matter everywhere, has come thither. And if some do not allow this, it is for want of knowledge of the causes, for so long as there comes matter from above, and the land there decreases, it must needs in another place increase. This is the cause of the movement of the earth that Aristotle speaks of, which like the other elements, has its continual shifting, land being formed where before was sea (as the sea shells witness, which are found in the land far from the sea) and altering into sea where before was land. Concerning some rivers or fountains that betwixt their springs and the sea do not run but through rock and stony ground, that they at their ends, where they come into the sea, do not bring any growth, but that contrarily there is great depth found, as betwixt the cliffs in Norway and suchlike places, it is founded upon natural known reason, for when all the materials of the high lands, which now make the growth, by rains and snow shall be wholly washed away, and the Alps shall stand in the sea, as now the cliffs of Norway do, then shall the like happen there. We might hereof yet speak much more, as how and wherefore at some places nothing but sand gathers, at other places pebbles and stones, at other places soft mud, at other places hard clay, with the circumstances thereof. But since enough has been said, for so much as the matter of fortification requires, we will leave it at this.

The manner of the growth of the low grounds being thus explained, so are thereby known their common properties through the causes: as that they being unwalled, must needs with high floods lie under water, to wit with those highest floods, which commonly come (especially in Europe, and in the lands that do

ghemeenelick commen (immers in Europa, ende de landen die niet Zuydelicker en ligghen als Egypten) inde nawinters, of voorfomers: want by aldien de contrari ghebeurde, te weten datse met de hoochste vloeden niet onder en quamen, soo souden de hoochste vloeden soo hooghen oft hoogher anwas moeten ghemaect hebben als sy self sijn, t'welck na dit eenvoudich ansien onmeughelick is: Ick segghe na dit eenvoudich ansien, om datter verclaren der * uijtneminghen, meer woorden soude behouven dan wy hier gheschickt hebben te beschrijven. Ten anderen, soo is bekent waerom dat sulcke landen soo gantsch even sijn in ghenouch op waterpas ligghen: Ten derden waerom sy vet sijn: Ten vierden waerom sy ghemeenelick by een rivier ligghen: Ick seggh ghemeenelick eensdeels om dat de rivieren somwijlen verlopen: Ten anderen om datter tot etelicke plaetsen wel anwas comt van stroom die niet langher en ghebeurt, dan tot dattet reghenwater of sneewater al afgheloopen is. T'welck verstaen sijnde wy sullen tot de sake commen.

6^e VERSCHIL, VANDE VOORDEELEN

*ende achterdeelen der sterckten op plat
anghedassen landt.*

VOORDEELEN.

TEN 1^{en}, soo isser overvloedicheyt van goede vette eerde, om stercke wallen en catten te maken.

Ten 2^{en}, men can deur de rivier lichtelick met cleyne cost, alle nootlicheyt brenghen om de stercke te bouwen, oock al t'ghene de inghesetenen van dien daer na behouven.

Ten 3^{en}, het is vruchtbaer landt, t'welck bebouwet sijnde, gheeft overvloed van leefstocht voor den inwoners der stercke.

Ten 4^{en}, wanneer het rivierwater hoogher is als het landt, soo can men t'landt onder water brenghen, deur sluysen, of met den dyck deur te steken, om daer mede het leggher des viants te benonwen.

Ten 5^{en}, soo en is sulck landt het graven niet soo seer onderdaen, eensdeels om datter waterich is, ten anderen datmen de gravers van verre siet.

Ten 6^{en}, men can de stercken daer van form maken soomen wil, volmaecter dan op ander plaetsen.

Ten 7^{en}, den viant heeftier moeyte om hem te bedecken, hy wort van verre verhindert.

ACHTERDEELEN.

TEN 1^{en}, soo connen het 1^e, 2^e, 3^e, ende 4^e punt, oock strecken tot achterdeel der stercke. Wat het 1^e belangt, soo de eerde goet was
tot

not lie more southerly than Egypt) in the latter part of winter, or in the beginning of summer: for if the contrary should happen, to wit, that with the highest floods they should not overflow, then the highest floods should have made growths as high or higher than they themselves are, which to the simple insight is impossible. I term it simple insight, because the explanations of the exceptions would require more words than we are here minded to use. Secondly, it is known wherefore such lands lie even, yea level as water. Thirdly, why they are such rich soils. Fourthly, why commonly they lie on rivers. I say commonly, partly because the rivers sometimes alter their course: On the other hand, because in some places growth comes by means of a stream which continues no longer than until the rain water or snow water has all run off. Which being understood, we shall come unto the matter.

6th DIFFERENCE

Concerning the advantages and disadvantages of fortresses
upon plain silted-up land

Advantages

First, there is abundance of good rich earth, with which to make solid walls and cavaliers.

Secondly, we may by the river easily bring all necessities for the building of the fortress, as well as everything that the inhabitants need.

Thirdly, it is fertile land which, being cultivated, affords abundance of victuals for the inhabitants of the fortress.

Fourthly, when the river water is higher than the land, then can the land be flooded by means of sluices or by cutting a hole in the river dike to trouble therewith the army of the enemy.

Fifthly, such land is not much subject to sapping and digging, partly because it is watery, and partly because the diggers are seen from afar.

Sixthly, the fortresses may be made in it of what fashion one will, more perfect than in other places.

Seventhly, the enemy having trouble to cover himself, he may be hindered from doing it from afar.

Disadvantages

First, points 1, 2, 3 and 4 may also tend to be disadvantageous to the fortress. Concerning the first, as the earth was good to make strong walls, bastions and

tot stercke wallen, bolwercken en catten, sy is oock goet voor de viant tot stercke schantfen borstweeren en hoochden.

Ten 2^{en}, condemen deur de rivier lichtelick alle nootlicheyt brengen om de sterckte te bouwen, ende t'ghene de inghesetenen behoufden, soo sal de viant daer deur oock lichtelick connen brengen met cleene cost, al wat hy tot sijn legher behouft.

Ten 3^{en}, de vruchtbaerheyt des landts comt den viant oock wel te pas totter onderhoudt van sijn legher.

Ten 4^{en}, dat de belegherde het landt onder water connen brengen tot haer voordeel, dat can de viant soo hy meester vanden dyck is, self doen tot der belegherden achterdeel, hun daer deur benaut houdende met weynich volcx, ende daerentusschen met den meesten deel sijns leghers na ander voordeel trachten.

Ten 5^{en}, soo mach sulcken stercke (by aldien het inghelaten water dat niet en verhindert) van allen sijden bestormt worden.

Ten 6^{en}, sy is van groote cost, om datse groote bolwercken catten en grachten moet hebben, daer en is niet veel van selfs tot voordeel als inde gheberchten.

Ten 7^{en}, alsoo de gront weyck is, het can licht ghebeuren datter een bolwerck of wal invalt, die op corten tijt, noch met cleyne cost niet en can hermaect worden.

7^e VERSCHIL VANDE VOORDEELEN *ende achterdeelen der stercten op gheberchte.*

VOORDEELEN.

TEN 1^{en}, sy sijn versckert deur de omliggende oneven diepten ende valleyen, teghen peerden, schantfgraven, ende groot gheschut.

Ten 2^{en}, sooder eerde ghenouch is, de stercke can met minder cost eer ghemaect wesen dan op de platte landen, want sy en behouft soo groote grachten, bolwercken, wallen noch catten niet, dier ghemeenelick van selfs sijn.

Ten 3^{en}, de viant moetter seer verscheyden ligghen, waer deur deen hoop dander in tijt van noot niet lichtelick helpen en can.

ACHTERDEELEN.

TEN 1^{en}, de omliggende oneven diepten ende valleven des voorgaenden 1^{en} punts, can de viant oock tot sijn voordeel ghebruycken, om bedestelick deur de leegheden te commen, ende de stercke met onverhoede stormen te overvallen.

Ten 2^{en}, alle nootlicheyt soo wel om te bouwen als onderhouden, en

cavaliers, it is also good for the enemy to make strong trenches, parapets and heights.

Secondly, if by the river we can bring all things necessary for making the fortress and that the inhabitants have need of, so can the enemy by it also easily with small cost bring all that he has need of for his army.

Thirdly, the fertility of the soil will also well serve the enemy for the maintenance of his army.

Fourthly, as the besieged may flood the land for their benefit, so likewise may the enemy, being master of the dike, to the disadvantage of the besieged, keeping them thereby short with few people, and with the greatest part of his army seek a further advantage.

Fifthly, such a fortress (if the water let in does not hinder it) may be assailed upon every side.

Sixthly, as it is very expensive, because it must have great bastions, cavaliers and ditches, there is not much advantage in it, as in the hills.

Seventhly, because of weakness of the ground, it may happen that a bastion or a wall may fall into the ditch, which cannot again be repaired quickly and with little cost.

7th DIFFERENCE

Concerning the advantages and disadvantages of fortresses upon hills

Advantages

First, they are protected by the uneven depths and valleys lying round about them, against horsemen, trench making¹⁾, and great ordnance.

Secondly, if there be earth enough, the fortress may be made with less cost than upon plain ground, for it does not need such great ditches, walls or cavaliers, because commonly they are there of themselves.

Thirdly, the enemy must lie greatly dispersed, through which one regiment or quarter cannot easily help the other.

Disadvantages

First, the uneven depths and valleys round about, spoken of in point 1 before, may be used also by the enemy for his profit, to pass under cover through the depths, and scale the fortress unawares.

Secondly, all necessary things, both for building and maintenance, cannot be

¹⁾ By "Schantgraven" Stevin must here have meant the systematic attack by means of trenches (sapping; see Part 3: *Of besieging Towns and Fortresses*).

worter niet ghebrocht dan met groote moeyte ende cost.

Ten 3^{en}, de hooghden hebben ghemeenelick ghebreck van water.

Ten 4^{en}, sy sijn het graven onderdaen.

Ten 5^{en}, sy lyden schade vande reghen, deur dien de eerde ghemeenlick daer soo goet niet en is, als van plat anghewallen lant, oock om dattet reghenwater daer met meerder ghewelt schuert.

Architellus.

Ten 6^{en}, de * Boumeester en can de form niet kiezen diet hem belieft, maer moet hem na de ghelegenthenthey ghevoughen, nemende meer plaets dan hy van doen heett, ofte min dan hem behouft.

8^e VERSCHIL, VANDE VOORDEELEN

ende achterdeelen der stercken in Zee.

VOORDEELEN.

TEN 1^{en}, als sy 1500. voeten van landt ligghen, sijn verskert voor groot gheschut.

Ten 2^{en}, sijn verskert teghen t'begraven.

Ten 3^{en}, sijn verskert teghen het bestormen, want men can niet licht beletten datse haest hulpe krijghen.

*Munitie de
guerre.*

Ten 4^{en}, sy en behouven gheen costelicke holwercken.

Ten 5^{en}, sy en behouven gheen groote voorraet van leeftocht, * krijchtuych, noch van volck, alsoo alles daer lichtelick ghebrocht can worden.

Ten 6^{en}, sy en connen gheen groot perikel verwachten van t'gheschot op schepen, want die cranck sijn, ende onseker deur de beweghinghe der Zee, maer connen die schepen eer self beschadighen.

Ten 7^{en}, men cander schepen houden om de stercke te bewaren, ende om den viant self daer mede te quellen.

Ten 8^{en}, men cander een coopstat af maken, oock handiwerck luyden ende neeringhen in onderhouden.

ACHTERDEELEN.

TEN 1^{en}, sy en connen gheen goede grentse sijn van t'vaste landt, om datmen daer niet alijt vrijelick uijt comen en mach.

Ten 2^{en}, het peerde volck cander luttel voordeel doen, om de moeyelichey der oversettinghe.

9^e VERSCHIL VANDE VOORDEELEN

ende achterdeelen der stercken ande Zeecant.

VOORDEELEN.

TEN 1^{en}, soo sijnse deelachtich vande voordeelen die de sterckten hebben heel in Zee ligghende, voornaemlick int 5^e, 6^e, 7^e, ende 8^e punt, oock vande ghene die heel int landt ligghen.

Ten

brought but with great difficulty and cost.

Thirdly, the heights have commonly lack of water.

Fourthly, they are subject to sapping.

Fifthly, they suffer damage from the rain, because commonly the earth there is not so good as in low silted-up plains, also because the rain water upon hills frets more than in valleys.

Sixthly, the master builder cannot choose the shape he wants, but must work according to circumstances, either occupying more place than he would, or less than he needs.

8th DIFFERENCE

Concerning the advantages and disadvantages of fortresses in the sea

Advantages

First, if they lie 1500 feet from the land they are protected against great ordnance.

Secondly, they are protected against sapping.

Thirdly, they are protected against assault ¹⁾, for they cannot easily be prevented from receiving assistance.

Fourthly, they need no costly bastions.

Fifthly, they need beforehand no great store of victuals, guns or people, because all things can easily be brought to them.

Sixthly, they cannot be greatly damaged by ordnance from ships, for their shot is weak and uncertain owing to the movement of the seas and they may more offend the ships.

Seventhly, they themselves may maintain ships both to defend the fortress and offend the enemy.

Eighthly, there may be made a merchant town and craftsmen and trade maintained in it.

Disadvantages

First, they cannot be good frontiers to the mainland, because men cannot at all times have free passage out of it.

Secondly, horsemen can do little service, because of the trouble of carrying them to and fro.

9th DIFFERENCE

Concerning the advantages and disadvantages of fortresses upon the sea side

Advantages

First, they are partakers of the advantages that those fortresses have that lie wholly in the sea, especially in points 5, 6, 7 and 8 and also of those that lie wholly on the land.

¹⁾ "Assault" must mean here a systematic siege with complete investment, for a sudden assault after heavy bombardment by warships will mostly appear possible.

Ten 2^{en}, de viant om die te belegghen moetter dobbel legher toe hebben, deen te water dander te lande.

Ten 3^{en}, sy can dienen tot grentle ter Zee ende te lande, want by aldient noot is, men cander soo wel houden volck te peerde ende te voet, als schepen van oorlooch.

ACHTERDEELEN.

Sy sijn in perikel van belegghert te connen worden, niet alleenelick van vianden die hun na by gheseten sijn, maer oock die van seer verre lande sullen commen, ende uijt verscheyden houcken des weerelts daer hulpe connen cryghen, ende haer volck an lant sullen meughen setten.

10^e VERSCHIL VANDE VOORDEELEN
*ende achterdeelen der stercken in marasch,
 wijt van landt.*

VOORDEELEN.

TEN 1^{en}, sy sijn sterck, men cander van gheen sijden ancommen.

Ten 2^{en}, sy en behouven gheen sware bolwercken, wallen noch catten.

ACHTERDEELEN.

TEN 1^{en}, sy costen veel van bouwen, om dat de eerde wijt moet ghehaelt sijn, ende datter quade grondt is.

Ten 2^{en}, sy hebben quade stinckende locht (voornaemlick inde heete landen) veroirsakende siecken der inghesetenen.

Ten 3^{en}, sy sijn licht om belegghen met weynich volcx, want de viant can een schants legghen an die sijde daer de beleggherde an landt connen commen: Inder voughen dat hoe sy om haer gheleghentheyte stercker schynt, hoe sy haer selven schadelicker is.

Ten 4^{en}, de macht der cloucke crygsfluyden diemen daer in leght om die te bewaren, of om den viant te beschadighen, en can niet int werck ghestelt worden.

11^e VERSCHIL VANDE VOORDEELEN
ende achterdeelen der drooghe grachten.

VOORDEELEN.

TEN 1^{en}, ghevluchte menschen soo wel crygsfluyden als landluyden met beesten en goederen, connen in tijt van noot in drooghe grachten beschermt sijn.

Secondly, to besiege such a fortress, an enemy must have two armies, the one by sea, the other by land.

Thirdly, it may serve for frontier both by sea and land, for if need requires, there may be kept in it foot and horse as well as men-of-war.

Disadvantages

They are in danger of being besieged, not only by enemies that dwell near, but also by those that may come from far countries, and can get help out of diverse parts of the world and can land their men.

10th DIFFERENCE

Concerning the advantages and disadvantages of fortresses in marshes,
far from the land

Advantages

First, they are strong, one cannot from any side come near them.
Secondly, they need no great bastions, walls or cavaliers.

Disadvantages

First, they cost much building, because the earth must be fetched from afar and the soil is unfit.

Secondly, they have evil stinking air (specially in hot countries), causing sickness of the inhabitants.

Thirdly, they are easy to besiege with few people, for the enemy can make a fortress, where the besieged have access to the land: So that how much stronger they seem to be for their situation, so much more vulnerable they are.

Fourthly, the soldiers or forces that are laid in them to defend them, or offend the enemy, cannot be set to work.

11th DIFFERENCE

Concerning the advantages and disadvantages of dry ditches

Advantages

First, fugitives, soldiers as well as countrymen, cattle and goods, may in time of need be protected in dry ditches.

Ten 2^{en}, sooder de viant hout in worpt om te vullen, men cant verbranden, maer isser eerde, steen of ander onverbrandelicke stof in geworpen, men cander een grooten deel af wechdoen, deur r'behulp der heymelicke uijtganghen.

*Corridor of strade
aperta.*

Ten 3^{en}, sooder inde sterckte volck ghenouch is, men cander tot sijn wille ingaen om de selve gracht te bewaren, oock om deur heymelicke uijtspronghen den viant te verrasschen, voornaemlick alsser een * bedecte wech is.

Ten 4^{en}, daer is op sulcke drooghe plaetsen ghesonder locht.

ACHTERDEELEN.

TEN 1^{en} soo de viant meester vande cade wort, hy sal de belegherde beletten beesten inde gracht te houden, ende meer ander voordeelen daer af te genutten.

Ten 2^{en}, men sal den viant alldan niet lichtelick connen beletten de gracht te vullen, daer in te graven, ende schantzen op te worpen, daer mede hy hem sal bewaren teghen de onverhoede anvalen der belegherde.

*In bedorven tacl
Zapperende.*

Fluets.

Ten 3^{en}, sy sullen door r'behulp van sulcke opgheworpen schantzen, al * voortschuppemde meughen commen tot anden voer van een bolwerck of gordine, om die af te worpen, deur de bequaemste middel die hun goetduncken sal, ende dat sonder vande * strijckhoucken te connen beschadicht worden.

12. VERSCHIL VANDE VOORDEELEN

ende achterdeelen der grachten met water.

VOORDEELEN.

TEN 1^{en}, sijne beter verskert teghen het ondergraven.

Ten 2^{en}, al heeft de viant de cade ghewonnen, hy en mach daerom inde gracht niet commen.

Ten 3^{en}, soo de viant het water wil doen afloopen, daer gaet veel tijts en aerbeyt toe.

Zapperinghe.

Ten 4^{en}, hy en mach de muer niet naerderen deur het behulp van opworpinghe van schantzen, ofte * voortschuppighe inde gracht.

Ten 5^{en}, soot loopende water is, ende dat hy daer in vlietende stof worpt, sy en blijft niet ter plaets daer hyse begheert.

Ten 6^{en}, worpt hy daer in sinckende stof, daer gaet veel aerbeyt en tijt toe, eer hy de gracht can vullen.

ACHTERDEELEN.

TEN 1^{en}, de viant cander bruggen op schepen brenghe.

Ten 2^{en}, de belegherde en connender soo bequamelick gheen heymelicke uijtvallen doen.

Ten 3^{en},

Secondly, if an enemy should cast wood into the ditch to fill it, the wood may be burnt, but if it be earth, stone or any other material that will not burn, a great part of it may be carried away via the sallies.

Thirdly, if there are people enough in the fortress, one can at will go into the ditch to defend it, and also to surprise the enemy by unexpected sallies, especially if there be a covered way.

Fourthly, upon such dry places there is healthier air.

Disadvantages

First, when the enemy is master of the counterscarp, he will prevent the defenders from keeping cattle in the ditch, or from enjoying any other benefit of the ditch.

Secondly, the enemy cannot then easily be prevented from filling the ditch, nor from digging in it, from casting up trenches with which he can defend himself against the sudden attacks of the defendants.

Thirdly, they can with the help of such cast-up trenches, by sapping, come to the foot of a bastion or curtain to throw it down, by the readiest means that they shall think fit, and without being offended by the flanks.

12th DIFFERENCE

Concerning the advantages and disadvantages of ditches with water

Advantages

First ¹⁾, they are better protected against sapping and mining.

Secondly ¹⁾, although an enemy has won the counterscarp, yet he cannot come into the ditch.

Thirdly ¹⁾, if the enemy wants to drain the water, it requires much time and labour.

Fourthly, he cannot approach the wall by casting up a trench, or by sapping in the ditch.

Fifthly, if it be running water, and if he casts any floating matter into it, it will not remain where he would have it.

Sixthly, if he casts any sinking matter into it, it will require great time and labour before he can fill the ditch.

Disadvantages

First, an enemy can bring bridges upon boats in it.

Secondly, the besieged cannot so conveniently make any secret sallies.

¹⁾ Compare the 3rd proposition: "Of the approach through the moat" in Part 3: *Of besieging Towns and Fortresses*, where only wet ditches are discussed.

Ten 3^{en}, het water vervriest inde coude landen soo sterck, datmender met veel volcx ende ander sware saken can overcommen.

Ten 4^{en}, het veroirsaeft inde heete landen quade locht.

INT voorgaende 11^e ende 12^e verschil sijn verclaert de voordeelen ende achterdeelen van drooghe, oock van natte grachten, ende hoewel der menschen sinnen daer af verscheyden sijn, deen dese dander die voor bequaemst achtende, doch overcommen sy daer in, darmen die grachten voor de beste behoort te houden, welckemen tot sijn believen met water can vullen, ende als men wil die wederom drooghe maken.

B E S L V Y T.

TOT hier toe is int corte bescreven t'ghene ick vande Stercttenbouwing voorgenomen hadde. Angaende alle dwalinghen die den ervaren Leser daer in vinden sal, ick wilde wel dat hijse met teghenscrijven (doch in plat Neerduytsch, sonder vermenghing van quade Barbarische woorden, die hy in sijns moeders tael beter heeft) an yghelick openbaer maeckte: Want hoewel het missen byde Millers voor schandelick ghehouden wort, hier teghen stel ick dattet byde eerlicke eerlick soude wesen, oirsaeck te sijn, dat dese stof uijt quade talen oock inde alderbeste gherochte.

E I N D E.

VERBETERT DE FAVTEN ALDVS:

inde	{	1 ^e	sydens	{	34 ^e	reghel, voor	{	ven	stelt	{	van
		4			1			commende			comt
		10			16			sijn			sy
		19			4			Sraete			Straete
		34			36			8 6 7 3 1 8 2			8 6 7 7 6 7 4
		37			14			nerdervelde			nedervelde
		48			27			houcke			houcken
		49			12			vijhouck			vijfhouck
		71			12			ter			der
		73			6			is des			is in des
		83			29			wercke			welcke

Thirdly, water freezes so strongly in cold lands that it is passable with many people and other heavy things.

Fourthly, in hot lands it causes evil air.

In the former 11th and 12th differences are set forth the advantages and disadvantages of dry and wet ditches, and although men are of different opinions thereon, one considering this most convenient, the other that, yet they agree that those ditches are to be esteemed the best which men at their pleasure can fill with water and, when they will, make them dry again¹⁾.

CONCLUSION

Up to this point a brief description has been given of that which I had intended to say about Fortification. As to all the errors which the experienced reader will find therein, I wish he would make them known to everybody in a reply (but in broad Dutch, without any admixture of bad barbaric words, which he has better in his native language). For though to err is considered disgraceful among those who err, I would say on the contrary that it would be an honour among the honourable to cause this subject matter to pass from bad languages also into the very best.

The END.

¹⁾ This verdict by Stevin, which ditches should be considered as the best, has been put into practice by Coehorn, namely in the fortress Bergen op Zoom. This contained constructions (drains and suchlike) for forming drainage systems, by which the ditches could be kept dry or wet at pleasure. Also in other ways Coehorn succeeded in combining the advantages of dry and wet ditches (see Van Kerkwijk, *Handleiding tot de Kennis van den Vestingbouw*, Breda 1861, pp. 93, 108).

1

2

3

NIEUWE MANIERE
VAN STERCTEBOU

DOOR SPILSLUYSEN

NEW MANNER
OF FORTIFICATION

BY MEANS OF PIVOTTED SLUICE-LOCKS

1. The first part of the paper discusses the importance of the study of the history of the United States.

2. The second part of the paper discusses the importance of the study of the history of the United States.

DISCUSSION

This book of Stevin's, which was first published in Rotterdam in 1617, will be printed in Volume V of *The Principal Works* and discussed as part of his writings on hydraulic engineering. That it is treated also in this volume is obviously due to the fact that, as appears from the title, it claims to be a work on the art of fortification; in fact it indicates considerable improvements for fortresses situated on the waterfront and provided with wet ditches.

In the general introduction on Stevin's military publications we stated¹⁾ that the *New Manner* does not contain a new system of building fortresses; nevertheless, we do not consider Brialmont's verdict exaggerated when, after an enumeration of the advantages of sluices for the defense, he writes: "en un mot: Stevin ouvre une voie nouvelle à la fortification"²⁾, although he follows up this statement by saying that the new system succeeded in overcoming the prevailing "routine" with great difficulty only. Stevin probably realized this when he gave up his plan of publishing his book as part of a completely new *Art of Fortification*³⁾, which, however, had not been completed in 1617. It is certainly regrettable that the other parts have got lost⁴⁾, for otherwise we would have known Stevin's opinion on the classical Dutch system, in this case that of Marolois. Now we can only assume — from what is revealed to us in this respect by the figures of bastions and ravelins in the *New Manner* — that he joined this system, as, indeed, he had done already many times in practice⁵⁾.

The use of "pivoted sluice-locks" or sluices with swivel-gates or mitred doors for civil and military purposes is, for the general principles, described in 12 "Examples" of Chapter 3 of the book, their application in some special cases in Chapter 4, while a note at the end of this chapter also describes the application of 9 of the above-mentioned Examples. What especially attracts the attention is Stevin's knowledge both of the Dutch (and many foreign) fortresses and of the hydraulic engineering conditions in his country. Brialmont, who, as regards the building of sluices, esteems him more complete than Belidor⁶⁾, stressed this fact already:

"Au lieu de corriger individuellement toutes les places de la Hollande, comme il le fit pour Calais et quelques autres villes, il se contente de les classer par catégories et d'indiquer pour chacune d'elles le système d'écluses qui lui paraît le plus convenable . . ." ⁷⁾.

¹⁾ General Introduction, p. 7.

²⁾ Brialmont, *Oeuvres militaires de Simon Stevin* (III. Nouvelle fortification par écluses), p. 131.

³⁾ See the Dedication to the States-General and Gen. Intr. p. 8 and note 21.

⁴⁾ *Materiae politicae*, Titles and Arguments (fol. 143): Chapter 7. About the Art of fortification. The author has described a method of fortification different from the one which was formerly published, but is missing. . . ."

⁵⁾ Gen. Intr. pp. 17-26: Stevin's designs for Harderwijk, Flushing, Batavia, The Hague and IJzendijke, of which only the first has been drawn according to his system of 1594; see also the last part of the Introduction to Part I.

⁶⁾ Brialmont, p. 131.

⁷⁾ Brialmont, p. 133.

Also Jähns, who says of Chapter 3:

"Es ist dies der wichtigste Teil des Buches, welcher das technische Verfahren der Niederländer, die es so gut verstanden, das Wasser für ihre Verteidigungszwecke zu verwenden, in allen Einzelheiten veranschaulicht", praises the classification as follows:

"Den Beschluss macht eine interessante Aufzählung und Einteilung von Städten der Niederlande unter dem Gesichtspunkte ihrer hydrographischen Situation . . ." ⁸⁾.

The repartition on folio 57 of the book, referred to by the two authors, is in broad outline as follows:

1. Towns (fortresses), situated on the sea or on a tidal water, such as Sluys, IJzendijke, Tholen, Vere, Zierikzee (all in Zeeland); Willemstad, Geertruidenberg (both in North Brabant); Rotterdam, Dordrecht (both in South Holland); Enkhuizen, Amsterdam (both in North Holland).
2. Towns situated on large non-tidal rivers, which have smaller rivers running into them, like Arnhem, Zutphen (both in Gelderland); Deventer, Zwolle (both in Overijssel).
3. Towns on a large tidal water, but so far away from it that an army camp can be pitched in between, such as Bergen op Zoom (in North Brabant); Middelburg (in Zeeland); Brielle, Schiedam (both in South Holland) ⁹⁾.
4. Towns as under 3, on large, non-tidal rivers, which have a small river running into them, such as Doesburg (in Gelderland).
5. Towns situated on large, non-tidal rivers, without having a small river running into them, such as Woudrichem, Heusden (both in North Brabant); Zaltbommel (in Gelderland); Kampen (in Overijssel); Emmerik, Rees (both on the Rhine in Germany and at that time fortresses of the Republic).
6. Towns far from large waters, but on small, mostly unnavigable rivers, such as Bredevoort (in Gelderland); Meurs (on the Rhine, as before); The Hague, Breda and the like.

In addition, on folio 57 some further special cases are mentioned in which the discharge of small rivers can be utilized to improve the moats, namely at Harderwijk (in Gelderland) and Lingën (in Westphalia), which was taken by Prins Maurice in 1597, while on folio 58 the discharge of the Rhine at Katwijk is represented as serving for ships to sail from Leyden to the sea as well as to discharge the waters of Rhineland. Together with the projects laid out for Calais, Flushing (in Zeeland) and Deventer (mentioned above under 2 already), each design being illustrated with two drawings of fortresses added in print, Stevin has consistently suggested improvements for the defence of 35 fortified towns situated throughout the Republic. Only a few of his figures are reproduced here.

⁸⁾ Jähns, *Gesch. d. Kriegswissensch.*, pp. 841-842.

⁹⁾ Wauwermans, *Napoléon et Carnot*, Épisode de l'histoire militaire d'Anvers, 1803-1815 (1888), p. 46: "Nul terrain mieux que celui d'Anvers ne se prête à l'application de la fortification par écluses, dont Simon Stevin a posé les principes, qui étend l'action défensive à très grande distance du rempart proprement dit de la place".

With respect to the categories 1-6, these improvements successively consist in the application of the examples described in Chapter 3 and mentioned below:

for the categories 1 and 2 the examples 2 (the construction of two pairs of pivotted sluice locks, see figure 2, fol. 51), 3 (as example 2, but each pair of sluices covered by a ravelin; see figures 3 and 4, fol. 53-54), 4 (as example 3, but with a water-mill next to each pair of sluices; see figure 5, fol. 55) or 5 (as example 3, but with another ditch round the town, also provided with two pairs of pivotted locks, covered by the same ravelin as the pair in the other ditch; see figure 6, fol. 56;

for category 3 example 6 (between the town, improved according to example 3, and the sea a harbour, along which on either side a defence wall and at the mouth a fort and, at a distance of more than 1500 feet, the necessary intermediate forts; see figure 7, fol. 33);

for category 4 example 7 (the town improved according to example 3 and the river passed through the centre of the town, with or without a pivotted sluice at the passage of the moat; see figure 8, fol. 35);

for category 5 example 8 (of the town improved according to example 3 the ditches are sluiced and the harbours are scoured by utilizing the fall on the river between the harbours, etc., see figure 9, fol. 37);

for category 6 example 9 (where the river flows into the town ditch a pivotted sluice; where it leaves the ditch a widened basin; see figure 10, fol. 39).

Of a non-military nature are examples 10 and 11, concerning respectively "houders" or basins, now called more frequently scouring basins¹⁰⁾ for scouring of harbours or for drainage, and the digging of waterways through areas "in which peat is cut", respectively. The 12th — and last — example, however (folio 45), which deals with scouring of waterways (river arms and estuaries) between two islands or between an island and the mainland, is partly of a military nature, because in Stevin's time — more than nowadays — situations occurred in which one of the islands or the mainland at a greater or lesser distance was in the hands of the enemy. This may appear from the indication of these situations, including: the Eendracht between the island of Tholen and the mainland of North Brabant, the Rode Vaart near Klundert, completely silted up in the 18th century and the Vaart through the Schor at St. Anna ter Muiden, near Sluis in Zeeland Flanders; this canal too has long since ceased to exist. Figure 15 (folio 46) indicates how Stevin hoped to achieve the objective by constructing two pairs of pivotted sluices, figure 16 (folio 48) shows how each pair could be protected by means of a fort.

To conclude this survey the following remarks should be made on the *ravelins* suggested by Stevin, which, together with the roughly indicated town walls¹¹⁾ and the forts¹²⁾, constitute the fortification elements proper of the New Manner. For further elucidation here has been reproduced the figure

¹⁰⁾ At Willemstad (in North Brabant) one still speaks of the East- and the West-houderdam. On July 6, 1615 the fortress was officially handed over to Prince Maurice, one of the conditions being that the Prince "should for all time repair and maintain the pier and the East-houderdam with the sluices and other works pertaining to them". (K. Dane, *Willemstad, Historisch overzicht van stad en polder* (Willemstad, 1950, p. 59).

¹¹⁾ See the figures on folios 23, 24, 27, 31, 33, 35, 37 and 39.

¹²⁾ See the figures on fol. 33, 48 and on the two pages of the *Appendix*, of which Brialmont in note 23 on page 133 of his study gives a quotation to demonstrate Stevin's reputation as an engineer.

on folio 28 of the book. In connection with the dimensions of 50 feet for the width of the ditch and of the sluice doors on fol. 25 and 26, it is evident that, to cover the pair of locks, the ravelin would be equipped with faces of about 250 feet length, a size fitting very well in Stevin's and Marolois' systems.

In the *Art of Fortification* of 1594 Stevin in principle did not include the ravelins, at least not for regular fortresses, which is one of the characteristic features of his system. However, in the end of the 4th "Difference" of chapter 6 he changes his mind, recognising the necessity of adapting the fortifications to local conditions¹³). Obviously, these may be considered to include the very vulnerable sluices at the entrances to the moats¹⁴).

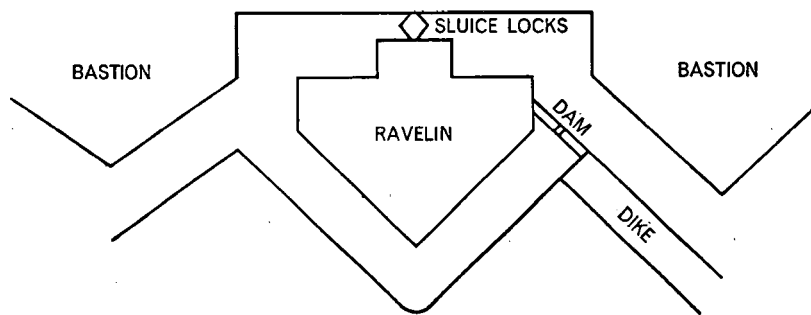
CONCLUDING REMARKS

Stevin has probably failed to reap immediate success with his meritorious proposals and designs for the construction of pivotted sluice locks in fortifications protected by ravelins. Still, it would certainly be worth the trouble to find out whether afterwards perhaps pivotted sluice locks, either for inundation or as lift lock, have been applied in Dutch fortresses for the objective envisaged by him. We have in mind for instance fortified towns like Bergen op Zoom, Brielle, Gorinchem, Hellevoetsluis, Sas van Gent, Flushing and Willemstad, some of which are also mentioned in the *New Manner*¹⁵).

¹³) *The Art of Fortification*, p. 51.

¹⁴) Concerning the ravelins Brialmont observes (note 18 to page 131) that Stevin places his sluices on the least exposed spots and covers them with large ravelins. He considers them better protected than the sluices described by Coehorn in chapter VII, with illustration Q, of the latter's *Nieuwe Vestingbouw* (Netherl. ed. Leeuwarden 1702, fol. 169-72; French editions Wezel 1706, p. 243 and The Hague 1741, p. 269), namely with double gates and situated on either side of a ravelin in the river dike, outside the fortress (English transl. by Th. Savery, London 1705, p. 168).

¹⁵) The following fortresses were provided with the sluices mentioned in their description, on behalf of the defence or for other purposes: Bergen op Zoom, Grave, Sas van Gent, Flushing as well as those still existing: Brielle, Gorinchem, Hellevoetsluis, Willemstad.



Ravelin, with locks.

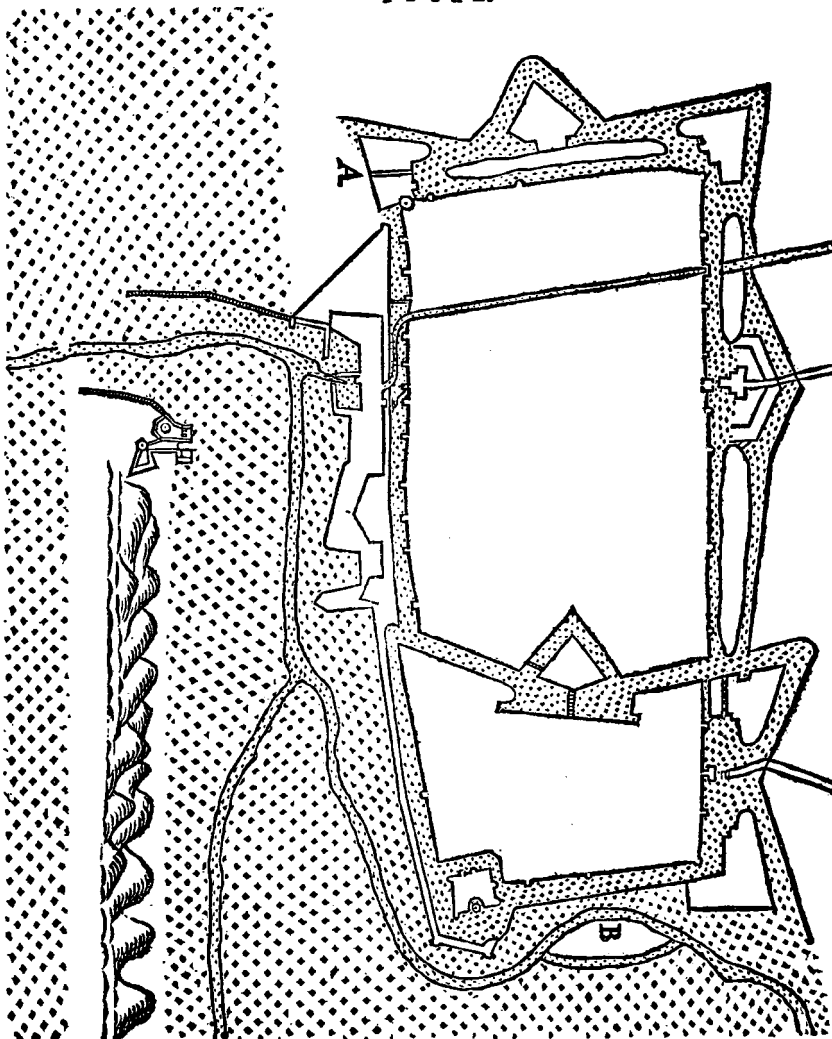


Fig. 1. Fortifications of Calais, without locks (fol. 50).

VAN STERCKEBOON.

51

2 FORM.

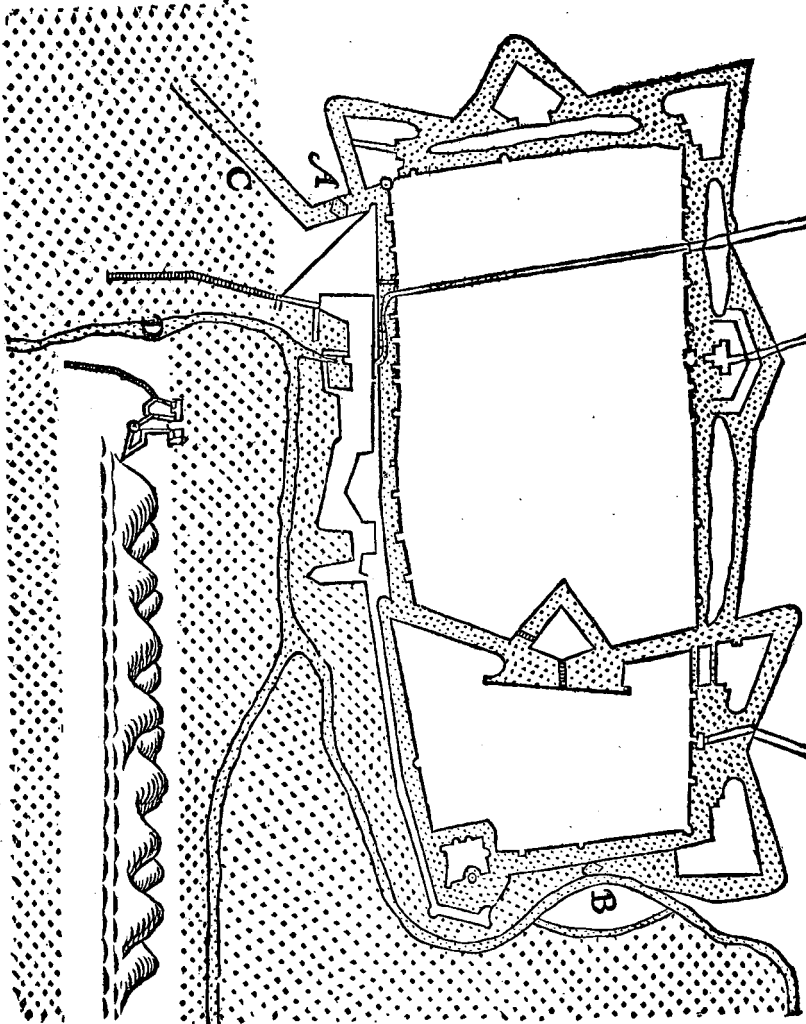


Fig. 2. Fortifications of Calais, with locks (fol. 51).

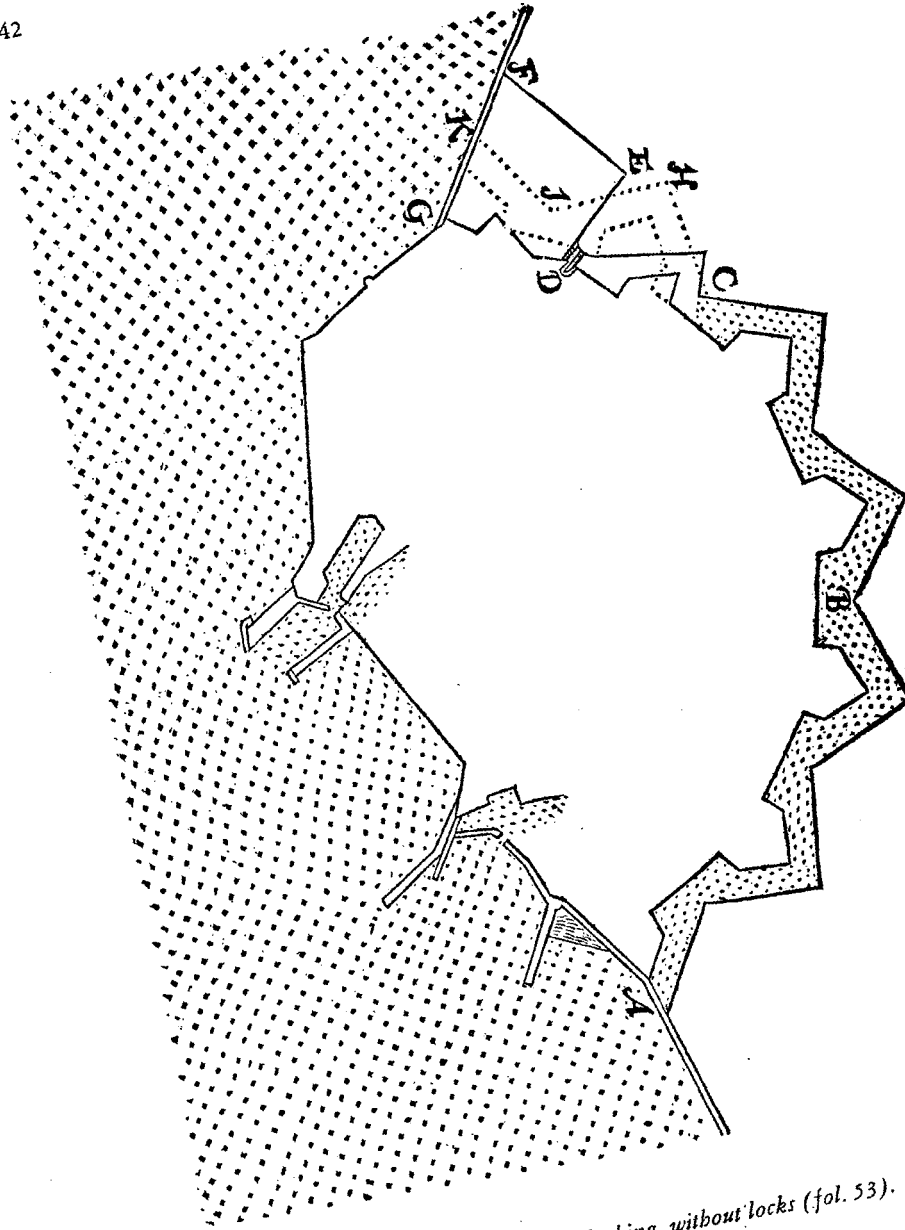


Fig. 3. Fortifications of Flushing, without locks (fol. 53).

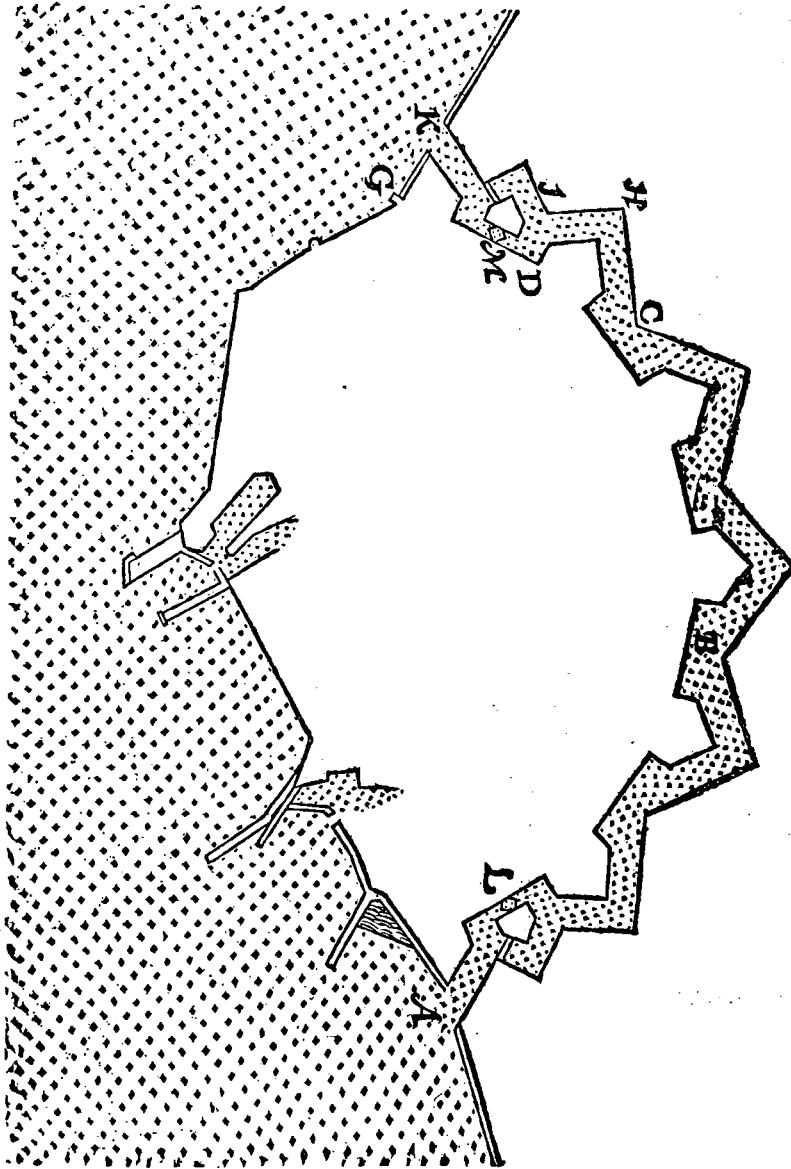


Fig. 4. Fortifications of Flushing, with locks (fol. 54).

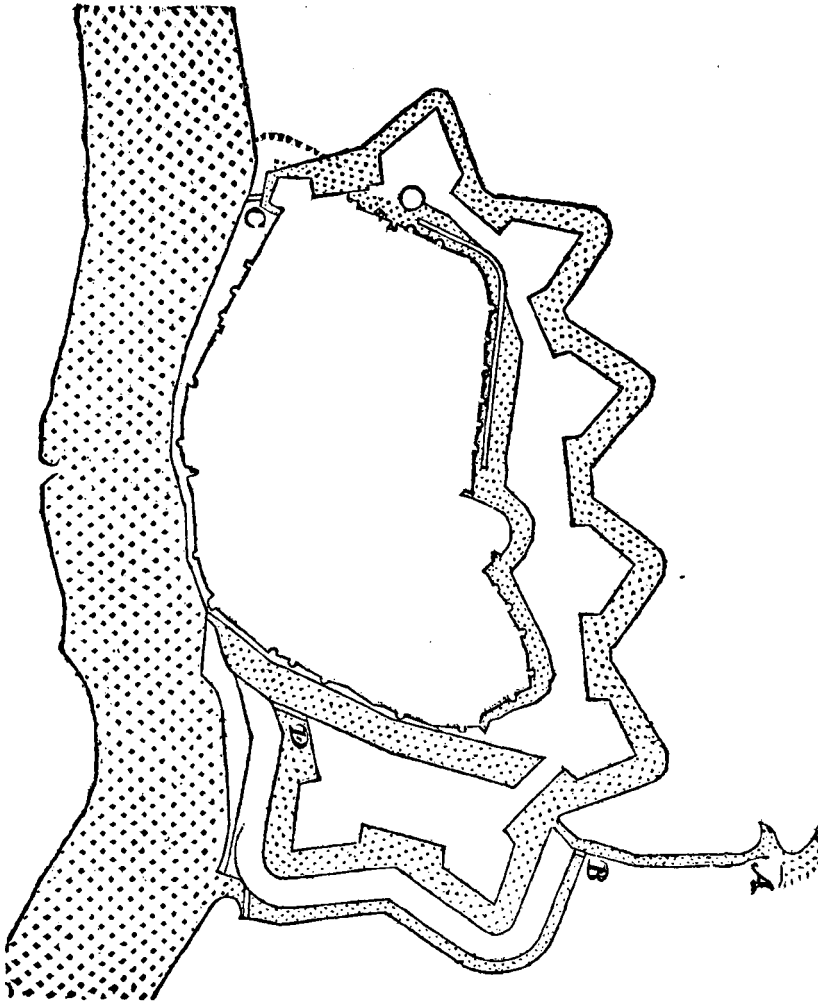


Fig. 5 Fortifications of Deventer, without locks (fol. 55).

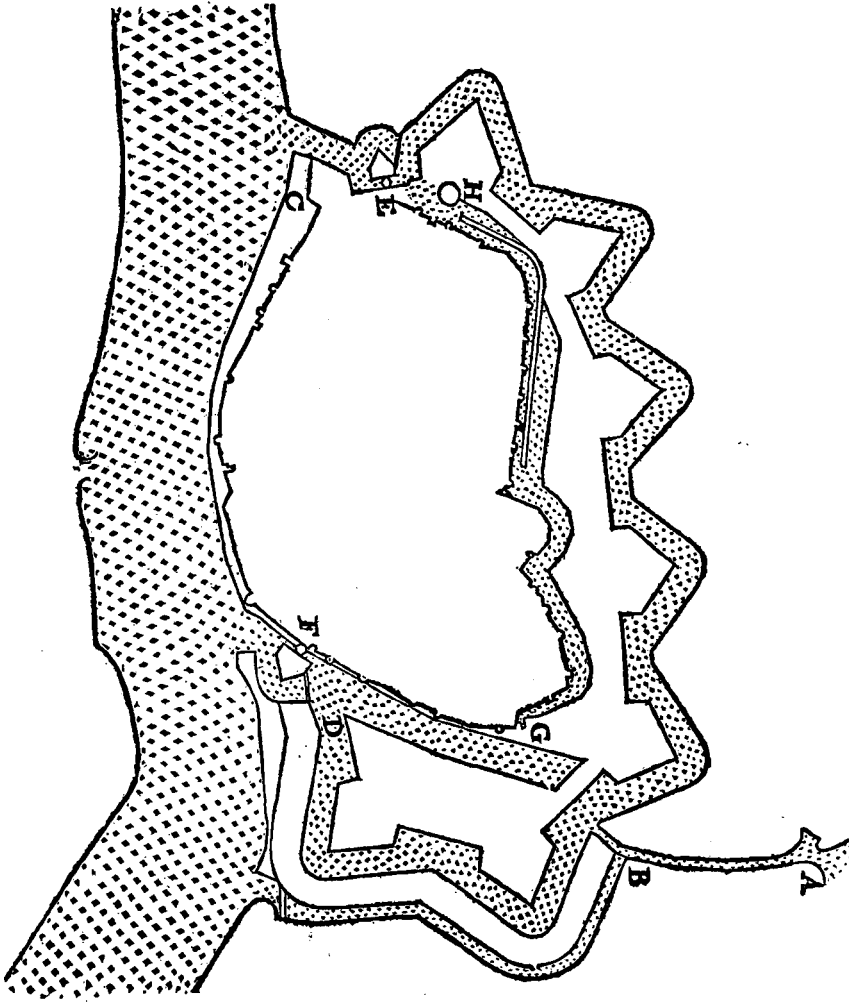


Fig. 6. Fortifications of Deventer, with locks (fol. 56).

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is crucial for ensuring transparency and accountability in the organization's operations.

2. The second part outlines the various methods and tools used to collect and analyze data. This includes both traditional manual methods and modern digital technologies, highlighting the benefits of each approach.

3. The third part focuses on the role of human resources in the data collection process. It discusses how training and support for staff can significantly improve the quality and reliability of the data collected.

4. The fourth part addresses the challenges and limitations of data collection. It identifies common pitfalls and provides strategies to overcome them, ensuring that the data remains valid and useful for decision-making.

5. The fifth part concludes by summarizing the key findings and recommendations. It stresses the need for a continuous and iterative process of data collection and analysis to stay relevant in a rapidly changing environment.

LEGERMETING

THE MARKING OUT OF
ARMY CAMPS

1

2

INTRODUCTION

"The Quartermaster General *Simon Stevin* assigns to each body of soldiers their quarters to lodge in, and is in command of all the others, both Quartermasters General and private Quartermasters, mounted as well as on foot; assigns to the private Quartermasters of the various Regiments the respective order of their quarters and the place, where their regiments are to be lodged; that is why all the Quartermasters together with the Quartermaster General have to ride in front of the first body of troops in order to obtain the required space for their respective regiments. He receives a monthly salary of . . ." ¹⁾

This excerpt from the MS "*Ruich Ontwerp van Krychs-Saken*", which has presumably been compiled about 1610 and which assigns Stevin to the group of "Principale Crijchs-Officieren die int Leger gebruyckt worden" (Chief Army Officers, who are employed in the army) ²⁾, briefly explains the task of the "Legermeter" (as Stevin styles himself ³⁾ and was called in official documents), a function, which apparently will not have differed much from that of quartermaster general.

But why was the book that rightly is praised as the standard work on camp-measurement in Stevin's time, not published until 1617? It is known, that already long before his swearing-in on January 31st, 1604, he had served in the States Army, and should have come into this office in the year 1593 ⁴⁾, so that it is certain that he has been a witness to many of Prince Maurice's sieges (apart from other campaigns) from that year onwards. The lay-out and internal organization of the

¹⁾ "Den Quartiermeester Generael *Simon Stevin* geeft elcke troupen syn Quartier omme te logieren, ende commandiert over alle andere, soo wel generaele als particuliere Quartier-Meesters soo te peerde, als te voete; geeft den particulier Quartiermeesters van den Regimenten die ordre van quartieren, end die plaetse, waer hun regimenten sullen coomen te liggen, daeromme alle quartiermeesters bij den Quartiermeester Generael voor aen die eerste troupe moete rijden, omme die plaetsen voor haere Regimenten t'ontfangen sin gagie is ter maent . . ."

The "gagie" (pay), Stevin's monthly salary has not been filled in; according to the "Staten van Oorlog" (States of War) of 1607 and following years he has earned as an engineer 50 pounds (guilders); the latter is also stated in *Het Staatse Leger*, Vol. II, p. 414.

²⁾ In his book Stevin does not mention his name in the respective list (fol. 16); we do find however the names of the quartermaster general of the army Solem (Antoine de Solempne) and of the quartermaster general of the cavalry Lieven Cijjs (Livinus Chijs).

³⁾ Cf. the signature of the Dedication and the resolution of the States General dated March 23rd 1618, by which f 200,— is being granted to "Simon Stevin van Brugge Legermeter van Hare Ho.Mo." with regard to the dedication of the two books: *Castrametatio* and *Nieuwe maniere van Stercktebou door Spilshuyzen*. The description in MS. 128A-10 (Royal Library, The Hague), fol. 21 and 22, of the office of quartermaster general or "Opperlogierder", fully tallies with the one quoted by us from the *Ruich Ontwerp* (cf. also *Mat.Pol.* pp. 209-225 definition 13).

⁴⁾ General Introduction, p. 17 and note 41.

armycamps or entrenched "quarters", doubtless one of the inventions of Prince Maurice and his cousin Count William Louis of Nassau, on the model of the Romans, will certainly have been considerably improved by Stevin in all those years⁵). Thus in this domain there was great knowledge and experience at his disposal, when at the end of his career he could afford the time to write his *Legermeting* or *Castrametatio*. Indeed this writing gives evidence of ample preparation and besides sober-mindedness we find a versatile professional knowledge and erudition; the classification of its subject-matter however, as such very systematically arranged, still requires, on account of its many recapitulations, some additional discussion. The general tenor of Stevin's treatise, one might say: its justification, has been to give a description of "the encampment in the field" as it was effected during Maurice's campaigns: according to the example set by the Romans yet without following them in too servile a manner, as the organization of the various troops and their equipment in the Army of the States General (Their High- and Mightinesses) differed considerably with that of the Romans.

This difference in organization is paid particular attention to, both in the beginning and at the end of the book, which after a significant Dedication to the States General⁶) and the customary "kortbegrijp" (Argument), in the present instance no more than an enumeration of the titles of its subject-matter, has been subdivided into 4 chapters.

In the first three of these the author gives in succession:

1. a sketchy outline, together with the necessary explanations and figures, of a Roman army camp (according to Polybius) taken in a general sense, and describing in detail the method of encampment of the States army (infantry and cavalry), and their command (the Prince's quarters, the Artillery-General's quarters and those of the staff-officers), the equipment (naturally only with regard to the carriages or "waggons"), the arrangement of the "market-place" and finally the encampment as a whole, taking the one before Juliers (Gulik) in 1610⁷) as an example;
2. An outline in the form of 7 "lists" about the organization, likewise according to the States Army before Juliers, viz. of the commanding and other officers⁸), the regiments (infantry and cavalry), the artillery (ordnance and equipment belonging to it, horses and finally "the officers", including the Engineers, Conductors, Captains of the pioneers and the Miners and even Naval Captains and sailors), the war-munitions and other things, the carriages and ships for the various commanders, army units and services.

This chapter ends with an important remark on an army that is on the march and that has been divided into three "tochten" (bodies) (front-, centre- and rear;

⁵) Brialmont (Steichen, *Mémoire* pp. 120-127: II. *De La Castrametation*: pp. 218-224: *Notes et renvois*) pp. 121, 122 and additional notes.

⁶) The wording of this dedication is important in many respects; inter alia Brialmont has drawn attention to it. As to the reward cf. note 3.

⁷) General Introduction, p. 21.

⁸) Officers were formerly synonymous with Officials (Stevin calls them "Ambtlieden"), both in a military and non-military sense; as a distinction, even in the 18th century, one did speak of "military officers".

nowadays these are called: advanced-guard, main-guard and rear-guard), and on the aids to the camp-measurers, one to each body of troops, who were selected from the engineers.

3. The way in which the quadrilateral "quarters" were drawn on paper, according to the lists showing the strength of the forces, etc. then marked out on the camp-site by the camp-measurer and his assistants, the measuring of the camp-streets within these quarters for each regiment and the space required for the army-huts in the respective streets or rows, the alarm-posts and finally a series of regulations for the upkeep of the camp in its various parts ⁹⁾).

The fourth and last chapter comprises three subjects of quite a different nature, viz. an exposition of the reasons why Maurice had deviated from the Roman method of measuring army camps, a project by Stevin himself for an ideal army camp, based upon Xenophon's general rule and quoted several times by him ¹⁰⁾ and an account of the army organizations (or as Stevin says: "Krijchsvolcx-verdeelingen") of the Hebrews, Greeks, Romans and Tartars, with their advantages and disadvantages, giving preference to the first. We shall revert to the final views of this last chapter later on.

From the preceding exposition it appears that the book contains but few instructions and first of all a description with figures of the army camps and their various camp-sections (and one of a complete camp taken as an example) from Prince Maurice's large campaigns. Therefore it is not to be wondered at, that in Stevin's days these data are also found elsewhere. As a matter of fact in the dedication of his book he acknowledges that "ooc over korte jaren herwaerts, veel en wel vande leghermeting geschreven is" (also during recent years a great deal has been written and well written about camp-measurement).

As most important sources in this respect we might mention: Samuel Marolois' *Sterckten-bouwingh* (building of fortresses) and as such the first publications, those of 1614 and 1615 ¹¹⁾ containing various descriptions of the "logimenten" (quarters), with reference to a number of four plates (a total number of 8 figures) and the MSS (as much as possible in chronological order):

- a. *Observationes des Grafen Johann des Mittleren von Nassau-Siegen* (Wiesbaden, State Archives, 1597). In the publications of the Historical Society (Works, 3rd series no. 76) by J. W. Wijn (Utrecht, 1947) we find on pp. 22-25 a chapter, entitled: "Von Leger zu schlagen" (About pitching an army camp) which begins as follows: "Es kann keiner kein ordentlich quartier schlagen er sey dan ein guter Aritmeticq und Geometer" (no one can pitch a good army camp provided that one should be a good arithmetician and geometrician). The description is confined to general instructions and dimensions and inter alia to references to the siege of Grol in 1597; figures are missing.

⁹⁾ Wijn, p. 415, states Stevin's suggestions for maintaining order and safety in the camp; these are also found in Freitag.

¹⁰⁾ *Castrametatio*, fol. 3, 43, 44; Stevin might have derived this rule from *Xenophontis quae exstant opera*, of which work there were two copies of the 1594-edition and one of the 1596-edition in Prince Maurice's library (Two of the afore-mentioned copies are still found in the Royal Library, The Hague); cf. also the French translation of Xenophon's *Cyropaedia* by Charpentier (Paris, 1749), Vol. II, pp. 174-176 (Edition dating from 1594: *Hist. de Institutione Cyri*, fol. 226).

¹¹⁾ *General Introduction*, p. 20, note 53.

- b. *Ruich Ontwerp van Krychs-Saken* (MS. III-1G. 79 in the Archives of the General Staff, Dept. Ancient History of War, to be dated back to 1610). This comprises as Vol. 4: "Die Logieringe" (The Encampment) together with representations of "Formen van Logeeringen soo wel ten deel als int geheel vant Leger met sijne Verclaringhen" (Systems of encampment given in parts as well as in general of the Army with its explanations):

Quartier van S. Pr. Extie (Quarters of his Princely Excellency) (cf. *Legermeting* fol. 9)

Quartier van die Magasinen ofte van den Heer v. Kessel (Artillery General) (Quarters of Seigneur van Kessel's stores) (id. fol. 10)

Die Soedelmerckt met Syne affdeijlingen (id. fol. 13)
(The Sutler-market and its sections)

Logeering van een Regiment te voete (id. fol. 7)
(Encampment of an Infantry Regiment)

Logeering van een Regiment Ruyterie (id. fol. 8)
(Encampment of a Cavalry Regiment)

Form van Logeering eens Colonels ofte Oversten te Voet (cf. Marolois, plate 28)
(System of Encampment of an Infantry Colonel or Lieutenant-Colonel)

Then follow 8 "Figures" of quarters as a whole, viz.:

Quartier van 't ganse Leger Infanterie end Cavalerie;
(Quarters of the entire Infantry and Cavalry)

Quartier van het voetvolck sonder die Ruijters;
(Quarters of the Infantry without the Cavalry)

Quartier vant jaar 1606. Hoe S. Pr. Extie met zijn gantse Leger Ruyters en voetvolck gelogeed heeft; ¹²⁾

(Quarters in the year 1606. Way of encampment of His Princely Excellency and his whole army of Cavalry and Infantry)

First figure altered;

Second figure altered;

Third figure (the whole Army);

Third figure altered (Infantry without Cavalry);

Idem Idem (Idem: Quartier Gelyck het in der daet is gemaect worden voor Gulijck (Sept. 1610; cf. *Legermeting* fol. 15)
(id.: Quarter as it has actually been built before Juliers)

- c. *Militaire Afbeeldingen*, aanwijzende de Legertogten, Campementen, Logeeringen, Slag-ordres . . . Onder de Princen van Orange en de Legers van den Staat gebruyckelijk (Military Illustrations, indicating the Marches, Encampments, Quarters, Battle-arrays . . . as customary under the Princes of Orange and in the States Army (MSS. 1A. 750 and 751 Library of the War Ministry, The Hague, to be dated back to 1610-1623). This comprises in its second part 23 pages; presumably from the year 1610: "de Logieringhe" (the Encampment). Among the "Retrenchementen, Quartieren" etc., as represented therein, we find on fol. 15 the one before Juliers and on fol. 17: "Quartier de Son Exce."

¹²⁾ 1606 was the year in which Maurice had to restrict himself to the defence in order to repulse an imminent invasion by Spinola, who nevertheless managed to capture Groel and Rijnberk (Bos-scha Vol. I, p. 317; *Het Staatsche Leger*, Vol. II, pp. 84, 85; Wijn, *Het Krijgswezen in den tijd van Prins Maurits*, p. 541).

estant en Campaigne" (His Excellency's Quarters during a Campaign); in the last-mentioned drawing one of the army tents bears Stevin's name.

- d. *Formen van Logeeringen*, soo wel ten deel als int geheel, vant leger met zijn verclaringen (Systems of Encampment in detail as well as in general of the army, and its explanations) (MS.128-A14 Royal Library, The Hague, to be dated about 1615). Among the 24 figures in this MS the following are of particular importance:
- (fol. 4): Quartier van zijn Ex.cie alleen met zijn Eijgen gevolch (His Excellency's Quarters and his private suite) cf. *Legermeting*, fol. 9; one of the tents of the private suite bearing Stevin's name);
 - (fol. 10): Logement van een Kolonel en zijn Officieren (Quarters of a Colonel and his Officers), cf. Marolois, plate 28;
 - (fol. 11): Logementen van twee Kapiteinen (Quarters of two Captains), (idem, figures 124 and 125);
 - (fol. 12): Quartier van een Regiment van 20 Compagnien (Regimental Quarters of 20 companies) (idem, plate 27).

The first mentioned figure, which is also found in the *Castrametatio*, yet without heading or marginal notes, does not occur with Marolois; with the last-mentioned three (coloured) drawings it is just the reverse; concerning the latter it is to be assumed that Marolois must have used them for his book, which as such might have been the reason why Stevin will have refrained from adopting them¹³).

- e. *Verschyde Legerquartieren* (various Army quarters) (MS.128A-20 in the Royal Library, The Hague, dated as before). The contents of this MS. merely differ in minor points from those mentioned sub d.

Apart from these data, which have been collected in *chapter 1*, there are those of an organizational character, a summary of which has been given in "lists" and published in *chapter 2*, being for the contemporary an indispensable supplement to the sketchy information. To us these statements concerning personnel, troops and not in the least those regarding the ordnance and other army-equipment, are an important source of information concerning the army-organization in the days of Prince Maurice (cf. Wijn, p. 414 and Henricus Hondius dating from 1624¹⁴).

In *chapter 3* we find the camp-measurer in his element as a surveyor of the plan of the army-quarters¹⁵); here the subject-matter has been described in such a clear and expert manner that, after the above explanation, we might as well leave out any further comment.

¹³) Consequently Wijn gives in his chapter "Legering" (Encampment) on pp. 407-413 eight figures, i.e. four by Stevin and four (including the bottom one on p. 413) by Marolois.

¹⁴) Henricus Hondius, *Korte beschrijvinge ende afbeeldinge van de generale regelen der Fortificatie*, etc. (Brief description of the General rules of Fortification, etc.) (The Hague, 1624), 3rd Volume: "handelende van de Officieren, van den Treyn, van de Artillerie, Munition ende Vivres, etc. (dealing with the Officers, the Army-train, the ordnance, Munitions and victuals, etc.).

¹⁵) Instead of "afsteker" (marker-out) we also find in the resolutions the title of "afsteekener van de quartieren" (tracer-out of the plan of the army-quarters) cf. resolution of the States General of December 24th, 1603 and January 2nd 1604; R.G.P. 92, p. 520 and 101, p. 117.

Thus there remains *chapter 4*, which — as has already been stated — is found to be a combination of three different subjects. Of these the second section, containing Stevin's proposal for a permanent camp, is kept very concise, presumably because of the fact that its realization, if it should have been possible at all, would certainly have been very difficult as naturally any army-organization is always liable to change. Moreover the execution of Stevin's design would have required special conditions of a local and varied nature. However as an ideal army-camp it deserves as much appreciation as his ideal town-plan ¹⁶).

The first section, which deals with the deviations from the Roman way of encampment ¹⁷) contains a continuation and partly a recapitulation of the statement given in the first section of chapter 1, entitled: "Vande legering int ghemeen, mette form des Romeynschen Leghers" (About the encampment in general together with the figure of a Roman Army camp). In both sections Stevin mentions the Polybian army camp as his starting-point; the ground-plan taken from Lipsius' translation of 1585 ¹⁸) has been printed in chapter 1 ¹⁹), however in chapter 4, fol. 43, Stevin recapitulates the objections against it, which Prince Maurice had experienced in its application and which chiefly consisted in a lack of space for the soldiers of the States Army; further it appeared from experience that camp-sites measuring 2,000 feet in length and width on a ground, that has not any undergrowth, cultivation or other obstacles, hardly ever occur and that in case of a siege one had to adapt it to the local situation the investment demanded; according to Polybius himself the space to be marked out was to be enlarged or reduced either according to an increase in strength of the legions or a decrease through heavy casualties ²⁰).

The third section of chapter 4 brings the reader to another problem, that, if one should overlook Stevin's lengthy speculations on the armies of Antiquity, appears to be of particular importance with regard to the encampment: the most suitable organization of the States Army corps (infantry and cavalry). In his investigation of this problem the author arrives at the "tienighe verdeeling" (decimal order) and demonstrates this by the army-organization of the Israelites or Hebrews ²¹), "d'eerste die men by schrift vint" (the first that is found in writing) of which he circumstantially describes the order and its advantages in nine points on fol. 49-54. That, in contrast to the Greeks and the Romans, also the Tartar armies under

¹⁶) With regard to the figure and description of Stevin's town-plan cf. MS 128A-9 II (Royal Library, The Hague) fol. 2, *Van de oirdening der Steden* (About town-planning), in which fol. 5-11: *Vande form der Steden* (About the lay-out of towns); cf. also *Mat. Pol.* I, pp. 1-128.

¹⁷) With regard to these deviations cf. also Brialmont, p. 123 and Dijksterhuis, p. 241 section 3.

¹⁸) About the value of Lipsius, *De Militia Romana* cf. inter alia Bosscha Vol. I, p. 196; Jähns, pp. 448, 870; Wijn, p. 481 and Dijksterhuis, p. 239.

¹⁹) In Brialmont, plate III we find a figure of Stevin's ideal encampment, together with that of Juliers.

²⁰) Wijn, pp. 417, 418.

²¹) Stevin refers on fol. 46 to the author Josephus, from which it can be concluded that he owes his knowledge on the subject to the *Jewish Antiquities* by Flavius Josephus, published in 1594 at Leyden by Everardus Bommelius.

Tamerlan and Dzenzis Khan ²²⁾ had adopted this order, is being described both in chapter 1 (fol. 4) and in chapter 4 (fol. 47). However, for lack of data about the Tartar Army camps, he has followed the *Castrametatio* of the Romans, who apparently also in this respect have been influenced by the Greeks ²³⁾.

Upon closer examination of this branch of the Roman art of war a question forces itself upon us, why the army camps in the second Punic war, as depicted by Polybius, were chosen as an example and not those of the later period of the Roman conquests under Caesar and his successors. The answer is self-evident, because it was Polybius' description that was again brought to light in Stevin's time, when apparently a writing of a more scientific nature dating 3 or 4 centuries later, such as the one by Hyginus, was not yet common knowledge ²⁴⁾. Max Jähns in his *Geschichte der Kriegswissenschaften*, mentions (p. 108) one Hyginus, who lived about 200 A.D., as an early scientific author on the Roman *Gromaticæ* or geodesy in its full extent, viz. its theory, its practical application, in civil life as well as in the military domain; the Amsterdam edition of 1660 of his treatise by Rhododus Hermanus Schelius is of particular importance to us because it also includes Polybius' Liber VI about the Roman "castra" of about 150 B.C. (text in Greek and Latin with the drawing by Lipsius). The Hyginus-edition of 1607, published by Scriverius at Leyden, has probably attracted less attention, as it was published as an appendix to Vegetius, an author in the 4th century A.D. and who no more than Hyginus gave representations of army camps.

We have elaborately dwelled on this latter writer, because, besides Jähns, there are still three other authors known to us from the end of the 19th and the beginning of the 20th century, who have drawn attention to the value of his writing for the knowledge of the Roman army camps and the art of fortification. They are: A. von Domaszewski (*Hyginus Gromaticus*; Leipsic 1887), Colonel G. de la Noë (*Principes de la Fortification Antique*, II, *Fortification Romaine*; Paris 1890) and J. H. Holwerda (*Nederl. vroegste geschiedenis*, Earliest history of

²²⁾ On fol. 4 Stevin gives a survey of the army-organization of the Mongolian conqueror Tamerlan (1336-1405), which he has presumably derived from the *Histoire du grand Tamerlanes*, published at Brussels in 1601 and which should have been adapted from ancient Arabian sources by Jean du Bec, abbot of Mortemer. The latter, however, seems to have compiled his writing without availing himself of reliable data, which came to light when F. Pétis de la Croix, professor of Arabic, published in French in Paris in the year 1722 the 15th century chronicle by Sharaf ed Din: *Zafar-namé* or *the Book of the Victories of Lord Timur the Splendid* (Communication made by the Oriental Department of the library of the Leyden University; cf. also Harold Lamb, *Tamerlane, The Earth Shaker*, London 1929, pp. 257-259).

In contrast with the abbot of Mortemer's argument (which has been adopted by Stevin), Tamerlan's armies must have chiefly consisted of cavalry, yet organised according to the decimal order, sub-divided into units consisting of 10 to 10,000 men (Pétis de la Croix, Tome II, Livre 3, chap. XI: *Timur fait la revue de ses troupes*). This order must have been adopted by Tamerlan from his predecessor Dzenzis Khan (1167-1227), referred to by Stevin on fol. 47 as: "Cangio, the great Cam." Here he quotes, where his army-organization is concerned, the author Aiton meaning: Haythonus, whose original work, written in the Armenian language, was published in Latin at Hagenau in 1529, entitled: *Liber historiarum partium orientis*. In chapter XVI we find Stevin's argument indicated as follows: "(Changius Can) praecepit, quod sub quolibet denariorum, praeponeretur unus, et super decem milia praeponeretur unus, et super mille praeponeretur unus, et vocavit aciem decem milia armatorum, Turmam". (Dzenzis Khan laid down that any decimal numeration should have a leader, thus a unit of 10,000 should be controlled by one and a unit of 1,000 equally so and he called a battle-array consisting of 10,000 armed men a Turmam).

²³⁾ Polybius, just as Xenophon, was a Greek; he worked for years as a hostage under the Romans.

²⁴⁾ Here is meant the edition of the year 1607, quoted by Jähns; cf. also note 40.

the Netherlands; 2nd edition 1925, pp. 159-161). From these publications it appears, that although the Romans applied the same principles in the building of their temporary and their permanent camps, one should positively make a distinction between the organization (structure) and the fortification of these two camp-specimina. In the case of a permanent camp, serving the purpose of defending the colonies or the conquered outer provinces of the Roman empire, the characteristic features of the art of fortification and town-planning came to the fore, whereas with the temporary camps the encampment of the troops for a short period of time, i.e. during marches or in the neighbourhood of the enemy, was of paramount importance. The latter comprised the army camps as described by Polybius and which at a later date formed the subject of Hyginus' study: *De Castrametatione* ²⁵).

As has already been stated, Stevin quotes several times Cyrus' method of encampment as it has been briefly described by Xenophon (abt. 430-350 B.C.) ²⁶); till now we have not been able to ascertain whether Polybius has actually endorsed these fundamental principles which would have been very reasonable as such.

As yet it should be observed, that an important item of the encampment in a more limited sense, the erection of the actual lodgment or shelter of the soldiers and officers, has been disregarded in Stevin's book. He only mentions the number of huts for the soldiers and officers of lower rank and tells us that they are constructed of straw and wood by the soldiers themselves (fol. 36, 39); except those in the quarters of the Prince (fol. 9), he does not even mention the tents, in which the higher officers were accommodated and which had to be carried along as well ²⁷). On the other hand in the book by Marolois we do find illustrations of tents and huts (of a very simple form) and also in Freitag's *Architectura militaris* (figures 111 and 112) there are very good illustrations of army-huts.

As an example of a "neo-Roman" army camp that of Prince Maurice before Juliers of 1610 is known best of all ²⁸); as we have seen, its ground-plan figures as a kind of model not only with Marolois and Stevin but also in most MSS, dealing with the encampment of the States army. Yet it is not more than an example; Brialmont rightly observes that even a mathematician such as Maurice could not but by way of exception stick to the usual rectangular form of encampment, as used by his Roman predecessors ²⁹). Nevertheless it seems not super-

²⁵) Domaszewski, who gives as a title: *De Munitionibus castrorum*, observes (p. 39, note 1): "Es ist ein weitverbreiteter Irrtum, die Angaben der Lagerbeschreibung bei der Erläuterung der Ueberreste römischer Standlager heranzuziehen. Ist man doch so weit gegangen, in jedem Limescastell den Hyginus wiederzuerkennen." (It is a wide-spread error, when giving a detailed description of an encampment to bring into the commentary the remains of the Roman permanent settlements. Has one actually gone so far as to discover Hyginus in every Limes-fort).

²⁶) cf. note 10 and Brialmont p. 127.

²⁷) That Stevin did realise the importance of camping in tents also for the soldiers, appears from *Beeckman's Journal*, fol. 218-vo. line 36; 219-220, line 3. (de Waard, Vol. II, p. 425; *Mat. Pol.* p. 222); probably here he has in view the night-camp during marches for: "daermen een blijvend leger houdt, daer maeckt men hutten als beter synde om te logieren" (where one keeps a permanent encampment there one erects huts providing a more suitable accommodation).

²⁸) *General Introduction*, p. 21.

²⁹) Brialmont, p. 124.

fluos to notice still a second example, viz. the one concerning Grol in 1597³⁰), thus from Stevin's early military years, to prove finally that the "example" of 1610 must have been particularly in the public eye. From the history of military science and other sources it is known, that Prince Maurice with the siege of Groenlo or Grol, which lasted from September 8th to September 30th 1597 and about which we have certain knowledge that it must have been attended by Stevin himself³¹), has encamped the greater part of his army forces viz. 8 regiments of infantry and 7 regiments of cavalry, of which it is assumed that they represented a joint strength of 5,000 men and 1,200 horses, in a camp of rectangular shape, measuring about 2,000 feet in width and 2,400 feet in length³²). So it was larger than that of Juliers, measuring 1,750 x 2,000 feet, which, however, did not comprise the cavalry³³). For the rest the lay-outs of these two camps are perfectly alike, as far as it could be ascertained from the drawings³⁴). In what manner the occupation of the camp before Grol was carried out, we find very briefly described by Duyck (*Journal*, part II, p. 348 et seq.):

September 11th (showery, rainy weather), the advance-guard arrived early before the town;

September 12th (very showery and rainy), the soldiers in the encampment were all busy with the erection of their huts; the entrenchment of the camp was marked out and the alarmplaces (round about the regiments 250 feet in width) were levelled;

September 13th (the weather is rather nice), the whole encampment was entrenched which was carried out early in the morning . . . in the evening the approach to the town was started.

From this diary it appears that the first day must have been devoted to the dividing of the camp, for the next day the troops could start building their shelters, all at great speed.

As to Maurice's camp before Juliers, we still found, apart from the data mentioned in the General Introduction, the following data:

By resolution of February 17th, 1611, the States General granted "the copperplate

³⁰) In addition to the camp of Grol Brialmont also mentions inter alia that of Grave, the fortress which was besieged by Prince Maurice in 1602. In the *Journal by Anthonis Duyck*, published by Lodewijk Mulder, The Hague 1866, Vol. III, p. 422 we read about that siege the following remarkable passage: "His Excellency took great pains to provide all the troops their quarters to measure, by which much time was wasted, so that this day the respective quarters could not be allotted to all the soldiers, as one was too particular as to their dimensions."

³¹) *General Introduction*, p. 17, and note 44; cf. also Dijksterhuis, p. 170.

³²) The figures show mutually small differences: Duyck Vol. II, p. 348 states "een viercant van 2420 voeten lengte ende 1920 voeten breete" (a square of 2,420 feet in length and 1,920 feet in width), Blaeu's *Atlas der Steden* gives "langte des Legers 2375 voeten" (Length of the encampment 2,375 feet) and "Breete des Legers 2000 voeten" (width of the encampment 2,000 feet); thirdly there exists a map drawn of the siege, in which the camp is represented.

³³) *Castrametatio*, fol. 14 and 34; Matthias Dögen, however, in his *Streitbau-Kunst* (Amsterdam 1648) on plate X represents an other army camp: "Castrorum metatio observata Mauricio Auriaco in expeditione Juliacensi", in which were encamped 12,560 "Pedit". (infantry) and 2,925 "Equitum" (cavalry) measuring 3,320 x 2,100 feet.

³⁴) Compare the plates 1 and 3, following p. 258.

engraver Floris Balthasar at Delft an amount of fl. 200.— for his engraving and printing on satin the siege of the town of Juliers and its entire situation . . . 35); and f. 75.— to Andries Sersanders, who by order of His Excellency has drawn the plan and made a fair copy of it of the siege of Juliers, together with all its quarters, outworks, approaches and battalions in due and proper form according to the art of Geometry, and who has presented it to the Lords (Seigneurs) of the States" 36).

Both works of art have been preserved and lend themselves, — with regard to the Prince's encampment, indicated therein —, better than any other historical print of the siege 37), for a comparison with Stevin's "form" (figures 2 and 3).

The copperplate engraving by Floris Balthasar, size 41 x 49 cm, has been reproduced on a reduced scale in the work *Dutch and Flemish Etchings, Engravings and Woodcuts, abt. 1450-1700* by F. W. H. Hollstein, Vol. II, p. 13; it represents a beautifully drawn bird's-eye view and gives a lively image of the siege of the fortress and of its surroundings, in which the elevated almost square encampment is very conspicuous. The original etching is in the "Rijksprentenkabinet" of the Rijksmuseum, Amsterdam. The drawing by Andries Sersanders, with French legend and notes in printed form and hand-coloured, belongs to the Bodel-Nijenhuis collection in the Library of the Leyden University (Portfolio 117, no 24). The actual arrangement of the army camp can be judged to better advantage here than in the smaller engraving by Balthasar, the more so because various parts are indicated by letters, being explained in the caption of the print. There is a marked conformity with the ground-plans by Marolois and Stevin: only the two gunpowder cellars M and N, drawn by Sersanders in the camp, do not occur with the afore-mentioned authors.

In the work by Henricus Hondius of 1624, as quoted in note 14, we find on fol. 67 a description (together with figure) of the siege of Juliers of 1610. Here Maurice's encampment has not been represented, however the author concludes his narration by saying: "As regards the quarters . . . they can be seen on the large map made by Andries Sersanders Engineer, and is to be printed and issued by me" 38). The map by Sersanders, as described above, had already been dedicated and presented to the States General 13 years before, in 1611.

In concluding this introduction we should like to put the question: has Stevin's (or Maurice's) *Castrametatio* also been followed in later days?

This question can be answered in the affirmative by referring to later campaigns and to authors, who have copied figures and text from the *Castrametatio*. As regards the campaigns, one should first consider the sieges of Prince Frederick Henry, who had shared so many of his brother's feats of arms, and occasionally

³⁵⁾ "plaetsnyder Floris Balthasar tot Delft f 200,— voor door hem in koper gesneden ende op sattijn gedrukt de belegeringe der Stadt Gulich met alle de gelegentheyt van dezelve . . ."

³⁶⁾ "Andries Sersanders die by last van Syne Excellentie opgemaect ende int nette gestelt heeft de plant (tekening) vande belegering van Gulich, met alle hare quartier, buytenwercken, approchen ende bataillons inde beste forme na de konste vande Geometrie, ende die Heeren Staten gepresenteert".

³⁷⁾ Muller, *Historieplaten* (Historical illustrations), states inter alia the illustration by Baudartius. *Afbeelding ende beschryving van alle de veldslagen, belegeringen enz.* (Representation and description of all the battles, sieges, etc.) (Amsterdam, 1615).

³⁸⁾ "Wat de quartier belangt . . . de selve kanmen sien inde groote kaerte daer van gemaect by Andries Sersanders Ingenieur, ende wort by my gedrukt ende uytghegheven".

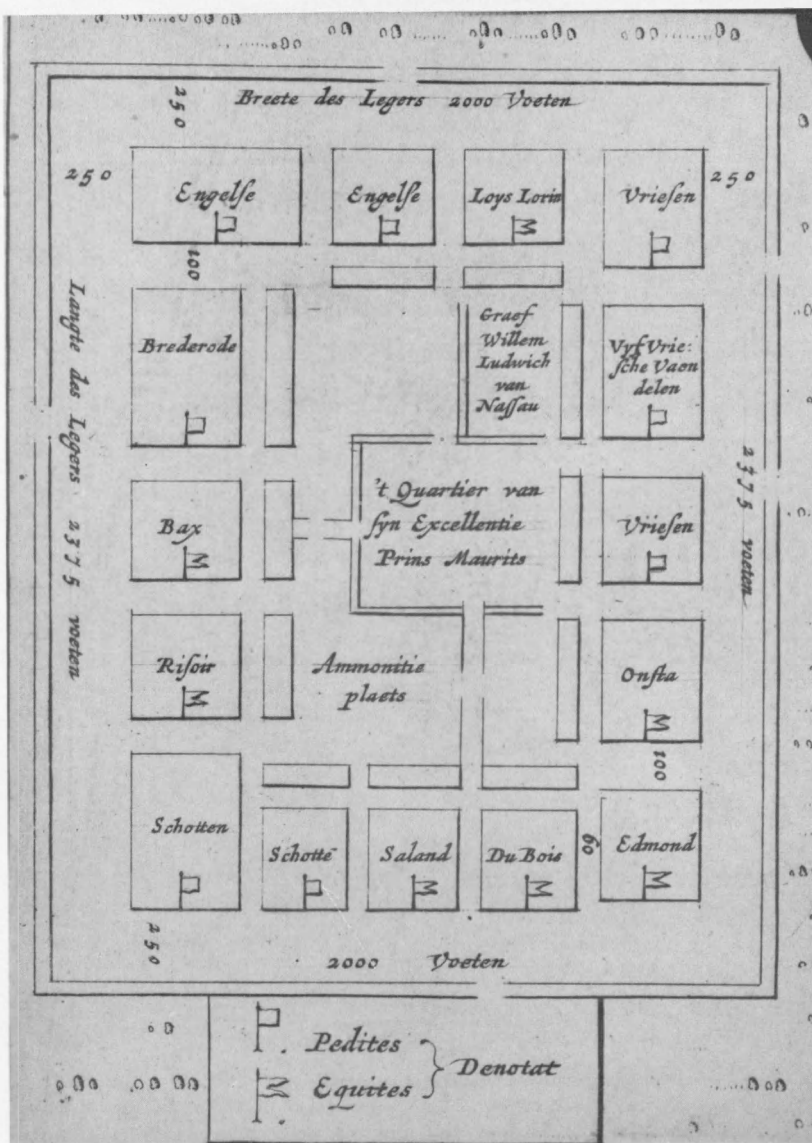


Fig. 1. Camp of Prince Maurice before Grol in 1597
(from the plan by Joan Blaeu in 1649). Cf. p. 257

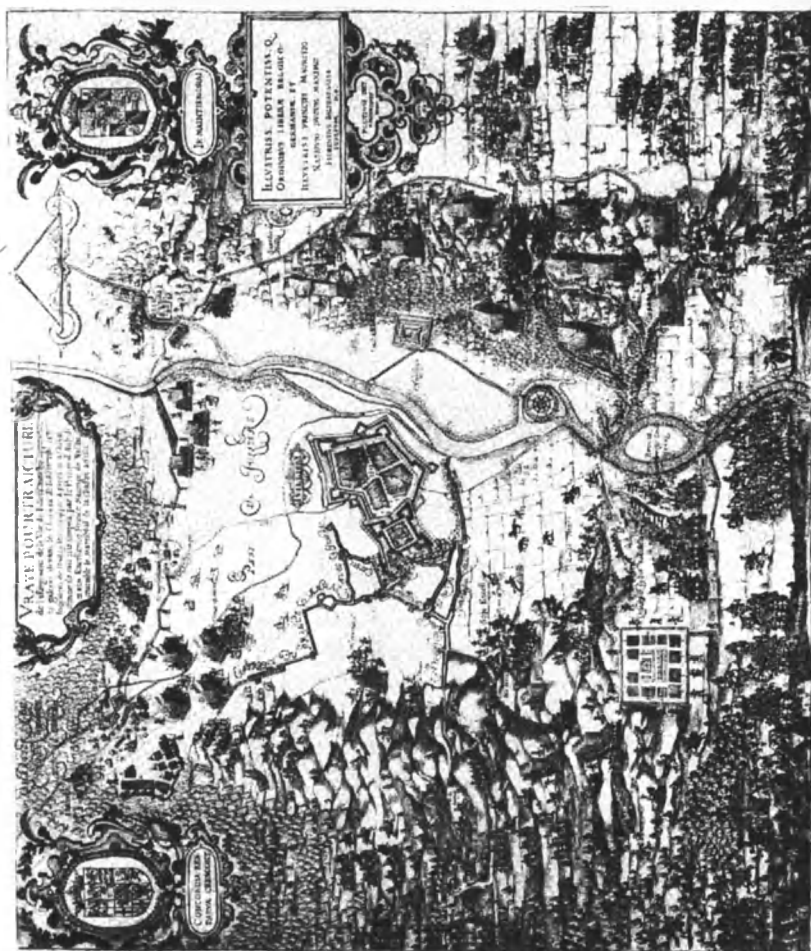


Fig. 2. *Siege of Juliers by Prince Maurice in 1610*
(Engraving by Floris Baltasar van Berckenrode). Cf. p. 258

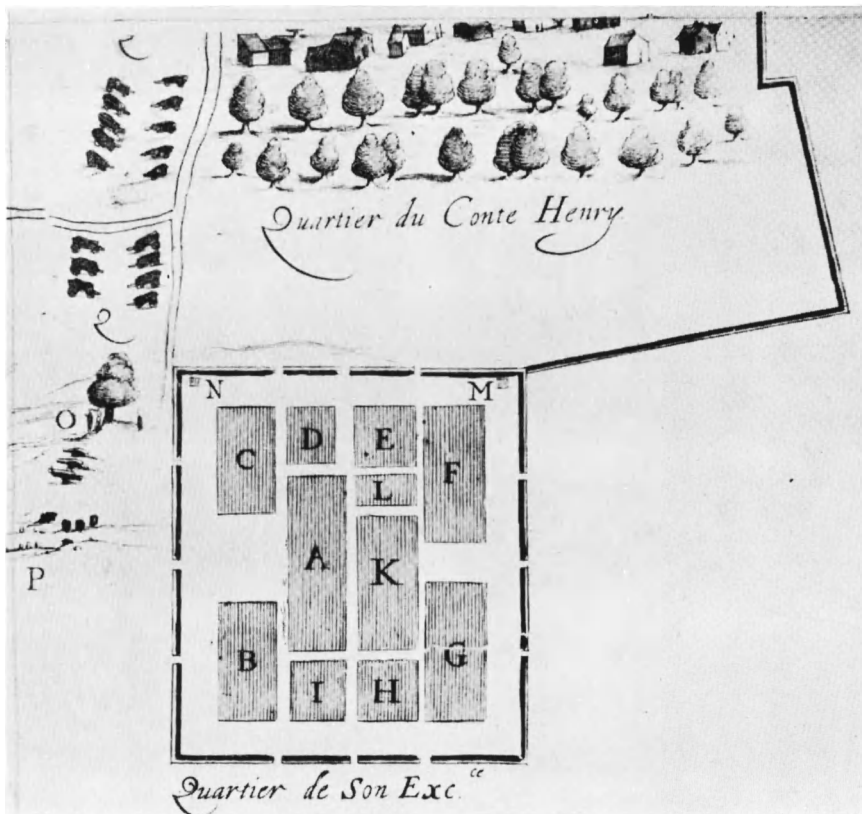


Fig. 3. Camp of Prince Maurice before Juliers in 1610
(from the engraving by Andries Sersanders). Cf. p. 258

Explanation of the quarters, etc.

- | | |
|--|---|
| A. Tentes de son Excellence. | H. 6 Comp. Allemanes |
| B. 16 Comp. Vallons du Comte Johan Ernst. | I. 8 „ Frisons. |
| C. 15 „ Anglois du Regt. d'Horace Vere commandé par Metkercke. | K. Magazin de l'Artillerie. |
| D. 4 „ Gardes. | L. Officiers de l'Armee. |
| E. Vivandiers | M. N. Caves à pouldre de Canon |
| F. 19 Comp. Francois de Mr. de Béthune. | O. l'Arbre où son Excellence alloit voir avec la Lunette. |
| G. 19 „ „ de Mr. de Chastillon. | P. Magazin des Gabions et facines. |
| | Q. Quartier des Chariots, des vivres & munitions. |

here we do find again the classical army camps of Maurice, inter alia before Grol in 1627 and before Breda in 1637, yet only with respect to the quarters of officers second in command.

As to the author-followers, Brialmont ³⁹⁾ demonstrates that Stevin's work has been the basis of various writings, in which one finds exactly the same fundamental principles. He gives as an instance Marolois' *Sterckten-bouwingh* of 1627, Adam Freitag's *Architectura Militaris* of 1630, Manesson Mallet's *Travaux de Mars* of 1671 and some later works.

As to the afore-mentioned three authors we have already stated about Marolois, that the first edition of his book dates from 1614/1615 and that he must have used the same sources as Stevin had resorted to; Freitag, who in 1629, when he was matriculated at the Leyden University, was 21 years of age, has only attended some of Frederick Henry's sieges, yet he fully described the castrametatio from the days of Maurice, which he explained by means of 6 figures ⁴⁰⁾. Mallet finally gives in the 3rd volume of his work, both in his description and illustration, no more than an entrenched encampment and the way in which the cavalry (a squadron of 100 horses) and the infantry (two companies of 50 men each) were encamped, all this entirely in accordance with Marolois and Stevin. With all these authors after Stevin, including Marolois, who has presumably been followed most ⁴¹⁾, the description of the castrametatio links up with that of the attack of a fortress by means of "approches" (approaches) and further works of attack. Thus Stevin's *Castrametatio* as such is much more individual and his work proves to be more detailed and complete than any other; yet also for him "the besieging of towns and fortresses" has been the subject of elaborate study, for which purpose we refer to the 3rd part of this book.

³⁹⁾ Brialmont, p. 125, note 22.

⁴⁰⁾ Freitag, (edition of 1642), fol. 130-141 and figures 107-112; on fol. 131 he refers to Vegetius, lib. 1., cap. 22 and Hyginus with regard to the "Castra strataria" in a siege (cf. also Wijn, p. 404).

⁴¹⁾ Marolois and Freitag have, where the castrametatio is concerned, also been imitated by Matthias Dögen, as mentioned in note 33, and further by Gerard Melder in his book: *Van de fortificatie en Bataillons etc.* (About fortifications and Battalions etc.), published by Jan van Waesberge, at Utrecht in 1658 and at Amsterdam in 1664, the third part of which containing 7 "Instructions" and 4 figures dealing with "het logeren" (the encampment).

1

2

CASTRAMETATIO,
Dat is
LEGERMETING.

Befchreven door *Symon Stevin* van Brugghe,

Na d'oordening en 'tghebruyc

VANDEN DOORLVCHTICHSTEN

Hoochgeboren Vorst ende Heere MAVRITS PRINCE van Oraengien, Grave van Nassau, Catzenellenboghcn, Vianden, Moers, &c. Marcgraef vander Vere, ende Vlißinghen, &c. Heere der Stadt Grave, ende 'sLandts van Cuyc, St. Vyt, Daesborch, &c. Gouverneur van Ghelderlant, Hollant, Zeelant, Westvrieslant, Zutphen, Vtrecht, Overysfel, &c. Opperste Veltheer vande verenichde Nederlanden, Admirael generael vander Zee, &c.



TOT ROTTERDAM,

By Ian van VVaesberghe, inde Fame.

ANN • 1617.

Prince Maurice's titles are found to correspond for the greater part with those in the French edition and in Orlers' *Geslacht-boom der Graven van Nassau* (genealogical tree of the Counts of Nassau, Leyden 1616) p. 118.

Daesborch, just as Vianden and St. Vyt, was a possession in Luxemburg.

For the title Governor instead of Stadtholder cf. inter alia Japikse, *Geschiedenis van het Huis van Oranje-Nassau* (History of the House of Orange-Nassau). The Hague 1937, vol. I, pp. 128, 130, 179.



AEN DE HOOCHMOGEN-
DE HEEREN DE GENERALE
STATEN DER VEREENICHDE NEDER-
LANDEN.

NAdien van ouden tijden, en ooc over korte ja-
ren herwaerts, veel en wel vande Legherme-
ting gheschreven is, als wesende een der voor-
naemste deelen des Krijchs, daer de voor-
naemste Amptlien des Leghers vande Ro-
meynen, te weten de *Tribuni* het bewint af hadden, zoo
heeft syn *Vorstelike Ghenade* die ernstelic doorlesen, en dat
niet alleen * spieghelingsche wijze, maer boven dien de zel- ^{* Theorid.}
ve dadelic te wercke ghestelt, daer by voeghende syn ey-
ghen vonden ende oordeninghen na den eysch vande ma-
niere des Krijchs diemen nu ter tijt voert: Alwaer bevon-
den wort, dat nadien elc in syn quartier (ter plaets gheko-
men wesende) terstont bout, om haest bevrijt te zijn tegen
reghen, onweer, of heet Sonneschijn, en daerentusschen
t'ghebou int gheheel oordentelic moet voortgaen, ooc om
het heele Legher haest te moghen omgraven, zoo was het
noodich veel Amptlien aen't beleyt van dien hun wel te
moeten verstaen, zommighe in't gheheel, ettelicke inde
bezonder deelen, als van regimenten of ander quartieren
daer sy de last af hadden, tot welcken eynde aen elc onder-
richting ghedaen wiert na den eysch van syn quartier:
Maer om zulcke onderrichting noch beter te doen, zoo
heeft my de bequaemste wegh ghedocht vande stof der
(...) 2 Legher-

TO THEIR HIGH AND MIGHTINESSES THE LORDS OF THE
STATES GENERAL OF THE UNITED NETHERLANDS.

As in olden times and also during recent years there have been ample and excellent writings on the Art of marking out army camps, being one of the principal elements in warfare, of which the principal military officers of the Romans, viz. the *Tribuni*¹⁾ were in command. Therefore His Princely Grace has elaborately studied these writings, not only theoretically but also by practical application, whilst adding to them his own inventions and methods according to the requirements of the Art of war of our times. Hereby it was found that since everybody (after having reached his destination) starts building his lodgings at once in order to be sheltered as quickly as possible from rain, thunder or fierce sunshine and meanwhile the building of the camp as a whole has to proceed in an orderly manner also with a view to a speedy entrenchment, it was essential that a great many officers had to know their jobs well, particularly so as to the conduct of the work in hand, some with regard to the work in general, a great many others with regard to its various parts, such as the respective regimental or other quarters of which they were in charge and for which purpose every one of them received special instruction according to the requirements of his lodgings. However, in order to improve this instruction, I have thought that the best course to pursue would be to give the subject-matter of the *Castrametatio* the following explanation.

¹⁾ In the earliest army of Rome each regiment was under the command of a special officer, the "tribunus militum". In Republican days the command of each legion was vested in six tribunes, who commanded in rotation. From 207 B.C. twenty-four of these officers were elected by the people (tribuni militum a populo). When more than four legions enlisted the consuls chose the additional tribunes, who were called "Rufili". Caesar changed this and gave their work to his "legati". The office of the "tribuni" was still continued, but less responsible work such as attending exercises and drills, granting discharges or furloughs, keeping the military rolls, was now left to them. They were occasionally entrusted with the command on the march. The permanent camps were then also entrusted to a new command, the "praefectura castrorum". (See for the duties of the Tribuni when camping, inter alia Loeb Classical Library, Polybius, *The Histories* III, p. 329-353).

Leghermeting dese verklaring te doen : Want hoewel daer af (als voren verhaelt) veel gheschreven is, zoo vereyscht nochtans alnu dit bezonder ghebruyc syn bezonder onderrichting. Ooc heeft my ghedocht myn beroep zulcx te vereyfschen, om dattet v *Hoochmoghende Heeren* beliest heeft my vande Leghermeting den last te gheven, daer af ic de voorgaende jaren inde * daet te Velde de oordening en bevel van syn *Vorstelicke Ghennade* gevolcht hebbende na myn vermoghen, zal nu inde spiegheling, voorderlic zijnde totte daet, zoo veel doen als ic kan. Daer me ic ooc te vrymoedelicker voortga, om dat op voorleden jaren de grontteekeninghen der Veltlogieringhen vande Leghers uwer *Hoochmoghentheden*, begheert zijn geweest niet alleen by leeghe perfoonen, maer ooc by groote Vorsten in verre Landen.

Aengaende tghene hier in beter zoude hebben kunnen ghedaen zijn, bidde my daer af ontschuldicht te worden, als gebrekende aende volkomen wetenschap, diemen acht gheen mensch te hebben, ende niet aen den goeden wille, daer me ic na myn ghering vermoghen bereyt ben tot uwe *Hoochmoghentheden* dienst.

Gheschreven inden H A B O H, den 4 November, 1617,
door uwe *Hoochmoghentheden* Leghermeter en onderdani-
ghen Dienaer

Symon Stevin.

For, although (as has been stated before) there has been written a great deal about it, its particular application as such, requires special instruction. Further I have thought that my profession calls for this action, as your High- and Mightinesses have been graciously pleased to entrust me with the Castrametatio; and, where in previous years, I have followed in the field the method and instructions of His Princely Grace in practice to the best of my ability, I shall now devote myself to its theory as it is conducive to its practice. I shall therefore boldly pursue my endeavours since in previous years the ground-plans of the encampments in the field of your High- and Mightinesses' armies were not only desired by persons of lower rank but also by great sovereigns in distant countries.

As to all that could have been done better in this writing, I beg to be excused, it being merely attributable to a lack of complete knowledge, that no man can possess, and not in any way to a lack of good will, by which in my humble power I am willing to serve your High- and Mightinesses.

Written in the Hague, November 4th 1617, by your High- and
Mightinesses' camp-measurer and obedient Servant

Symon Stevin

EER-DIGHT.

tot verbreydingh van den onverdelghe-
lijcken Naem van

MEESTER SYMON STEVYN.

DE Oude worden nu daerom zeer hoogh ghepresen,
Om datter doen altyt bevonden zijn te wesen
Van wien iet merckens waert, in konst oft ooc in daet,
Te weghe was ghebracht, dat sy tot ieders baet,
En hunnen grooten Naem, dat by gheschifte stelden,
Op datmen t'alder tijt eeuwigh dit zoude melden,
Alzoo te zijn betracht. Maer vele Schrijvers out
Gheschreven hebben veel met zulcken schijn zoo stout
Als oft sy zulcken konst verstonden, oft die daden
Zelfs hadden me ghedaen; Maer waren zelfs in't raden
Daer noyt eens by gheweest. Lof zij dan dees *Stevyn*,
Die grondelijcken stelt, de konst ghebruyct te zijn,
En ooc de wijs daer by, daer hy met syn verstande
Zelfs toe gheholpen heeft met raedt en metter hande:
Stevyn die met syn konst de gantsche *Vveerelt* pocht,
Vviens hoogh-ghetroonden Naem vliegt boven in de
Locht.

A. S.

SONET 1)
AUQUEL EST FAIT
jugement de ceux qui ont bien campé.

En parcourant de l'oeil l'Histoire de *Bellonne*,
Pour y marquer au vray qui a campé le mieux:
Je trouve que le *Juif* son Camp si bien ordonne,
Qu'aucun guerrier qui soit sous la cappe des Cieux.

Tamerlan l'imitant, emporte la Couronne
Estant en ce haut point, prudent, caut, curieux;
En apres aux *Romains* puis aux *Grecs* je la donne
S'estants aussi monstrez de bien camper soigneux.

Mais comme un brave Aiglon volant dessus la nue
Laisse de loing l'Austruche en trompant nostre veüe,
Ainsi le grand *Nassau* surpasse tous ces Mars;

Car il campe luy seul d'une telle maniere
Qu'il sera à jamais de loger l'Exemplaire
Aux *Juifs*, à *Tamerlan*, aux *Grecs*, & aux *Ceasars*.
De Neree.

¹⁾ Instead of translating the Dutch laudatory poems into English we have reproduced the sonnets from the French 1618-edition. About the poet: Richard Jean de Neree it is known inter alia that he was born in Caen in the year 1579 and was matriculated at Leyden university in November 1601 as a student of divinity.

By resolution of the States General of August 28th, 1611 he was appointed chaplain to Châtillon's Regiment and has presumably been one of the three chaplains referred to on folio 16 of the present work. He dedicated several of his writings to Prince Maurice to whom he is said to have been army-chaplain from the year 1611 to 1623 (*New Netherl. Biographical Dictionary* V-362).

LOF-DIGHT OP DE LEGHERMETINGH,

Beschreven door Meester S. Stevyn.

Vermaerde Oorlooghs-lien in daet en rijpen rade,
Zijn deur des *V*Veerelts rondt veel overal bespeurt
In d' alderoutsten tijt, die deur huns *V*yandts schade,
Hem looflijc aengbedaen, na hebben zelfs ghebeurt
't Bezit van Stadt en Landt: Maer gheen in tijt voorleden
Dat na-ghekomen, oft te vreeghe heeft ghebracht,
Twele Roma heeft bestaen, dat zoo zeer is bestreden,
En zoo bestreden heeft, als oyt kan zijn bedacht:
Zoo dat gheen volc zoo fel, noch gheen zoo stercke Steden,
Gheen Landen noch zoo rijk, gheen Vorsten zoo ghemant,
Vermochten teghen hun, oft sy zijn als vertreden
Van 'trijcke Roomsche Rijk, en vrome Roomsche hant,
Deur hun goet Krijghs beleyt, en arghe Oorlooghs listen:
*V*Vaer van 'tvoornaemste is hun Leghermetingh vvijs,
Die sy zoo vast en veel op 't aldermoedighst vvijsen
Te slaen met alder vaert, dat niemant voor hun prijs
Noch na behalen zal, dan d' Hoogh-gheboren **HEER**,
Den vvijs-vermaerden Vorst **MARITIUS van NASSOUVE**,
*V*Viens vvijs-beroemden Naem, en opghehoopte Eer,
Deur heel de *V*Veerelt klinck, deur synen dienst ghetrouwe
Ghedaen ons Vaderlandt, deur syn beleyt in 't slaen
Syns vaste Legher-plaets; dat sy zelfs moesten vluchten,
Die met een groot gheveelt van volc hem quamen aen
Om slaen syn kleyne Heyr, op 't onverzien in duchten.
En op dat ooc den vlijt, en groot' ervarentheyt
Te meerder blijcken mach van desen **PRINS verheven**,
Zoo heeft v syn **STEVYN**, als Dienaer vvijs verbreijt,
De vvijs naetelijc in Druc net vvt-ghegheven.

A. S.

SONET ¹⁾
A MONSIEUR STEVIN,
Mathematicien & Ingenieur de Son Excellence, &c.

Grand *Aenée* il falloit le burin d'un *Virgile*
Pour graver tes beaux faits sur un bronze eternel;
Alexandre eust voulu qu'*Homere* autant habile
Eust arboré les Siens sur un estage tel.

Pour moy, je suis fâché qu'une plume puerile
Ternisse les Lauriers d'un *Heros* immortel;
Que quelque Esprit divin tous ses Gestes n'enfile,
Pour les cloûter dessus le plus sublime autel.

Il est vray qu'on ne peut nullement les comprendre,
L'*Infini* ne pouvant par le fini s'entendre;
Mais aumoins devoit-on, ne les profaner pas.

Un seul *Stevin* paroist digne d'un si grand Maistre;
Monstrant comme il assied son Camp sans rien omettre;
Aussi autre que luy ne le pouvoit ça bas.

De Neree.

¹⁾ See the note on p. 267.



KORTBEGRYP DER LEGHERMETING.

DE Ede Leghermeting zal tweederley zijn: Ten eersten vande manier diemen dadelic ghebruyct heeft inde Leghers der **HOOCHMOGHENDE HEEREN STATEN**, na den eysch haerder middelen ende omstandigheden, daer af drie Hooftstucken zullen beschreven worden. Ten anderen vande manier met heele volkomentheyt, ghelijc de Romeynen (van zeer groote macht zijnde) ghelogeert hebben, daer af ic int vierde Hooftstuc zegghen zal. Maer om het inhoudt van elc der voorschreven vier Hooftstucken int korte te verklaren, zoo valt eerstelic te aenmercken, dat aenghezien eermen aen't meten komt, gheweten dient wat Leghermeting beteeckent, zoo zal het eerste dusdanich zijn:

1 HOOFTSTUC *vande bepaling of beschrijving der Leghermeting.*

BEkent wesende watmen met Leghermeting verstaet, zoo moet, eermen daer toe komt, gheweten zijn watter zal ghelogeert worden, tot welcken eynde men zeker lijsten beschrijft, die ghestelt zullen worden onder een opschrift, aldus luydende:

A 1 HOOFT-

SUMMARY OF THE CASTRAMETATIO.

This Castrametatio is to serve a double purpose: firstly by its application as actually used in the encampments of their High- and Mightinesses the Lords of the States General according to the requirements of the military equipment and attendant circumstances, which will comprise three chapters. Secondly the very perfect method of encampment of the Romans (being very powerful) and with which I shall deal in chapter 4. But in order to explain the contents of each of these four chapters in a concise manner it should be observed first of all, that before one arrives at the actual marking out it should be known what Castrametatio stands for, so that Chapter 1 will read as follows:

CHAPTER 1 *on the definition or description of Castrametatio.*

If one knows what Castrametatio (the marking out of army camps) stands for, before carrying this into effect, one should ascertain the composition of the army that has to be lodged, for which purpose one makes up special lists, to be arranged under the following heading, reading:

2 H O O F T S T V C, *vande Lijsten inhoudende tghene in
een teghenvvoordich Legher moet ghelogeert vvorden.*

Daer na volcht de manier der meting onder dusdanich
opschrift:

3 H O O F T S T V C, *vande teeckening of meting des
Leghers.*

Ten laetsten zal volghen het voorschreven Hoofstuc
vande manier der Leghermeting met heele volkoment-
heyt, hebbende een opschrift als volcht:

4 H O O F T S T V C, *van tghene myns ghevoelens oorbaar
ende noodich zoude zijn totte gheduerighe form eens Leghers,
die altyt de zelve mocht blijven.*

En zal tot meerder klaerheyt by elc Hoofstuc ghestelt
worden syn Kortbegrijp, vervanghende de opschriften der
verscheyden leden van dien.



CHAPTER 2, *about the lists comprising what has to be lodged in a contemporary army camp.*

Then follows the manner in which the marking out is to be effected under the heading:

CHAPTER 3, *about the ground-plan or marking out of the camp.*

Finally there is to follow the afore-mentioned Chapter on the manner of marking out, to entire perfection, army camps under the following heading:

CHAPTER 4, *about that which in my opinion will be admissible and necessary with regard to the permanent form of an encampment which has to be kept always the same.*

And for the sake of clearness each Chapter will be provided with a summary of the titles of the respective sections.



I HOOFTSTVC.

Vande bepaling of beschrijving der Leghermeting.

KORTBEGRYP DESES I HOOFTSTVCX.



E ghedaente der Leghermeting zal in dit I Hooftstuc deur 11 leden verklaert worden.

Het 1 lidt vande logering int ghemeen, mette form des Romeynschen Leghers. D'ander volghende leden zijn vande ghedeelten des Leghers dat hier zal beschreven worden, te weten:

Het 2 lidt vande form van een vendel voervolk.

Het 3 vande form van een regiment voervolk.

Het 4 vande form van een vaen Ruyters.

Het 5 vande form van een regiment Ruyters.

Het 6 vande form des quartiers van syn *Vorstelijcke Ghewade*.

Het 7 vande form des quartiers vanden Generael der artillerie.

Het 8 vande form des quartiers der Amptliën die in dit Legher by malkanderen ghelogeert worden.

Het 9 vande form des quartiers vande waghens.

Het 10 vande form der march.

Het 11 vande form des Leghers int gheheel.

I LIDT.

Vande logering int ghemeen, mette form des Romeynschen Leghers.

OM voor eerst te verklaren d'oorfaec waerom dese logering te velde gheseyt wort Leghermeting, zoo is te weten, datse toegaet door een verdeelinghe der logijsten met overvloedighe meting aen allen oorten des Leghers, waer deur de Romeynen het zelve niet onbecuamelic ghenoeemt hebben *Castrametatio*, ^{* Castrametatio.} dat is Leghermeting, zulcx dat ic (henlien daer in volgende) by dien naem blijven zal. Om nu te komen totte beschrijving der eyghenschappen van dien, zoo is voor al te weten, dat hoewel verscheyden menschen verscheyden oordeninghen verdencken, d'een beter als d'ander, zoo isser nochtans wat ghemeens daermen na der Krijchervarens ghevoelen op behoort te letten ende na te trachten: Tzelve beschrijft Xenophon met korte woorden verhalende de manier der Legherlogering van Cyrus, waer af den zin dusdanich is: Te weten, dat den Velroverst om aen allen oorten even na te wesen, behoort te logeren int middel van't Leger, ontrent hem hebbende de Amptliën gheen krijghevolk zijnde, metsgaders krijghevuych, leeftocht,

A 2 bagage,

CHAPTER 1

On the definition or description of *Castrametatio*.

SUMMARY OF THIS FIRST CHAPTER.

The form and substance of *Castrametatio* will be explained in this first chapter in 11 sections. Section 1 deals with encampment in general, including the plan of a Roman army camp. The other sections concern the parts of the army camp to be described below, i.e.:

- | | | |
|---------|----|--|
| section | 2 | plan of a company of infantry. |
| " | 3 | plan of a regiment of infantry. |
| " | 4 | plan of a squadron of cavalry. |
| " | 5 | plan of a regiment of cavalry. |
| " | 6 | plan of the quarters of His Princely Grace. |
| " | 7 | plan of the artillery-general's quarters. |
| " | 8 | plan of the quarters of the officers to be lodged together in this camp. |
| " | 9 | plan of the quarters of the army-waggons. |
| " | 10 | plan of the market-place. |
| " | 11 | plan of the encampment as a whole. |

SECTION 1

On encampment in general, including the figure of a Roman Army camp.

In order to explain first why this encampment in the field is called *Castrametatio*, it should be known that it consists of a distribution of the lodgings with a great many measurements in all parts of the camp, for which reason it has been aptly called *Castrametatio* by the Romans, i.e. measurement of the army camp (or camp-measurement for short), so that I (following them in this) shall stick to this name. Now in order to arrive at a description of the properties of this conception, it should be known first of all that although different people may devise different methods, one better than the other, still there is something of a general nature which from the point of view of military experience should be considered and aimed at. This is described by Xenophon ¹⁾, when he briefly narrates Cyrus's method of encampment, which is to the effect that the general, in order to be equally near to all parts of the camp, should be lodged right in the centre of the camp, having about him the officers who do not belong to the soldiers, together with the military equipment, the provisions, the baggage, and the personnel assigned thereto; moreover

¹⁾ p. 399. V, 8-11. "*The arrangement of his camp*. Accordingly, he himself first took up his position in the middle of the camp in the belief that this situation was the most secure. Then came his most trusty followers, just as he was accustomed to have them about him at home, and next to them in a circle he had his horsemen and charioteers; for those troops also, he thought, need a secure position, because when they are in camp they do not have ready at hand any of the arms with which they fight, but need considerable time to arm, if they are to render effective service.

To the right and left from him and the cavalry was the place for the targeteers; before and behind him and the cavalry, the place for the bowmen. The hoplites and those armed with the large shields he arranged around all the rest like a wall, so that those who could best hold their ground might, by being in front of them, make it possible for the cavalry to arm in safety, if it should be necessary." (Loeb Classical Library, Xenophon, *Cyropaedia* II, p. 399).

bagage, ende het naghevolgh van dien : Voort dat al dese behooren omvanghen te worden vande Ruyters, ende om de zelve het voetvolc, uyt oorzaec datter teghen een haestighe overvalling des Vyants eer ghewapent ende ghereet is om vechten, dan de Ruyters, wiens peerden moeten ghezadelt ende ghetoomt worden, benevens de wapening haers eyghen lijfs : boven dien ist voetvolc ooc bequamer om te belaten des Vyants onvoorzien aenkomst over de gracht ende borstweer des Leghers, waerentusschen de Ruyters hun konnen veerdich maken : Doch heeft Xenophon dese reghel zoo ghemeen beschreven, dat mender geen bezonder grontteekening uyt maken en kan, na de manier ghelijck Cyrus die ghebruycte.

Daer is noch een Legheroordening gheweest by Tamerlan, die zeer bezonder schijnt gheweest te hebben, beschreven int Arabisch door Alhacen int 5. Hoofstuc, en overghet int Fransoys door den Abt van Mortemer, welc Legher tot onderscheyt van zeker vijfander Leghers, het Keyserlic ghenoeemt wiert, gheduerlic inhoudende 60000 voetknechten, en 40000 peerden, waer in Tamerlan wilde dattet eerste ghetal daer bevel over gheschiedde, zoude zijn van 10, daer na van 100, daer na van 1000, daer na van 10000, noch warendertotte wacht des Velt-oversten 4000 mannen te voet, met 2000 peerden die rontom hem logeerden: boven dien noch 25000 arbeeyders totte begraving en verstercking des Leghers, want het in gheen Sieden gheleyt en wiert, maer moest altijt winter ende somer te velde zijn, zoo wel in tijt van vre als van krijch, en treckende van d'een plaats tot d'ander, moest over al begraven worden : Dit Legher diende om altijt metter haest ghereet te wesen daert noodich viel, oock tot verstercking en te rechtbrenging van d'ander vijf Leghers die in onorden mochten gherocht zijn, welcke laghen in Sorie, China, Cambalu, Moscovie, en Cheronnese, elc van 40000 te voet, ende 20000 peerden, doch niet altijt te velde ghelijc het Keyserlic, dan alleenlic alst noot was : Maer want in dit Keyserlic Legher op den tijt van zeker twee of drie jaren cenighe onorden inghebroken was, die Tamerlan Axalla dede te recht brengen, zoo is daer uyt grootelickx te vermoeden datter op de manier der logering zeker oorden was, ghemerct de verlogering altijt geduerde, met een zelve menichte van volc, altijt in een zelve oorden van verdeling, dat boven dien Tamerlan op d'oorden int ghemeen zoo ernstich acht nam : Doch de form van dien onbeschreven zijnde, zoo en is daer af niet eyghentlicx te zegghen.

Maer Polybius beschrijft der Romeynen Leghermeting met meerder onderscheyt, zulcx datter verscheyden Schrijvers grontteekeninghen uyt ghetrocken hebben, onder welcke my ter hant ghekomen zijn die van Patricius, den Hertoch van Vrbin, Robertello, des Choulx, en Lipsius, uyt de zelve heb ic Lipsius form nagheteckent om hier tot voorbeelt te stellen, alwaer den vierhoec A des Velt-oversten logijst bediet prætorium ghenacmt, de vierhoecken met B zijn voetvolc, met C Ruyters, de rest zijn markt, quæstorium, straten, en ander quartieren van des Leghers naghevolgh, gheen krijchslin wefende, daer af hier na int bezonder eyghentlicker zal ghezeyt worden, alnu ghenoech zijnde de manier van der Romeynen veltlogering int ghemeen aenghewesen te hebben, om uyt den rouwen beter te verklaren wat Leghermeting beteekent.

Dit

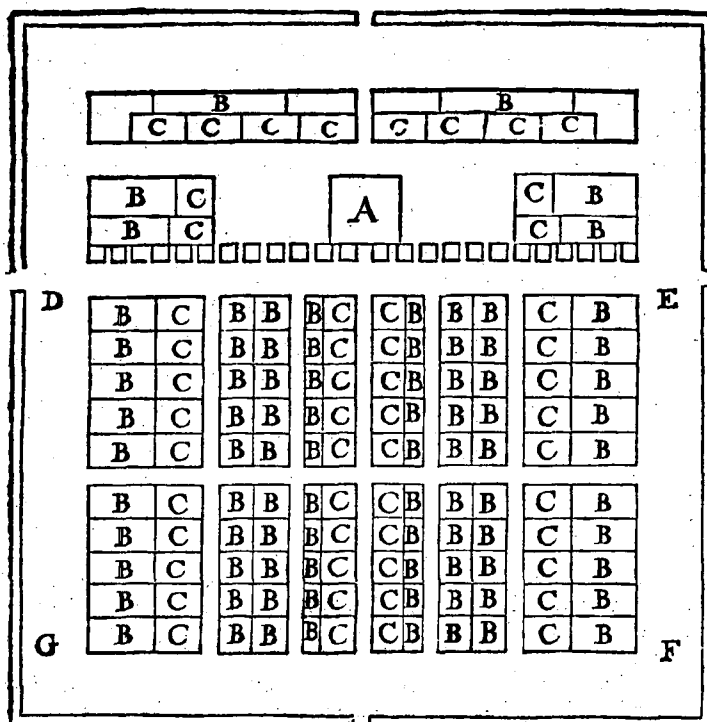
that all these should be surrounded by the Cavalry, and that the Cavalry should be equally surrounded by the infantry, since the latter, when attacked by the enemy by surprise, will be under arms and ready to fight more quickly than the cavalry, whose horses have to be saddled and bridled, while the men themselves have to put on their armour; besides the infantry is better able to prevent the enemy from suddenly crossing the ditch and scaling the parapet of the encampment, while the cavalry get ready for battle. But Xenophon has described this rule in such a general manner, that one could not derive from it an accurate ground-plan, after the method adopted by Cyrus.

There has also been a method of encampment under Tamerlan, which is said to have been very singular and which has been described in Arabic by Alhacen in his chapter 5 and translated into French by the abbot of Mortemer; Tamerlan's army camp was called the Imperial Camp, to distinguish it from five other camps, and consisted permanently of 60,000 foot and 40,000 horse, of which the smallest unit to have a commander, according to Tamerlan's wishes, should be 10, then 100, then 1000 and then 10,000; the general's guard yet consisted of 4,000 foot and 2,000 horse, that were encamped about him. In addition there were 25,000 workmen to carry out the entrenching and fortification of the camp, because Tamerlan's military forces were not cantoned in towns but had to remain in the field winter and summer, in times of peace as well as of war, and since they travelled from one place to another, they had to be lodged time and again in fortified encampments. This camp had to stand by at once, wherever this should be required, serving at the same time as the reinforcement and redressing for the other five camps in case they had run riot, which latter lay in Syria, China, Cambalu¹⁾, Russia and Chersonese²⁾, each camp consisting of 40,000 foot and 20,000 horse, not always being in the field, like the Imperial army, but only in times of need.

But as riots had broken out in this Imperial Camp covering a period of two or three years, which Tamerlan had suppressed by the aid of Axalla, it may be generally concluded that there existed a positive order in the method of encampment; seeing that these army camps always consisted of an equal number of men, always grouped in the same order, while besides it is known that Tamerlan as a rule strictly observed the military discipline. But since we have no description at our disposal, we cannot make any definite statement about this method of encampment.

¹⁾ *Cambalu* was the capital of Cathay, the empire of the "Great Cham", situated North-Eastly of the Chinese wall (cf. Nicolaas Witsen, *North and East Tartary*, Amsterdam 1692, 1705; especially p. 966; the map of 1663 by J. Blaeu of "Tartaria sive Magni Chami Imperium . . . Cambalu Cathaye metropolis habet 28 mill. in circuitu").

²⁾ *Cheronese*, corrected to Chersonese, here signifying the Crimean peninsula, conquered about 1380 by Tamerlan from the Golden Horde of the Muscovites.



Dit zoo zijnde, Het is te weten dat syn *Vorſelicke Genade* int begin voor elc Soldaet ontrent zoo veel plaats veroordende als de Romeynen deden, latende yghelic, na tghemeen ghebruyc des teghenwoordighen tijts in syn regiment haer hutten bouwen zoo ſy't verſtonden, zonder aen zeker reghel verbonden te wesen. Maer Colonellen en Capiteynen deden haer klachten, onmoghelic te zijn haer volc op zoo klein begriip te legghen, ghelijc ooc bleec metter daet: Doch alzo der Romeynen eyghentlicke verdeeſing van elc vendel by Polybius niet beſchreven en is, maer dat hy alleenlic daer toe vierhoecken noemt, zo heeft syn *Vorſelicke Genade* die veroordent na tghene hem docht den krijch defes tijts te vereyſſchen, welcke zulcx was, dat ſylieden met minder plaats danſe te voren hadden, zeyden ruymte ghenoech te hebben en bequamelic ghelogeert te zijn: Boven dien heeft hy reghel gheſtelt op d'ander quartier, daer af ick inde navolghende leden de formen zal beſchrijven, op dat des Leſers ghedacht een * gront mach hebben om lichter te verſtaen tghene daermen af ſprecc, en waer na datter eyntlic ghetracht wort.

2 LIDT.

Vande form der logijſten eens vendels voetvolc.

TOt een vendel van 100 voetknechten veroordentmen twee rijen hutten, en wort tot elcke rijke plaats ghegheven lanc 200 voeten, breed 8 voet, en een ſtraet tuſſchen beyden breed ooc 8 voet, waer in de hutten haer deuren

A 3

of uyt-

Polybius¹⁾, on the other hand, describes the art of camp-measurement of the Romans more accurately, in fact in such a manner that several authors have copied his ground-plans, of which there came to my hand those by Patricius, the Duke of Urbino, Robertello, des Choulx, and Lipsius; from all these I have copied the figure by Lipsius, to serve as an example here: where the quadrangle A stands for the general's quarters, called praetorium, the quadrangles with B stand for the infantry, those with C for the cavalry, the remaining part comprising the market-place, quaestorium, streets, and quarters of the personnel, who do not belong to the soldiers, about whom we shall speak later in greater detail; since so far the art of camping of the Romans has been sufficiently described in a general sense to make it possible to explain roughly what *Castrametatio* means.

This being so, it should be known that his *Princely Grace* at first assigned to each soldier just as much space as the Romans did, leaving it to every man in his regiment, according to the general custom of the times, to build his hut as he could, without being tied down to further instructions. However, the Colonels and Captains complained, that it was impossible to lodge their men in such a small space, which proved to be true in practice. Yet, since the Roman partition as such of each company has not been described by Polybius and since he only mentions quadrangles for them, his *Princely Grace* has therefore determined these according to the contemporary requirements of warfare to the effect, that those, who were being assigned less space than they had had before, maintained that they had space enough and that they were comfortably lodged. Besides he has regulated the other quarters of which I shall describe the figures in the following sections, so that the Readers' thoughts may have a foundation to form a better idea of the subject under discussion and what we are finally aiming at.

SECTION 2

Plan of the lodgings of a company of infantry.

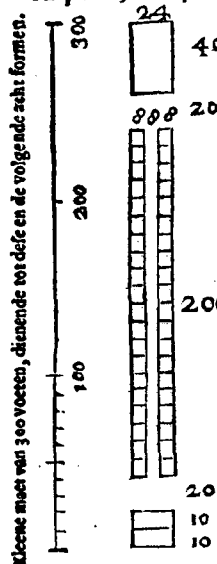
To a company of 100 men infantry there are allotted two rows of army-huts, each row measuring 200 feet in length and 8 feet in width with a street in between, equally 8 feet wide into which the huts either open by means of doors

¹⁾ For Polybius cf. note 23 of the Introduction; for Francesco Patricius and his works: *La militia Romana di Polibio, di Tito Livio e di Dionigi Alicarnasseo* (Ferrara 1583) and *Paralleli Militari* (Rome 1594) cf. Dijksterhuis, p. 239 and note 2, Hahlweg pp. 184, 185 and notes; for Francesco Maria, Duke of Urbino, cf. Castriotto-Maggi, who call him (fol. 110): "vero maestro di guerra, di felice ricordanza"; Jähns, pp. 472, 774, also about his lieutenant Giambattista della Valle di Venafrò, whose small work, named *Vallo*, was first published in Venice in 1521; these two authors also occur in Vermeulen, *Handboek Geschiedenis der Nederlandsche Bouwkunst*, II, pp. 408, 411; for Francisco Robertello's Latin translation of *Aelianus* (Venice, 1552) cf. Hahlweg pp. 150, 194, 302, 303; for Guillaume du Choul's *Discours sur la castramétation et discipline militaire des Romains*... (Lyons, 1555) cf. the "Oranje-Nassau boekerij" in Royal Library, The Hague, and the Dutch translation by M. Smallegange (Amsterdam, 1684), cf. also the important article by Turpin C. Bannister, *Oglethorpe's Sources for the Savannah Plan* (Journal of the Society of Architectural Historians, May 1961) p. 59 on du Choul and p. 62 on Stevin's *Castrametatio*; for Lipsius cf. note 18 of the Introduction and Dijksterhuis, pp. 239, 348.

of uytcomft hebben. Hier voor heeft den Capiteyn een vierhoec breed als fyn vendel 24 voet, lanc 40 voet, met een straet tuffchen hem en het Krijchsvolk breed 20

voet: Achter dit krijchsvolk is een vierhoec voor Soetelaers hutten breed 24 voet, lanc 20, welverftaende dat de achterfte helft daer af is ledighe plaets dienende tot kooepullen der Soetelaers dier hutten, en ooc der Soldaten van dat vendel die mochten begheeren zelf te koken, wantmen henlien niet toe en laet zulcx by haer hutten te doen om het perijckel des brants, voorts isser een straet tuffchen dese hutten en het Krijchsvolk breed 20 voet, waer in de Soetelaers hutten haer deuren of uytcomft hebben: En is een vendel in als lanc 300 voeten, breed 24, waer af de nevenftaende form tot naerder verklaring dient.

Dit is geweest voor een vendel van 100 mannen of daer ontrent, doch staet te ghedencken dat voor grooter vendels de menichte der rijen vermeerderd wort, als voor 150 mannen of daer ontrent drie rijen, voor 200 mannen of daer ontrent, vier rijen en zoo voorts.



3 LIDT.

Vande form der logijften eens regiments voervolk.

GHenomen dat een regiment hebbe 10 vendels, elc van 100 mannen, hier af wort den Colonel int middel ghelogeert tuffchen de Capiteynen over elcke zijde vijf, yder vendel van form ghelijc int 2. lidt ghezeyt is, en tuffchen elcke twee vendels een straet breed 8 voet, daer in de hutten rugheling na malkander staen, dienende tot eyghen gherief der Krijchliën: de voorfte zijde van des Colonels perc doet 64 voeten, en achterwaert zoo veel als hy van doen heeft: het overschietende is ten deele voor hutten des Predicants, Schrijvers, Barbiërs, en andere gheen Krijchsvolk wesende, de rest voor waghens en karren vande Soetelaers des zelve Colonelschaps. Dese ledighe plaets int middel des regiments wort ooc voor bequaem ghehouden teghen brant, om twier, (als het ongheval ghebeurt) daer te doen stuyten, om d'ander helft te bewaren. De Soetelaers hutten zijn aldus achter de regimenten veroordent voor de ghene die daer begheeren te komen, zonder bedwonghen te wesen op de markt te logeren, om redenen dat ettelicke Soldaten by de Soetelaers hun koften koopen, en daghelicx gaen eten, of op de kerf haer voetsel halen, ooc datter Soldaten des regiments zijn diens huysvrouwen, kinderen, of ymant vanden haren met zoetelrije het Legher volghen, en begheeren by het regiment van haer Mans of Vaers te logeren, zulcx dat zoo wel d'een als d'ander daer megherief is, beter dan offte verre van malkander waren: Ooc zijnder Kramers, Sweertvaghers, Zadelmakers, Spoormakers, Smeen, Kleermakers, Schoenmakers, Backers, Vleeschslachters, en ander Ambachtliën, daer af eenighe zeker regimenten volghen en daer by begheeren te logeren, ander die de markt verkiesen, twelcmen yghelic vry stelt, te meer om dattet inde Steden tot gherief

or apertures. Facing the street the captain has a quadrangle of equal width as his company i.e. 24 feet, 40 feet in length with a street 20 feet wide between him and the soldiers. Behind these soldiers there is a quadrangle for the sutlers' huts 24 feet in width and 20 feet in length, on the understanding that the unoccupied half at the back remains available for the cooking-pits of the adjacent sutlers' huts and also for those soldiers of the company, who want to prepare their own meals, for they are not allowed to do their own cooking near their huts, because of the risk of fire. Further between these huts and the soldiers there is a street of 20 feet in width into which the sutlers' huts open either by means of doors or apertures. Thus the total length of a company amounts to 300 feet, width 24 feet, about which the adjacent figure gives further explanation.

This has been for a company of 100 men or thereabouts, yet it should be borne in mind that with larger companies the number of rows is to be increased i.e. for a company 150 men strong or thereabouts three rows, for a strength of 200 men or thereabouts 4 rows etc.

(The figure on the opposite page bears the inscription: "Small measure of 300 feet, serving the purpose of this figure and of the following 8 figures".)

SECTION 3

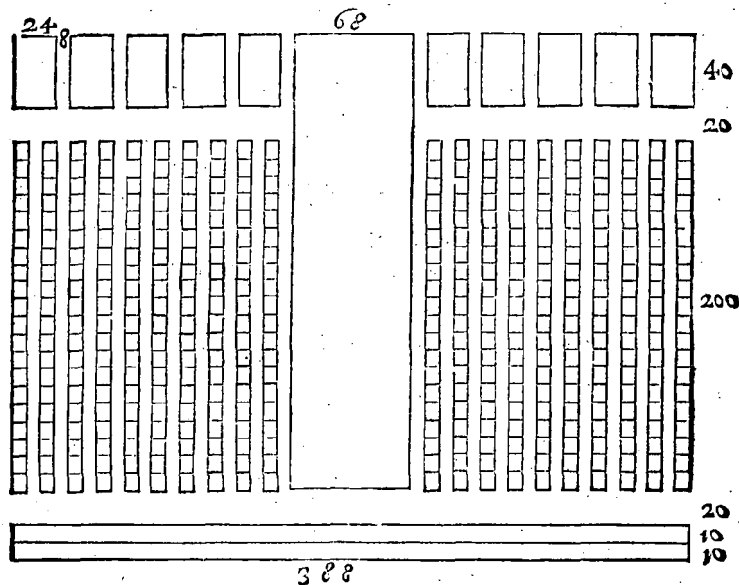
Plan of the lodgings of a regiment of infantry.

If we take it, that we are having a regiment consisting of 10 companies, comprising 100 men each, then the Colonel is to be lodged in the centre among the captains, of whom there are 5 on each side (each company according to the figure in section 2) and between every two companies there is a street 8 feet wide, in which the huts are placed back to back, the street serving for the personal convenience of the soldiers. The front side of the park assigned to the Colonel, is 68 feet ¹⁾, whereas at the back there is all the space required by him; the remaining space being available for the huts of the army-chaplain, the clerk and the barber and all those, who do not belong to the military; the rest is to be reserved for the waggons and carts of the sutlers belonging to the regimental staff. This unoccupied space in the centre of the regiment is also considered to be useful in case of fire in order to arrest the flames (in case of an accident) in order to safeguard the other half. The sutlers' huts are therefore placed behind the regiments for the benefit of those, who prefer to lodge there rather than in the market-place, since there are a great many soldiers, who buy their provisions at the sutlers' and daily go and have their meals there or go and get their food on credit ²⁾, whereas there are also regimental soldiers, whose wives, children or other relations are following the army with provisions, wanting to encamp with their husband's or father's regiment, thus serving their mutual interest better than by being far apart from each other. Then there are the pedlars, sword-cleaners, saddlers, spur-makers, smiths, tailors, boot- and shoemakers, bakers, butchers and other tradesmen, several of whom follow special regiments and wish to encamp with them, while others prefer the market-place, which is left free to choose for any one, the more so because in the towns for the

¹⁾ A width of 68 feet has been adhered to (see fig. on folio 7 and calculation fol. 17); 64 is a printer's error that has been corrected in the German edition of 1631.

²⁾ "Op de kerf" translated by "on credit" according to the French edition.

gherief der Burgherije zoo toegaet, alwaer elc woont of op de marct of in zulcke straten als hy wil: Doch staet te ghedencken, dar vol zijnde de rijc der Soetelaers hutten achter een regiment, twelc achter elc vendel bedraecht 32 voeten, zoo en moghender niet meer komen, ghelijc daer af onder anderen naerder zal ghezeyt worden int 6 lidt des 3 Hooftstuck.



Dit is gheweest voor een regiment van 10 vendels, doch staet te ghedencken dat na meerder of minder menichte der vendels, het regiment verbreet of ghesmalt wort, blijvende altijt den Colonel int middel, uytghenomen als de vendels onparich ghetal zijn, want alsdan komt op d'een zijde een meer als op d'ander.

Merct noch wel te ghebeuren alsmen de Ruyterije waghens en het heel Legher by den anderen wil logeren, dat de regimenten van't voetvolc na de oordening als voren al tzamen niet breet ghenomen en zijn om de alarmplaetsen over al wel te besetten, en de rest te vervanghen: Doch machmen in zulcken ghevalle de langde vande rijen der hutten nemen op 100 voeten, die hier boven is gheweest op 200, ghevende elck vendel vier rijen, maer al de rest als voren, want hier me vallen de regimenten bykans noch eens 200 breet.

4 LIDT.

Vande form der logijsten eens vaens Ruyters.

Tot een vaen van 100 Ruyters veroordentmen twee rijen hutten, en wort tot elcke rijc plaats ghegheven lanck 200 voeten, breet 10 voeten: Tusschen dese hutten komen twee rijen peerden, diens plaats breet is 10 voet, en lanc ghelijc vande hutten 200 voet, zulex dat op elcke zijde staende 50 peerden, komt voor elc 4 voet: En staet elc peert metté hoofde na de hutte syne Ruyters, blijvende tusschen

convenience of the citizens it has been so arranged, that any one can live where he chooses i.e. either in the market-place or in any street he wishes. Yet one should bear in mind, that if the row of the sutlers' huts at the back of the regiment should be full up, covering a length of 32 feet at the back of each company, there are not to come anymore, as, inter alia, will be explained in section 6 of chapter 3.

This has been the arrangement for a regiment consisting of 10 companies, yet it should be borne in mind that the room for the regiment is increased or decreased according to the greater or lesser number of companies, the Colonel always remaining in the centre, except when the companies are having odd numbers, for in that case there is one company more on the one side than on the other.

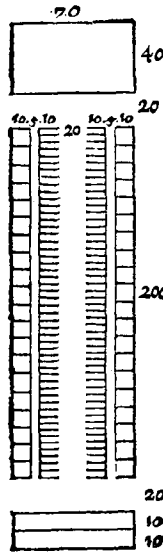
Further it should be observed, that if one wants to encamp the cavalry, waggons and the whole army together, the infantry regiments arranged according to the method adopted heretofore, have not been taken altogether too wide, in order to occupy the alarm-posts in an adequate manner everywhere and to supply the rest.

Yet in this case the length of the rows of army huts could be adjusted to 100 feet instead of 200, as given above, allotting 4 rows to each company, leaving the rest unaltered, thus causing the respective regiments to turn out almost twice as wide.

SECTION 4

Plan of the lodgings of a squadron of Cavalry.

For a squadron of 100 men Cavalry one allots two rows of army-huts and to each row one distributes 200 feet in length and 10 feet in width. In between these huts there are two rows of horses lined up occupying a space of 10 feet in width and similar to the huts 200 feet in length. Thus there are 50 horses on either side amounting to a space of 4 feet to one horse. Each horse is standing with his head facing the hut of his Rider, leaving a street 5 feet wide between the horses and



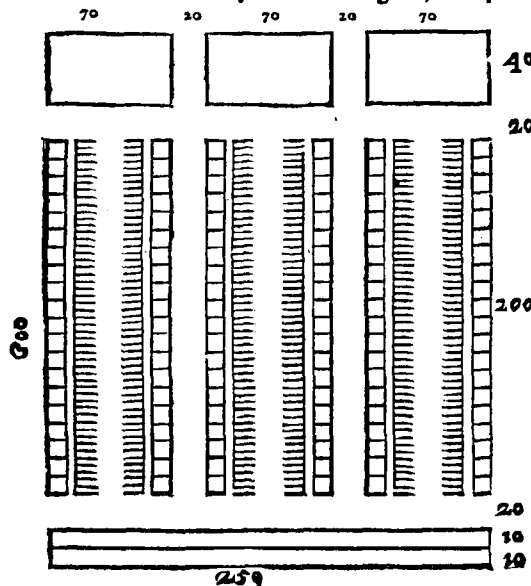
tusschen de peerden en de hutten een straetken van 5 voet, waer in de hutten haer deuren of uytkomst hebben : En tusschen de twee rijen peerden is een straet breed 20 voet : Hier voor heeft den Ritmeester een vierhoec breed ghelijc syn vaen 70 voeten, lanc 40, met een straet tusschen hem en het Krijchsvolc breed 20 voet : Achter dese Ruyters is een vierhoec voor Soetelaers hutten breed 70 voet, lanc 20, met een straet tusschen de zelve, en het Krijchsvolc breed 20 voet, waer in de hutten haer deuren of uytkomst hebben : En is de vaen in als lanc 300 voeten, breed 70. Merct noch dat dese oordening vande peerden metten hoofde te stellen na de hutten, en een straetken van 5 voeten tusschen beyden, gheschiet is met kennis van Ritmeesters en vernoeghen der Ruyters, om dat elc alzo bequamelic het oogh kan hebben op de haver die hy syn peert gheeft, en datse van syn nabueren niet ontleent en worde. Van tghenc ghezeyt is dient de nevenstaende form tot verklaring.

Dit is gheweest voor een vaen van 100 Ruyters of daer ontrent, doch staet te ghedencken dat voor grooter, de menichte der rijen vande hutten vermeerdert wort na behooren.

5 LIDT.

Vande form der logijsten eens regiments Ruyters.

Zommighe regimenten Ruyters worden hier ghemaect van drie vanen, eenighe van vier, latet by voorbeeld van drie zijn, elcke inhoudende 100 Ruyters : Dese vanen yder van form ghelijc int 4 lidt, worden alle drie nevens



den anderen geleyt, blijvende een straet tusschen elcke twee breed 20 voeten, daer in de hutte rugeling na malkander komen, dienende tot eygen gherief der Krijchsvolc. Des Colonels perc is het middelste der drie. Maer want zulcken Colonel hier altijd is een der Ritmeesters, die niet meer baggage en heeft als d'ander, zoo en wort hem geen meerder plaats gegeven. Dit regiment is in als lanc ghelijc voorgaende 300 voeten, breed 250, waer af de nevenstaende form tot naerder verklaring dient.

6 LIDT.

the respective huts, into which the huts open either by means of doors or apertures. Between the two rows of horses there is a street 20 feet in width. Facing these rows the Cavalry captain has a quadrangle at his disposal of equal width as his squadron, i.e. 70 feet and 40 in length leaving a street 20 feet wide between him and the soldiers. At the back of these soldiers there is a quadrangle for the sutlers' huts, measuring likewise 70 feet in width and 20 feet in length, leaving a street between these huts and the soldiers of 20 feet in width into which the huts open either by means of doors or apertures. Thus the squadron measures totally 300 feet in length and 70 feet in width. It should be observed, that the arrangement of the horses standing with their heads facing the huts and a small street of 5 feet in between, has been accomplished with full knowledge of the Cavalry captains and to the benefit of the horsemen, because in this way every one of them can easily keep an eye on the oats he is giving his horse and that it is not taken away by his neighbours. The adjacent figure serves as an explanation of that which is said heretofore.

This has been for a squadron of 100 men Cavalry or thereabouts, however, it should be observed that for larger squadrons the number of huts should be increased as required.

SECTION 5.

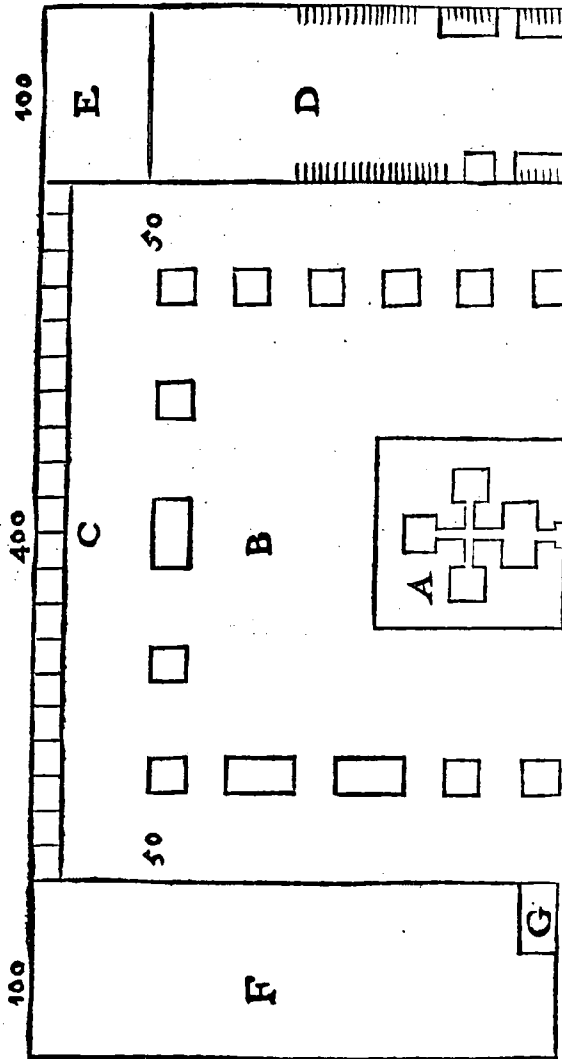
Plan of the lodgings of a regiment of Cavalry.

Various regiments are formed in this country out of three squadrons, some out of four; let it be for instance one out of three, each consisting of 100 men Cavalry. These squadrons, each formed according to the figure given in section 4, are all three of them lodged next to each other leaving a street in between wide 20 feet, in which the huts are being erected back to back, the streets serving to the personal benefit of the soldiers. The Colonel's park being right in the centre of the three quadrangles, for he is always one of the Cavalry-captains, who has not more baggage than the others and therefore he is not given any more space. This regiment (similar to the separate squadrons) measures 300 feet in length and 250 feet in breadth, about which the adjacent figure gives further explanation.

6 LIDT.

Vande form des quartiers van syn Vorstelicke Ghenade.

Hier toe wort genomen een vierhoeck van voren tot achter lanc ghelijc d'ander quartier 300 voeten, breed 600, waer in de deelen altijt op dusdani-
ghe form ghestelt worden : Den vierhoeck A begrijpt de Tenten van syn



Vorstelicke Ghenade, de
ander kleender vier-
hoeckkens Tentē be-
teyckenende zijn tot
het Hof ghehooren-
de, als des Hofmees-
ters, Secretarie, Edel-
lieden, Zael, Ghe-
meenzael, Keucken,
Gardemenger, Bot-
telrijc, Gardelinge,
de rest voor ander
persoonen: De plaets
Btusschen dese Ten-
ten, en de Tente A is
eē groot ledich perc,
waer in het Hofghe-
zinde haer t'zaem-
komst heeft, den bal
slaet, en hem ver-
maect : C zijn hut-
ten voor Dispensiers,
Botteliers, Spijswaer-
der, Wijntapper, Bier-
tapper, Zaelknechten
en ander Dienaers:
Ooc zijn onder dese
hutten den wijnkel-
der en bierkelder in
d'aerde ghegraven,
D den Stal, E Peer-
den der Edellieden,
F Wagens tot dienst
van't Hof, G Korde-
garde der wacht van
syn *Vorstelicke Ghenade*.

B

7 LIDT.

SECTION 6

Plan of the quarters of His Princely Grace. 1)

For these quarters one takes a quadrangle similar in length to the other quarters from the front to the back, measuring 300 feet in length and 600 feet in width, in which the various parts are always arranged in the following manner: the quadrangle A comprises the tents of his Princely Grace, whereas the other smaller quadrangles, representing tents, appertain to the Court, such as those belonging to the Majordomo, Secretary, Noblemens' Hall, General Hall, Kitchen, Pantry, Bottling-room, Linnen-room and the tents for other persons. The space B in between these tents and the tents marked A comprises a large open park, where the Court officials come together for recreation and enjoy themselves playing at ball or otherwise. C stands for the huts of the dispensers, butlers, stewards, wine- and beer-drawers, hall-stewards and other attendants. Moreover underneath these huts the wine- and beer-cellars have been dug into the earth. D represents the stable and E the Courtiers' horses, F the waggons in the service of the Court and G the "Corps de garde" of the body-guard of his Princely Grace.

¹⁾ With this translation we have also considered the French and German editions as well as the respective inscriptions (including also "Stevin") in the reproduced drawing from the Koninklijk Huisarchief (Royal Archives, The Hague, Inv. nr. 14-IX-2). Cf. fig. 4 in front of p. 260.

7 LIDT.

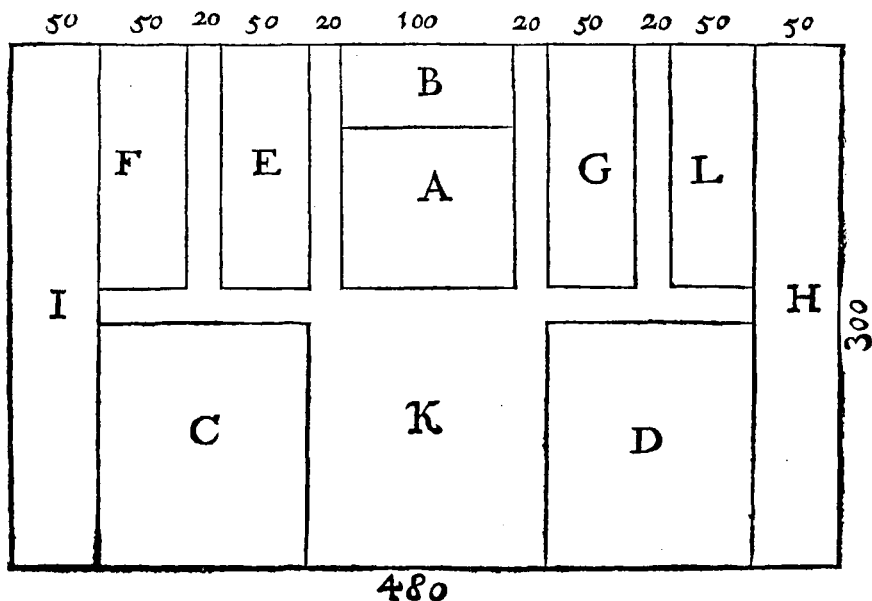
Vande form des quartiers vanden Generael der Artillerie.



Mer toe wort genomen een vierhoec lanc ghelijc d'ander van voren tot achter 300 voet, breer 480, waer in de vierhoeckighe percken van beteyckening zijn als volcht:

- A voor den Generael van't gheschut.
- B voor syn Lieutenant, met de Edellieden van't gheschut.
- C het Magazijn vande Artillerie, metten Commis, Controlleur, en Conducteurs van dien.
- D het Magazijn vande munitie van oorlogh, metten Commis, Controlleur, en Conducteurs van dien.
- E Ingenieurs met haer Conducteurs, Controlleurs vande fortication, met haer Conducteurs, Commis, en Schrijver.
- F Meester Connestabel, met syn Cannoniers, Meester vyerwercker, met syn Conducteurs, Petardier, Bateriaemeester.
- G Meester Timmerman, syn Lieutenant, met syn Timmerghezellen, Rademakers, Smits, Schanskorfmeester, Harniceurs, Kuyper, Prevooft van't gheschut, met syn dienaers, Chirurgien van't gheschut.
- H Matroosen om t'gheschut te trecken.
- I Pioniers met Mineurs.
- K ghemeene plaets dienende tot vergadering van volcen wagens die daer te doen hebben. L ledighe plaets voor onverdachte dinghen.

Tusschen dese percken zijn straten van 20 voeten breed, om elc zoo wel met waghens en peerden als te voet bequamelic te moghen komen tot syn logijst.



8 LIDT.

SECTION 7.

Plan of the Artillery General's quarters.

For this purpose one takes a quadrangle similar in length to the other quarters, from the front to the back measuring 300 feet in length and 480 feet in width, in which the quadrilateral parks are being distributed as follows:

- A to the General of the ordnance (Artillery General);
 - B to his Lieutenant, together with the Noblemen of the ordnance;
 - C the Storehouse of the Artillery, with its Surveyor, Superintendent and respective Conductors.
 - D the Storehouse of the war-munition, with its Surveyor, Superintendent and respective Conductors;
 - E Engineers with their Conductors and Superintendents of the fortifications with their conductors, surveyors and clerk;
 - F Master-gunner with his Gunners and Master-artificer with his Conductors, Petardeer and Battery-master;
 - G Master-carpenter and his Lieutenant, with his Carpenter-mates, Wheelers, Farriers, Master of the gabions, Greasers ¹⁾, Cooper, Provost of the ordnance with his assistants and Surgeon assigned to the ordnance;
 - H Sailors to draw the ordnance;
 - I Pioneers and Miners;
 - K rallying-place and drive-in for the soldiers and their waggons stationed there;
 - L open space for unexpected things.
- In between these parks there are streets 20 feet in width, so that each man may easily reach his lodging, both with waggons and horses and on foot.

¹⁾ *Harniceurs* (cf. also fol. 22, line 12: *Waghemeerders*=waggon-greasers); originally French word for experts keeping the ordnance in repair.

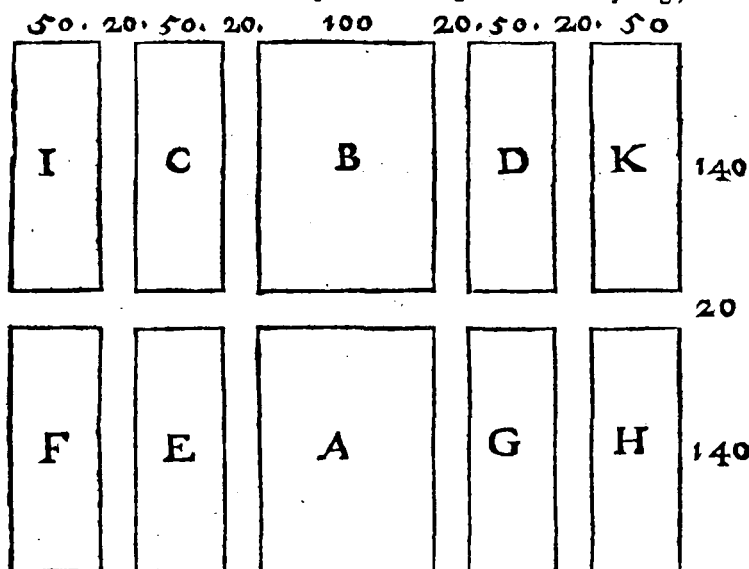
8 LIDT.

Vande form des quartiers der Officiers die in dit Legher by malkander ghelogeert worden.

Hier toe wort ghenomen een vierhoec lanc ghelijc d'ander quartieren van voren tot achter 300 voeten, breed 380, waer in de vierhoeckighe percken van beteyckening zijn als volgt:

- A Oversten vande Ruyterie.
- B Oversten van't voetvolc.
- C Lieutenant vanden Oversten vande Ruyteric.
- D Commissaris en Quartiermeester vande Ruyterie.
- E President, Fiscael, en Greffier vanden Krijchtract.
- F Prevooft generael.
- G Sergant Major.
- H Quartiermeester generael, en den Commis van't ghele.
- I Commissarissen vande monsterringhen.
- K Predicanten, Medicijn, en Chyrurgijn van't Hof.

Tusschen dese percken zijn straten van 20 voeten breed, om elc zoo wel met waghens en peerden als te voet, bequamelic te moghen komen tot syn logijst.



MERCT.

AEngezien in dit quartier der Amptlien ghelogeert worden den Oversten vande Ruyters, syn Lieutenant, Commissaris, en Quartiermeester, zoo mocht ymant dencken waerom daer in ooc niet ghelogeert en zijn Colonnellen, Ritmeesters, of ander Amptlien der Ruyterie, of nadien men dese by de Ruyters legt, waerom de ander niet ooc daer by verordent en zijn: De reden is, dat nadien heelen bevel of bediening haers ampts streckt int gheemeen overal de Ruyte-

SECTION 8.

Plan of the quarters of the officers to be lodged together in this Camp.

For this purpose one takes a quadrangle, in length similar to the other quarters, from the front to the back measuring 300 feet and 380 feet in width, in which the quadrilateral parks are being distributed as follows:

- A Cavalry-general;
- B Infantry-general;
- C Lieutenant to the Cavalry-general;
- D Commissary and Quartermaster of the Cavalry;
- E President, Judge, Advocate General (Fiscal) and Clerk of the Court-Martial;
- F Provost Marshal;
- G Sergeant-major;
- H Quartermaster-general and Pay-master ¹⁾;
- I Commissaries General of the musters;
- K Chaplains, Doctor and Surgeon of the Court.

In between these parks there are streets measuring 20 feet in width, so that each man may easily reach his lodging both with waggons and horses and on foot.

NOTE.

Since in these Officers-quarters the Cavalry-general, his Lieutenant, Commissioner and Quartermaster are lodged, one might think, why should not the Colonels, Cavalry-captains or other Cavalry-officers be lodged there as well or, as they are lodged with the Cavalry, why should not the others be lodged with them. The reason why is: that since their command or their tenure of office generally comprises all the Cavalry and is not confined to one particular regiment, as in the

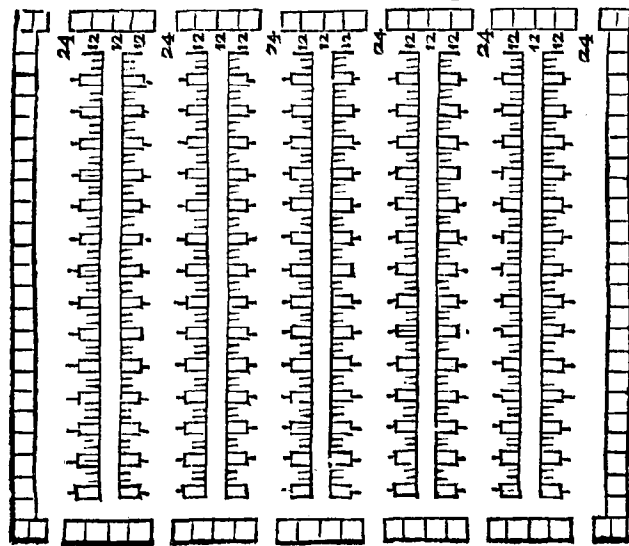
¹⁾ From the *Resolutions of the States General* (1602-1606) it appears that the offices of "Commis van 't ghelt" (paymaster or pagador) and "Monstercommissaris" (Commissary of the Musters) had been combined, viz. in the case of François Doublet, called "Waghemeester-Generael" (Waggon-master General) on fol. 16, 24, (*Nw. Nederl. Biogr. Woordenboek*, VII, 378).

rie, en niet over een bezonder regiment, ghelijc dat der Colonellen, zoo en vereyſchen ſy niet by eenich bezonder regiment te legghen, maer in een quartier ontrent het middel van al de Ruyterie, om over al bykans evenna te weſen. En deſghelijcx zalmen ooc verſtaen vande Amptlien des voetvolcx, en van al d'ander in dit quartier gheleyt, want haer bewint over tgeheel Legher ſtreckt. Aengaende generale Amptlien, als over Artillerie, munitie vande Artillerie, munitie van oorlogh, vivres, en vande waghens, die en moeten hier niet legghen, ghemerct ſy elc logeren by haer Magazijn, of by tghene daer ſy het bewint af hebben.

9 LIDT.

Vande form des quartiers vande waghens.

TOt de waghens wort ghenomen een vierhoec lanc van achter tot voren ghelijc d'ander quartieren 300 voet, breed na den eyſch vande menichre der waghens dieder int teghenwoordich Legher zijn, welcke breedte hier by voorbeelt ghenomen wort op 348 voeten: In dit perc worden de waghens met rijen ruggheeling na malkander gheſtelt, blijvende een ſtraecten tuſſchen beyden breed 12 voet, daer de Voerlien haer fourage in moghen leggen: Maer tuſſchen elc paer rijen komt een ſtraet breed 24 voet, daer deurmen het quartier uyt en in vaert: Op de vier zijden des quartiers komen hutten der Soetelaers die de waghens volghen, lanc van voren tot achter 12 voet: voor een wagen met haer drie peerden wort plaets ghegheven inde langde 12 voeten, twelc is de langde des waghens, en inde breedte 18 voeten, namelijk voor de breedte des waghens 6 voeten (alzo de aſſen lanc zijn 5½ voet) en voor de drie peerden 12 voet: Staet ooc te ghedencken dat de Voerlien ghemeenelic gheen hutten en begheeren, alzo ſy liever op haer waghens logeren of daer onder: doch dieſe hebben willen moghenſe bouwen achter haer waghens int ſtraecten breed 12 voet. Volghens de voorchreven maten, zoo kanmen in deſen vierhoec breed 348 voet, en lanc 300, brengen 10 rijen elc van ontrent 14 wa-



ghens, makende in als 140: En hoe wel datter veel meer aenghenomen zijn, zoo ſtaet te ghedencken datter veel gelatē worden by de ghene die ſy dienen. Van tgcne voorzeyt is wort hier tot meerder klaerheyt deſe form gheſtelt.

MERCT.

case of the Colonels, they need not to be lodged with one particular regiment, but in a quarter somewhere about the centre of all the Cavalry in order to be almost equally near unto all sides. And in the same manner the Infantry-officers will be regarded and all the others to be lodged in these quarters, because their respective duties cover the whole army camp. As to the commanding officers such as those of the Artillery, the Artillery-munition, war-munition, victuals and waggons, they should not be lodged here, as they are all lodged separately with their storehouse or with the equipment in their charge ¹⁾).

SECTION 9.

Plan of the quarters of the army waggons.

For the army waggons one takes a quadrangle similar in length to the other quarters from the front to the back measuring 300 feet, its width being determined according to the number of army waggons used in the contemporary States Army; here the width is taken as e.g. 348 feet. In this parking-space the waggons are placed back to back to each other leaving a small street in between of 12 feet in width, where the drivers may deposit their forage. But in between every two rows there is a street 24 feet in width, by which one can drive in or out of the quarters. On the four sides of the quarters there are the huts of the sutlers, who are following the waggons, measuring from the front to the back 12 feet. For a waggon and its three horses a space of 12 feet in length is reserved, being the length of a waggon, and 18 feet in width, i.e. 6 feet for the width of the waggons (the axles measuring $5\frac{1}{2}$ feet) and 12 feet for the three horses. It should be borne in mind however, that the waggoners as a rule do not want huts, as they prefer to sleep in or underneath their waggons, yet, those who do want huts for themselves are allowed to construct them at the back of their waggons in the small street 12 feet in width. According to the measures described heretofore the quadrangle measuring 348 feet in width and 300 feet in length can accommodate: 10 rows of about 14 waggons each, amounting to a total number of 140 waggons. And although the number of waggons engaged exceeds this number by far, it is self-evident that a great number of them are left with the army-unit they are serving. For the sake of clearness of all that has been said afore I am giving the adjacent figure.

¹⁾ The word "Magazijn", translated by storehouse, has not the same significance as "magazijn der Vivres" mentioned in line 8, fol. 14, since by the latter are meant separate quarters.

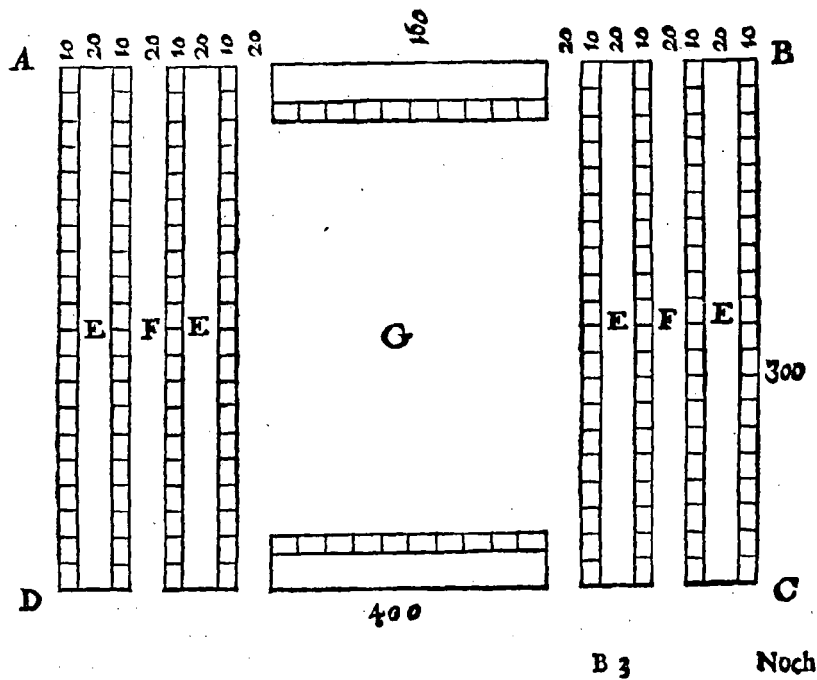
MERCT.

DE waghens worden ooc wel heel na malkander ghestelt, zulcx dat de tuyten bykans d'een d'ander gheraken, en alsdan konnender in een rijc wel drie-mael zoo veel staen, te weten 42, maer daer komt tweederley ongherief uyt: Ten eersten, dat elcke drie peerden niet bequamelic en konnen staen voor haer waghcn alzo die maer 5½ voeten breed en is: Ten anderen, dat de straten tusschen de waghens vervult wesende mette peerden, te nauwe vallen om menschen, waghens, en peerden daer tusschen deur te gaen, ten zy datmense veel breeder neemt, waer me men dan int gheheel meer plaats behoeft als na d'eerste wijze die bequamer is.

10 LIDT.

Vande form der Marct.

TOrte Marct wort ghenomen een vierzijdich rechthoec als A B C D, van voren tot achter, dat is van A tot D lanc ghelijc d'ander quartiercn 300 voet, en breed als A B 400: Hier op worden ghestelt verscheyden dobbel rijen van hutten, diens plaetsen lanc zijn 300 voet, breed 10, en een plaets tusschen beyden breed 20 voeten, als E, daer de hutten met haer rugghen aen koinen: Door dese plaetsen en gaetmen niet als door straten, maer dienen tot kooopputten en eyghen gherief der hutten: Tusschen elc paer rijen hutten is een straet breed 20 voet als F, en int middel van al de rijen der hutten een Marct als G breed 200 voet, ghelijc de volghende form naerder uytwijst.



NOTE.

The waggons are sometimes aligned very close to each other, in such manner that they are almost touching each other ¹⁾, to the effect that in this way a row can contain three times as many waggons, viz. 42, yet this leads to a twofold inconvenience: Firstly, that each team of three horses cannot stand comfortably before their waggon, the latter being merely $5\frac{1}{2}$ feet in width ²⁾ and secondly that the streets between the waggons are entirely occupied by the horses, so that they become too narrow for the men, waggons and horses to pass through, unless one should take them considerably wider, which would require altogether more space than by the first method, which as such is much more convenient.

SECTION 10.

Plan of the market-place.

For the market-place one takes a rectangle such as A B C D, measuring from the front to the back, i.e. from A to D, in length similar to the other quarters, 300 feet and 400 feet in width such as A - B. In this space various double rows of huts are placed, occupying a space measuring 300 feet in length and 10 feet in width, and a space in between of 20 feet in width such as E, where the huts open into at the back. These spaces are not meant for traffic as in streets, but serve for the construction of cooking-pits and for the convenience of the huts. Between each couple of rows of huts there is a street measuring 20 feet in width such as F and right in the centre of all these rows there is a market-place such as G, measuring 200 feet in width, as further explained in the figure below. It should be

¹⁾ The word "tuyten" has been avoided similar to the French edition reading: "les chariots touchant quasi l'un l'autre".

²⁾ The description is not very clear; from this it might be interpreted that the horses have to be lined up in harness, which naturally will not have been always so.

Noch is te weten datmen tvolc twelc op de Marct gelogteert is, verdeelt in Kramers, Comeniers, Vleeschslachters, en Herberghen, legghende elcke soorte in bezonder rijen, en op de groote Marct de rijcke winckels, als van Kramers, Sydelakenkoopers, en dierghelijcke: Int legghen der Herberghen wort ooc onderscheyt ghemaect en opzicht ghenomen vande deghelicke by malkander te voeghen, en de Bordeelen by haers ghelijcke.

M E R C T.

DAer zijn noch twee quartieren, t'een van vreemde Heeren, t'ander van't Magazijn der vivres, van wiens formen ic hier gheen teyckening en stel, om datmen de vreemde Heeren slechts een vierhoec gheeft lanc als d'ander quartieren 300 voeten, en breed na den eysch, waer in sy haer tenten, hutten, en percken doen veroordenen na hun belijfte: En ghelijcx ooc metten Generael vande vivres, ooc metter grof gheschut, twelc met al syn toebehoorende wagens ghesfelt wort in zulcken oorden als int 9 Lidt vande waghens ghezeyt is.

11 L I D T.

Vande form des Leghers int gheheel.

BY aldien hier in elc vendel evenveel mannen waren, in elc regiment evenveel vendels, en in een Legher altijt de zelve menichte van regimenten, ghelijck by de Romeynen toeginc, zoo zoude syn *Vorstelicke Genade* de regimenten van Voetvolc en Ruyters altijt lijcsformich en van evengroote plaets veroordenen, logerende de Pijskiers in d'een der twee rijen huttē, de Musquettiers in d'ander rije, volghens d'oorden die de Krijchsliden in haer rijen hebben, ghevende het Legher altijt een zelve form: Doch aengezien nu ter tijt noch in dese Landen noch elders zoort schijnt, gheen vermogen noch besluyt en is als by de Romeynen was, om vendels, regimenten, en legers altijt oordentelic vervult te houden, zoo kan goede regel op onvolkomen oorden nu meerder ghebruyc hebben dan op de volkomen; daerom zal ic hier benevens de voorgaende reghels der ghedeelten eens Leghers, noch verklaring doen vanden reghel dieder ghehouden wort op ons Leghers int gheheel, mette onghelijcheyt die se hebben, nemende tot voorbeeldt het Legher der *Hoochmoghende Heeren Staten* onder anderen voor Gulich des Jaers 1610, door twelc de meyning zal kunnen verclaert worden.

Inde volgende form deses Legers machmen zien tgene voren ghezeyt is, datmen na tracht, te verē dat de binnenquartierē geen Soldate vvesende, omvangen zijn van De Voetknechten, gelogiert aende alarmplaetsen, na den eysch der voorz gemeenen regel, uytgenomen dat de marct aende zelve alarmplaets komt, doch alzo de teyckening niet bequamer en scheen te vvillen vallen, tvviert zo besloten. De ledige plaets A, die by gemeenen regel voor 'tquartier van syn *Vorstelicke Genade* verordent vvoort, dient tot vergaring der gene die dagelick te Hove te doen hebben: De ledige plaetsen B, C, vvierdē bevvaert voor haer *Genaden Gr. Willem* en *Gr. Heyndric*, by aldiē sy daer gelogiert haddē, hoe vvēl het daer na niet en gebeurde. Noch staet hier t'aenmercken, dat de straten door de breedte des Legers als D, E, recht vallē, en evenbreet vā 30 voet, uyt oorzaec dat de quartieren al evenlanc genomen vvorden, te vveten van 300 voete, tvvelc anders zo niet lücken en zoude, vvaer af ic mersgaders ander omstandichedē inde teyckening des 3 Hooftstucx breeder zeggē zal. Aengaende hier in niet bevondē en vvordē quartierē voor verscheydē partijen des Legers, als Ruyterie, Artillerie, Wagens, daer af zal ic d'oorzaec verklarē inde teyckening des 3 Hooftstucx int 1^o Lit, achtende deur dese form des Legers, en der voorgaende gedeelten ooc des Legers der Romeynen, genoech verklaert te zijn vvat Leghermeting betteyckent, tvvelc in dit 1^o Hooftstuc voorghenomen vvaste doen.

known, that all the people lodged in the market-place, such as the pedlars, grocers, butchers and innkeepers are being distributed over separate rows. In the market-place itself we find the richest shops such as the draperies, the silk-cloth merchants and the like. To the distribution of the inns is also made distinction and paid special attention: the respectable ones are accomodated together and the brothels are placed with their equals.

NOTE.

There are still two other quarters, one for foreign Lords and another for the store-house of the victuals, of which I do not represent a figure here, because these foreign gentlemen are only given a quadrangle of equal length as the other quarters i.e. 300 feet, and its width as required and in which they have arranged their tents, huts and parks at their pleasure. The same also applies to the General of the victuals and also to the heavy ordnance, which together with all the waggons belonging to it, is being lined up according to that which is said about the waggons in Section 9.

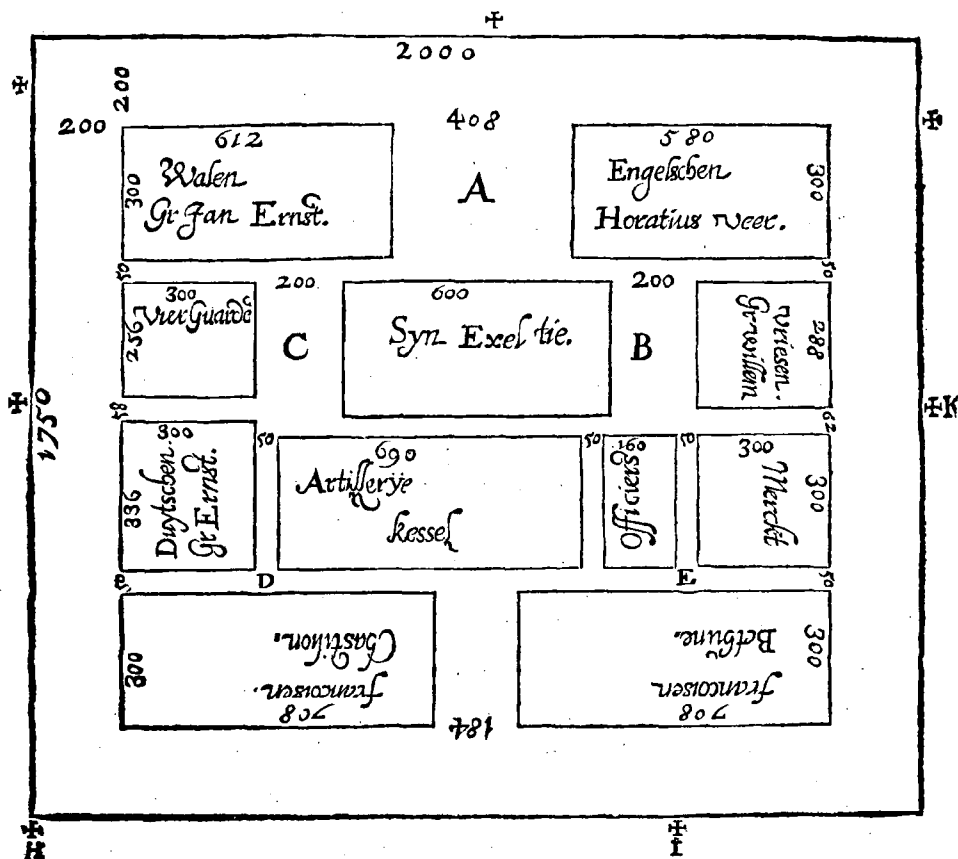
SECTION 11.

Plan of the encampment as a whole.

If here each company should consist of an equal number of men, each regiment of an equal number of companies and in an army camp should always be an equal number of regiments, the same as with the Romans, his *Princely Grace* would always give the infantry- and cavalry regiments a similar constitution and would allot to them an equal amount of space, in which the pikemen were to lodge in one of the two rows of huts, the musketeers in the other row, according to the alignment of the soldiers in their rows, causing the encampment to be always of the same form. However, as apparently nowadays in these countries nor in any other country there does not exist any power nor regulation (as it was found with the Romans) to keep the companies, regiments and army-camps always properly complete, it will be more effective to set up a rule for the incomplete order than for the complete one.

Therefore I shall as yet, in addition to the previous rules for the parts of an army camp, explain the rule that is observed in our Camps as a whole, with their inequality, taking as an example inter alia the army camp of the States General before Juliers in the year 1610, which will serve to clarify my statement.

In the adjacent figure of the camp one sees in effect that which has to be aimed at by the previous statement, viz. that the inner quarters, in which no soldiers are lodged, are being surrounded by the Infantry, who are encamped along the alarm-places, according to the general rule, apart from the fact that also the market-place lies on those alarm-places. However, as the ground-plan did not turn out better, it had thus been decided. The empty space A, which according to the general rule is being reserved for the quarters of his *Princely Grace*, has been marked out here as a meeting-place for those people, who have to be daily at Court. The empty spaces B and C were reserved for their *Princely Graces* Count William and Count Henry, in case they were to encamp there, although this did not occur. Furthermore it should be observed that the streets, running parallel in width to the camp, such as D and E, turn out straight, showing a regular width



De beteykening deser quartieren met haer breedten is op de zelve by gheschrift ghesfelt, aengaende haer langde die doet van elc by ghemeene reghel 300 voet, zulcx dat niet noodich en is naerder verklaring daer af te doen.

2 HOOFTSTVC,

Vande Lijsten, inhoudende tghene in een teghenwoordich Legher moet ghelogeert worden.

KORTBEGRYP DESES 2 HOOFTSTVCX.

E Ermen totte meting der quartieren komt, zoo ist noodich gheweten te zijn watter in elc quartier zal ghelogeert worden, om de grootheyt daer toe noodich te veroordenen na tbehooren, tot welcken eynde arnden Leghermeter behandicht worden copien der Lijsten daer toe dienende, die int Legher voor Gu-lich des Iaers 1610 dat ic tot voorbeeld nemen zal, waren als volght:

1 Lijste

of 50 feet on account of the invariable length of the quarters i.e. 300 feet; that this could not have been achieved otherwise, I shall, apart from other circumstances, explain in a more detailed manner in chapter 3, when drawing this camp. As to the omission in this drawing of the quarters for various army-units, such as the Cavalry, Artillery and Waggon I shall explain the cause in the drawing of Chapter 3, section 1. I am of the opinion that by the figure of this army camp and by the figures in the previous sections, including the Roman army camp, it has been sufficiently explained what *Castrametatio* actually means, as I had intended to do in this first Chapter.

The names of these quarters together with their widths have been inscribed in the respective spaces for these quarters; their lengths being, determined according to the general rule to 300 feet, so that I need not give any further explanation about it.

CHAPTER 2

About the lists, containing that which should be lodged in a present-day army-camp.

SUMMARY OF THIS CHAPTER 2.

Before one passes on to the actual marking out of the quarters it should be known what should be lodged in each quarter in order to be able to determine its size in the proper manner, for which purpose copies of the respective lists are handed out to the measurer of the army camp (camp-measurer). The following lists used in the army camp before Juliers in the year 1610, which I shall take as an example were drawn up as follows:

- 1 Lijste vande Officiers van't Legher.
- 2 Lijste vande regimenten Voervolc.
- 3 Lijste vande regimenten Ruyterie.
- 4 Lijste vande Artillerie.
- 5 Lijste vande munitie van Oorloogh.
- 6 Lijste vande Waghens.
- 7 Lijste vande Schepen.

1 L Y S T E,

Vande Officiers van't Legher.

SYN Vorstelijke Ghenade.
 Graef Heyndrick van Nassau Generael vande Ruyterie.
 Syn Lieutenant Marquette.
 Overste van't Voervolc Graef Ernst.
 Sergeant Major Generael Sedleniski.
 Commissaris Generael vande Ruyterie Stakenbroec.
 Quartiermeester Generael Solem.
 Prevooft Generael.
 President vanden Krijchraet.
 Fiscael.
 Greffier.
 Commis van tghelt.
 Waghemeester Generael Doublet.
 Syn Lieutenant.
 Quartiermeester Generael vande Ruyterie Lieven Cij.
 Medicijn van't Legher.
 Chirurgijns van't Legher.
 Den Prevooft van't water Kranendonc.
 Drie Predicanten.

M E R C T.

DAer zijn noch Officiers als vande Artillerie vande munitie van Oorloogh, vande Vivres, en vande Schepen: Maer aenghezien men in dese Lijste acht neemt op de Officiers diemen int Legher in een quartier by malkander leght, en dat die ander logeren by tghene daer sy tbcwint af hebben, zoo en wordense hier niet ghestelt.

2 L Y S T E,

Vande regimenten Voervolc.

Fransoysen.

HEt regiment van Chatillon is van 19 vendels, daer af volghens de bestelling de compagnie Colonelle heeft 200 mannen, een isser van 100, en 17 elc van 80, die hebben 40 rijen hutten, de voorzijde 708 voeten, en 1660 Soldaten.

De manier om dese 40 rijen hutten en voorzijde van 708 voeten te berekenen is dusdanich : Voor elcke 100 mannen eens vendels of daer ontrent veroordentmen

- 1 List of the Army Officers.
- 2 List of the Infantry regiments.
- 3 List of the Cavalry regiments.
- 4 List of the Artillery.
- 5 List of the War-munitions.
- 6 List of the Waggon.
- 7 List of the Vessels.

LIST 1.
Of the Army Officers. 1)

His Princely Grace.
 Count Henry of Nassau Cavalry General (Frederic Henry)
 His Lieutenant Marquette
 Infantry General Count Ernest. (Ernst Casimir of Nassau)
 Sergeant-Major General Sedleniski.
 Commissary General of the Cavalry Stakenbroec.
 Quartermaster General Solem.
 Provost Marshal
 President of the Court-martial
 Judge Advocate General
 Clerk of the Court.
 Paymaster.
 Waggon-master General Doublet.
 His Lieutenant.
 Quartermaster General of the Cavalry Lieven Cijls.
 Doctor of the Army-camp.
 Surgeons of the Army-camp.
 Provost of the Vessels Kranendonc.
 Three Chaplains.

NOTE.

There are still more Officers, such as those of the Artillery, of the War-Munitions, of the Victuals and of the Vessels. However, as the present List only comprises those officers in the Camp, that are lodged together, the other officers, being encamped with all that they are in charge of, are not mentioned here.

¹⁾ These officers of the army camp before Juliers are found to have been mentioned for the greater part by name in the battle-array of the general musters at Fort Schenkenschans in July 1610 (*Staatse Leger*, III, 14) and at the same time with regard to the interpretation of the various duties in *Wijn* (pp. 32-36 under "De Staf"), who has derived his data from the M.S. *Ruich ontwerp van Krijgssaken*. The name Doublet (cf. folio 11, note 1) is not mentioned by him, no more than Kranendonc, the "Prevoost van 't water" (Provost of the vessels), who, naturally, was charged with the administration of justice on the vessels and, inter alia, figures also in the Resolutions of the States General of 1604-1606.

men (ghelijc gezeyt is int 2 Lidt des 1 Hoofstucx) twee rijen hutten, voor ontrent 150 drie rijen, voor ontrent 200 vier rijen, en zoo voorts: Dien volghens de 19 compaignien moeten hebben 38 rijen, en noch 2 meer van wegen datter een compaignie is van 200 mannen, komt ghelijc daer staet 40 rijen; daer toe vergaert noch 40 van wegghen de straten die tusschen de rijen komen (zoo naerder te zien is inde form van't 3 Lidt des 1 Hoofstucx) maect tzamen 80, elc 8 voet, komt 640 voeten, daer toe vergaert 68 voeten voor breedte van des Colonels logijst, komt tzamen gelijc boven ghezeyt is de voorzijde des regiments van 708 voeten, en alzo worden ghevonden de rijen en voorzijden van al d'ander navolghende regimenten des Voetvolcx. Aengaende de 1660 Soldaten, die worden daer by ghesfelt om rekening op te maken hoe veel voeten elc regiment te delven heeft als men het Legher omgraven moet, daer af eyghentlic gezeyt zal worden int 5 Lidt van't 3 Hoofstuc.

Het regiment van Bethune is van 19 vendels, daer af de compaignie Colonelle heeft 200 mannen, een compaignie iijser van 100, en 17 elc van 80, die hebben 40 rijen hutten, de voorzijde 708 voeten, en 1660 Soldaten.

Duytschen.

Het regiment van Graef Ernst is van 6 vendels, daer af de compaignie Colonelle heeft 200 mannen, drie elc van 200, een van 150, en een van 100, die hebben 21 rijen hutten, de voorzijde 336 voeten, en 1050 Soldaten.

VValen.

Het regiment van Graef Ian Ernst is van 16 vendels, daer af de compaignie Colonelle heeft 200 mannen, twee compaignien elc van 100, en 13 elc van 70, die hebben 34 rijen hutten, de voorzijde 612 voeten, en 1310 Soldaten.

De vier garden.

Een garde van 250 mannen, twee elc van 200, en een van 150, die (wefende zonder Colonels plaats) hebben 16 rijen hutten, de voorzijde van 256 voeten, en 800 Soldaten.

Vriefen.

Het regiment van Graef Willem is van 8 vendels, daer af de compaignie Colonelle heeft 200 mannen, 7 compaignien elc van 80, die (wefende zonder Colonels plaats) hebben 18 rijen hutten, de voorzijde van 288 voeten, en 760 mannen.

Enghefschen.

Het regiment van Oratio Veer is van 15 compaignien, daer af de compaignie Colonelle heeft 200 mannen, de 14 compaignien elc 80, die hebben 32 rijen hutten, de voorzijde 380 voeten, en 1320 Soldaten.

Het regiment van Cecil is van 10 vendels, daer af de compaignie Colonelle 200 mannen, de 9 compaignien elc 80, die hebben 22 rijen hutten, de voorzijde 452 voeten, en 920 Soldaten.

Het regiment van Hallas is van 10 vendels, daer af is een compaignie van 90 mannen, vier elc van 80, en 5 elc van 70, die (wefende zonder Colonels plaats) hebben 20 rijen hutten, de voorzijde 320 voeten, en 760 Soldaten.

LIST 2.
Of the Infantry regiments. 1)

The French.

Chatillon's regiment consists of 19 companies of which, according to the commission, the Staff-company consists of 200 men, then there is one of 100 men and 17 of 80 each, who are occupying 40 rows of huts, measuring 708 feet in front and comprising 1,660 soldiers.

These 40 rows of army huts and their frontside of 708 feet are to be calculated as follows:

To every 100 men of a company of soldiers or thereabouts there are allotted two rows of huts (as has been mentioned in section 2 of Chapter 1), to about 150 men three rows and to about 200 men four rows etc. Therefore these 19 companies should occupy 38 rows, and another two, because of there being one company of 200 men, thus, as has been previously stated, there are 40 rows, hereto one should add another 40 on account of the streets that are to come between the rows (as it is shown by the figure in Section 3 of Chapter 1), which makes 80, each measuring 8 feet, amounting to a total of 640 feet to which 68 feet should be added for the width of the Colonel's lodgings making together, as has been stated above, a front-side width of 708 feet for the regiment. In the same way the rows and front-sides of all the other following Infantry regiments are being determined. As to the 1,660 soldiers they are stated in order to figure out how many feet each respective regiment will have to dig in case the encampment has to be entrenched, which is to be further explained in Section 5 of Chapter 3.

Bethune's regiment consists of 19 companies, the Staff-company of which is consisting of 200 men, then there is one company of 100 men and 17 of 80 each, occupying 40 rows of huts with a frontside-width of 708 feet and 1,660 soldiers.

The Germans.

Count Ernest's regiment consists of 6 companies, the Staff-company of which comprising 200 men, three of 200 men each, one of 150 and one of 100, occupying 21 rows of huts, the frontside 336 feet and 1,050 Soldiers.

The Walloons.

Count John Ernest's regiment consists of 16 companies, the Staff-company of which consisting of 200 men, two companies of 100 men each and 13 of 70 each, occupying 34 rows of huts, the frontside 612 feet and 1,310 Soldiers.

The four guards.

One guard consists of 250 men, two of 200 each, and one of 150, which (the Colonel's space lacking here) occupy 16 rows of huts, the front-side 256 feet and 800 Soldiers.

The Frisians.

Count William's regiment consists of 8 companies, the Staff-company of which comprising 200 men, 7 companies of 80 men each, occupying (the Colonel's space lacking) 18 rows of huts, their front-side 288 feet and 760 men.

¹⁾ The number of infantry-companies to a regiment on this folio and the next do not correspond with those in *St. Leger*, III, pp. 14, 15; whereas the names of the regimental commanders do tally, with the exception of Ogle instead of Hallas.

1

2

The English.

Horatio Vere's regiment consists of 15 companies, the Staff-company of which comprising 200 men, and the 14 companies of 80 men each, occupying 32 rows of huts, their front-side of 580 feet ¹⁾, and 1,320 soldiers.

Cecil's regiment consists of 10 companies, the Staff-company of which comprising 200 men and the 9 companies of 80 men each occupying 22 rows of huts, their front-side 420 feet ²⁾, and 920 soldiers.

Hallas's regiment ³⁾ consists of 10 companies, one of which consisting of 90 men, four of 80 each and five of 70 each, which (the Colonel's space lacking) occupy 20 rows of huts, their frontside 320 feet, and 760 Soldiers.

¹⁾ The front-side should be: 580 feet instead of 380 feet; cf. also fol. 15, 35.

²⁾ Ibidem 420 feet instead of 452 feet.

³⁾ The surname Hallas should be *Hollis* (cf. State of War 1609; Commission-book Council of State No. 1526 in General State Archives, The Hague, 1615; he is also mentioned together with 10 companies in the engraving of the siege of Juliers by Andrew Sersanders, as stated in the *Introduction* (fig. 3). Cf. also note 2 on fol. 25.

Schotten.

Het regiment van Cheec is van 10 vendels, daer af is een compaignie van 100 mannen, drie compaignien elc van 90, en zes elc van 80, die hebben 20 rijen hutten, de voorzijde 388 voeten, en 850 Soldaten.

Het regiment van Hindersham is van 19 vendels, daer af is een compaignie van 100 mannen, 18 compaignien elc van 70, die hebben 38 rijen hutten, de voorzijde 676 voeten, en 1460 Soldaten.

3 L Y S T E.

Vande regimenten Ruyterie.

Et regiment van Graef Heyndric is van 3 vanen, daer af is een van 250 mannen, een van 150, een van 70, die hebben 10 rijen hutten, en breede 430 voeten.

De manier om dese 10 rijen hutten te berekenen gaet toe als voren van't Voetvolc, wat de voorzijde van 430 voeten belangt, die is aldus berekent: Elc paer rijen heeft (als te zien is inde form van't 4 Lidt des 1 Hoofstuckx) 70 voeten, daerom de 5 paer rijen doen 5 mael 70, dat 350 voeten, daer toe de vier straten dieder tusschen komen elc van 20 voeten doende 80 voeten, maken t'zamen voorzijde des zelven regiments ghelijc daer staet 430 voeten. En alzo worden ghevonden de voorzijden van al d'ander navolghende regimenten der Ruyterie.

Aengaende de menichte der Ruyters in elc regiment, die en wort hier (ghelijc van't Voetvolc) niet berekent, om datnens totte omgraving des Leghers niet en ghebruyt.

Het regiment van Marquette is van 4 vanen, daer af een van 100 mannen, drie elc van 70, die hebben 8 rijen hutten, en voorzijde 340 voeten.

Het regiment van Stakenbroec is van 4 vanen, daer af is een van 100 mannen, een van 85, en twee elc van 70, die hebben 8 rijen hutten, de voorzijde van 340 voeten.

Het regiment van Waghemans is van 3 vanen, elc van 70 mannen, die hebben 6 rijen hutten, de voorzijde van 250 mannen.

Het regiment van Ryhoven is van 3 vanen, elcke van 70 mannen, die hebben 6 rijen hutten, en voorzijde 250 voeten.

Het regiment van Marcelis Bacx is van 4 vanen, elcke van 70 mannen, die hebben 8 rijen hutten, de voorzijde 340 voeten.

Het regiment van La-Salle is van 3 vanen, elcke van 70 mannen, die hebben 6 rijen hutten, voorzijde 250 voeten.

Het regiment van Smeltzing is van 3 vanen, elcke van 70 mannen, die hebben 6 rijen hutten, de voorzijde 250 voeten.

Het regiment van Quaet is van 3 vanen, elcke van 70 mannen, die hebben 6 rijen hutten, de voorzijde 250 voeten.

Het regiment van Graef Ian is van 3 vanen, elcke van 70 mannen, die hebben 6 rijen hutten, de voorzijde 250 voeten.

Het regiment van Ian Bacx is van 3 vanen, elcke van 70 mannen, die hebben 6 rijen hutten, de voorzijde 250 voeten.

The Scots ¹⁾).

Cheec's regiment consists of 10 companies, one of which comprising 100 men, three companies of 90 each and six of 80 each, occupying 20 rows of huts, their frontside of 388 feet, and 850 Soldiers.

Hinderscham's regiment consists of 19 companies, one of which being a company of 100 men, 18 companies of 70 each, occupying 38 rows of huts, their frontside of 676 feet, and 1,360 Soldiers ²⁾).

LIST 3.

Of the Cavalry regiments. 3)

Count Henry's regiment consists of three squadrons, one of which of 250 men, one of 150, one of 70, occupying 10 rows of huts with a (total) front-side of 430 feet.

The way of calculation of these 10 rows of huts is being effected as for the Infantry; with regard to their frontside of 430 feet, the latter has been figured out as follows: each pair of rows is (as shown by the figure in Section 4 of Chapter 1) 70 feet in width, which means that 5 pairs of rows measure $5 \times 70 \text{ feet} = 350 \text{ feet}$. Hereto are added the four streets coming in between, of 20 feet each, making 80 feet, running up to a total front-side of the respective regiment, as has been stated, of 430 feet. And thus the front-sides of all the other following Cavalry regiments are being determined.

As to the number of the horsemen in each regiment, this is not calculated here (as of the Infantry), because they are not used with the entrenchment of the Camp.

Marquette's regiment consists of 4 squadrons, one of which of 100 men, three of 70 men each, occupying 8 rows of huts with a frontside of 340 feet.

Stakenbroec's regiment consists of 4 squadrons, one of which of 100 men, one of 85 and two of 70 each, occupying 8 rows of huts with a frontside of 340 feet.

Wagheman's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts with a frontside of 250 feet ⁴⁾).

Ryhoven's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts, their frontside of 250 feet.

Marcelis Bacx's regiment consists of 4 squadrons of 70 men each, occupying 8 rows of huts, their frontside of 340 feet.

La Salle's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts, frontside 250 feet.

Smeltzing's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts, frontside 250 feet.

Quaet's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts, frontside 250 feet.

Count John's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts, frontside 250 feet.

John Bacx's regiment consists of 3 squadrons of 70 men each, occupying 6 rows of huts, frontside 250 feet.

¹⁾ Cheec's regiment does not figure in *St. Leger III*, we do find that of Brog, consisting of 10 companies; for Hinderscham read: *Henderson* (Sir Robert); cf. also James Ferguson, *Papers illustrating the history of the Scots Brigade in the service of the United Netherlands 1572-1782* (Edinburgh, 1899).

²⁾ The number of soldiers should be 1360 instead of 1460.

³⁾ The commanders of the Cavalry regiments and the number of companies correspond with those mentioned in *St. Leger III*, p. 15, except for Otmanson's company of dragoons not being mentioned by Stevin. The latter appears to have had a strength of 165 horses to a total number of 3020, equal to, the number of men.

⁴⁾ Front-side 250 feet instead of men.

4 L Y S T E.

Vande Artillerie.

Gheschut.

- 4 heele Canons toegherust op haer affuyten.
- 8 halve Canons toegherust op haer affuyten.
- 3 Veltstucken toegherust op haer affuyten.

Kruyt, Koghels en Lonten.

- 153120 Buskruyt.
- 3000 heele Canonkoghels.
- 6000 halve Canonkoghels.
- 40 blecke Kogheldozen tot heele Canons.
- 20 blecke Kogheldozen tot halve Canons.
- 1200 Koghels van 12.
- 3000 Lonten.

Affuyten en ander Gheschut-
vvaghens in voorraet.

- 2 Affuyten tot heele Canons.
- 4 Affuyten tot halve Canons.
- 1 Affuyt tot Veltstucken.
- 8 Blocwaghens.
- 20 Voorwaghens.
- 2 Raders tot heele Canons.
- 3 Raders tot halve Canons.
- 1 Radt tot Veltstucken.
- 5 Raders tot Voorwaghens.
- 2 Achterraders totte Blocwaghens.
- 1 Moraschle.

Gheschuts reedtschap diemen int
schieten ghebruyct.

- 45 Lepels.
- 45 Wijschers.
- 45 Aenzetters.
- 4 Lepels tot gloeyende koghels.
- 4 Haecken tot gloeyende koghels.
- 20 Borstonnekens met haer houten hamers en schotelkens.
- 90 Stelhouten.

Bocken met haer toebehooren.

- 2 Bocken volkomen.
- 5 Aertwinden.
- 2 Boccreepen met haer Steecreepen.
- 2 Bockhoofden.
- 3 Metale Schijven.

LIST 4¹⁾.
Of the Artillery.

The Ordnance.

4	whole Cannons mounted on their carriages.
8	demi-Cannons mounted on their carriages.
3	pieces of Field-Ordnance mounted on their carriages.
Gunpowder, Balls and Matches.	
153,120	pounds of Gunpowder.
3,000	Cannon-balls for whole Cannons.
6,000	Cannon-balls for demi-Cannons.
40	tin Cartouches for whole Cannons.
20	tin Cartouches for demi-Cannons.
1,200	Cannon-balls of 12 pounds.
3,000	pounds of Matches.
Carriages and other Ordnance-waggon in stock.	
2	Carriages for whole Cannons.
4	Carriages for demi-Cannons.
1	Carriage for pieces of Field-Ordnance.
8	Trucks.
20	Limbers.
2	Wheels for whole Cannons.
3	Wheels for demi-Cannons.
1	Wheel for pieces of Field-Ordnance.
5	Wheels for Limbers.
2	Back-wheels for the Trucks.
1	Marsh-sledge. (Sledge for crossing Marshland).
Ordnance tools used when firing.	
45	Ladles.
45	Drags.
45	Cannon-rammers.
4	Ladles for red-hot cannon-balls.
4	Pincers for red-hot balls.
20	Powder-barrels with their wooden hammers and small plates.
90	Wedges.
Gins and their accessories.	
2	Gins complete.
5	Capstans.
2	Gin-ropes and their tethers.
2	Gin-heads.
8	Metal Sheaves.

¹⁾ With the translation of the lists 4,5 we have consulted, apart from the French 1618-edition by Stevin himself, and the German edition of 1631 inter alia: Hondius. *Korte Beschrijvinge etc.* (cf. Introduction, note 14); further the Note following upon the preface of Em. van Meteren, *Historie der Nederlandse Oorlogen* The Hague, 1614; Appendices to: *The theatre of the present war in the Netherlands and upon the Rhine* (London, 1745) viz. *Explanation of Military Utensils* (with 2 plates) and *Mil. Dictionary*; E. Chambers, F.R.S. *Cyclopaedia or an universal dictionary of Arts and Sciences* (1778-1786).

LECHERMETING.

- 4 Knapen of Muenicken.
- 8 Weechboomen.
- 4 Kinnebackxbloex.
- 4 Ghierbloex.

Lamoentuych.

- 41 Lamoentuyghen volkomen.
- 41 Lamoenreepen.
- 900 Strenghe.
- 450 Gareelen.
- 60 Havickoppels beflaghen.

Hout tottet Gheschut noodich.

- 150 Swalpen.
- 54 Vuyren Balcxkens van 10 ellen.
- 200 Delen.
- 200 Kapravens.
- 500 Horden.

Handtreedtschap.

- 50 Spaden.
- 50 Schuppen.
- 50 Bijlen.
- 50 Handbijlen.
- 50 Haumessen.
- 22 Picken.
- 22 Hauweelen.
- 80 houten Handtboomen.
- 18 yfer Handtboomen.
- 2 Handtheyen.
- 8 Bierboomen om tBoskruyt te draghen.
- 4 Berrien om het Boskruyt te draghen.

Naghels.

- 4000 Wiffernaghels.
- 1000 Naghels van 6 duym.
- 2000 Naghels van 5 duym.
- 3000 dobbel Middelnaghels.
- 6000 enckel Middelnaghels.
- 8000 Schotspijckers.
- Alderhande bouts en lansen tot Affuyten en Voorwaghens

Licht.

- 200 Keerssen.
- 12 houten Lanteerens.
- 4 Tonnen Turcken.
- 4 Lampetten.

Koot-

4	Jacks or "Muenicken" (Monks).
8	Weigh-beams.
4	Jaw-blocks.
4	Pully-blocks.

Shaft-harnesses.

41	Shaft-harnesses, complete.
41	Shaft-straps.
900	Traces.
450	Harnesses.
60	Studded yokes.

Wood required for the Ordnance.

150	Sleepers.
54	Small deal beams, measuring 10 yards.
200	Boards.
200	Cross-beams.
500	Hurdles.

Hand-tools.

50	Spades.
50	Shovels.
50	Axes.
50	Hand-axes.
50	Slash-knives.
22	Picks.
22	Pickaxes.
80	wooden Levers.
18	iron Hand spikes.
2	Hand pile-drivers.
8	Carrying-poles to carry the Gunpowder.
4	Hand barrows to carry the Gunpowder.

Nails.

4,000	Drag- or seven-inch Nails.
1,000	six-inch Nails.
2,000	five-inch Nails.
3,000	double middle Nails.
6,000	single middle Nails.
8,000	Timbering-Nails.
All kinds of bolts and lynch-pins for carriages and limbers.	

Lighting.

200	pounds of Candles.
12	wooden Lanterns
4	Barrel Torches or "Turcken".
4	small Lamps or "Lampetten".

Koorden.

- 2 heele Trecreepen om t'Gheschut met volc te trecken.
- 3 halve Trecreepen om t'Gheschut met volc te trecken.
- 22 Stierreepen om de stucken Gheschut te stieren.
- 20 Treclijnen om Schepen te trecken met peerden.
- 3 Halslijnen om Schepen te trecken met menschen.
- 2  Zeylgaren.
- 6  Bindtgaren om de touwen te bewinden.

Verscheyden dinghen.

- 1000  yser voor de Smit.
- 1 hoedt Smekolen.
- Smits ghereetschap.
- Timmer-ghereetschap.
- 80 hayren Deckleen.
- 140 Schaepsvellen.
- 6 lederen Emmers.
- 570 vierkante Mandekens.
- 400  Reufel.
- 6 Smeerdoofen.

Trecpeerden totte Stucken Artillerie.

Voor 4 heele Canons op haer Blocwaghens yder 11 ghespan, komt	88
Voor 8 halve Canons yder 9 ghespan, komt	144
Voor 3 Veltstucken yder 5 ghespan, komt	30
Voor 6 Affuyten van heele Canons yder 4 ghespan, komt	48
Voor 4 Affuyten van halve Canons yder 3 ghespan, komt	24
Voor 2 Blocwaghens yder 1 ghespan, komt	4
Voor 8 Voorwaghens yder 1 ghespan, komt	16
Voor 6 Waghens die de Haecken voeren.	48
Voor 8 Molenwaghens.	48
In voorraet 20 ghespan, komt	40
Somme der Trecpeerden	<u>490</u>

Officieren vande Artillerie.

- D** En Generael vande Artillerie Kessel.
 Syn Lieutenant Grenu.
 Controlleur van't Gheschut Monier.
 Commis van't Gheschut Wtenbroec.
 10 Edellieden van't Gheschut.
 25 Conducteurs.
 6 Ingenieurs, te weten Hillebrant Smits, Oom Kees, Lambert Cornelis, Arent Arentz, Raef Dexter, Samuel Kloot, elc met haer Conducteurs.
 2 Controlleurs vande Fortificatien, d'een Nicolaes vander Mijl, d'ander Heyndric Schoutens, elc met haer Conducteurs, Commis, en Schrijver.
 C 3 Meester

Ropes and Cords.

2	complete Cables to draw the Ordnance by soldiers.
3	demi-Cables to draw the Ordnance by soldiers.
22	Guiding-cables to direct the pieces of Ordnance.
20	Pulling-straps to draw Vessels by horses.
3	Neck-straps to draw Vessels by soldiers.
2	Pounds of Canvas-yarn.
6	Pounds of Binding-yarn to be wound round the ropes.

Various objects.

1,000	Pounds of iron for the Blacksmith.
1	Measure of Forge-coal.
	Blacksmith's tools.
	Carpenter's tools.
80	Covers made of hair.
140	Sheepskins.
6	leather Buckets.
570	small square Baskets.
400	pounds of Lard.
6	Cases of grease.

Draught-horses for the pieces of Ordnance.

To 4	whole Cannons on their Trucks, each 11 teams (of two horses), there are put	88 horses
To 8	demi-Cannons, each 9 teams (of 2 horses), there are put	144 horses
To 3	pieces of Field-Ordnance, each 5 teams (of two horses), there are put	30 horses
To 6	Carriages of whole Cannons, each 4 teams (of two horses), there are put	48 horses
To 4	Carriages of demi-Cannons, each 3 teams (of two horses), there are put	24 horses
To 2	Trucks, each one team (of two horses), there are put	4 horses
To 8	Limbers, each one team (of two horses), there are put	16 horses
To 6	Waggons for the conveyance of the barges ¹⁾	48 horses
To 8	Mill-Waggons	48 horses
To 20	additional teams of horses in case of need, there are put	40 horses

Sum of the total number of Draught-horses 490 horses

¹⁾ By "Haecken" to be conveyed in 6 waggons by means of 48 horses are meant according to the French edition: "Pontons" (Pontoons or Barges); cf. also fol. 31 under "Brugschepen" (Pontoons).

1941-1942

1941-1942: 1st year of study. The first year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley. The first year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley.

1943-1944

1943-1944: 2nd year of study. The second year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley. The second year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley.

1945-1946

1945-1946: 3rd year of study. The third year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley. The third year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley.

1947-1948: 4th year of study. The fourth year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley. The fourth year of study was spent in the laboratory of the Department of Zoology, University of California, Berkeley.

Artillery Officers ¹⁾ ²⁾.

- Artillery General Kessel.
 His Lieutenant Grenu.
 Superintendent of the Ordnance Monier.
 Commissary of the Ordnance Wtenbroec.
 10 Noblemen of the Ordnance.
 25 Conductors.
 6 Engineers, i.e. Hillebrant Smits, Oom Kees, Lambert Cornelis, Arent Arentsz, Raef Dexter, Samuel Kloot, each with his Assistants.
 2 Superintendents of the Fortifications, the one Nicolaes van der Mijl, the other Heyndrik Schoutens, each with his respective Conductors, Commissary and Clerk.

¹⁾ For William Adrian, count of Hornes and Seigneur of Kessel, his lieutenant Paul Grenu and the Superintendent Anthony Monnier, cf. inter alia *St. Leger* III, pp. 13, 15, 195; as to the latter cf. also pp. 224, 225 with regard to his temporary service in Sweden of which there are important data to be found in Munthe: *Kongl. Fortifikationens Historia I*, (Stockholm, 1902) p. 220 etc.; for Commissary of the Ordnance and the Ammunition in the field Dirk Wtenbroec, cf. *State of War*, 1609.

²⁾ Engineer Hillebrant Smits has been in 1612 one of the surveyors of the damage at the Harderwijk Fortress (*Gelre, Bijdr. en meded.* 1924, p. 68); "Oom Kees", Lambert Cornelisz., Arent Arentsz., Raef Dexter and Samuel Cloot also occur in *St. Leger* III, pp. 15, 16; moreover "Captain Omkaes" figures in Porter, *Hist. Royal Engineers*, I p. 44 (London, 1889); in 1605 Raef Dexter has been, inter alia, Master of the Fortifications at Doesburg (*Rijks Geschiedk. Publicatiën* 101). For the superintendent Nicholas van der Mijle cf. also *St. Leger* III, 195, for the latter and Henry Schouten see *State of War*, 1609.

Meeſter Conneſtabel Ioos de Nol.

36 Canoniers.

Meeſter Vyerwercker, met 2 Conducteurs.

Petardier.

2 Bateria-meeſters.

Meeſter Timmerman Proot.

Syn Lieutenant Symon Gerbrantsz.

12 Timmerghezellen.

2 Rademakers.

2 Smits.

1 Schanskorfmaker.

2 Harniceurs of Wagheſmeesters.

1 Kuyper.

Prevoost van't Gheſchut met ſyn Dienaers.

Chyrurgijn van't Gheſchut.

Commis vande Trecpeerden.

Syn 11 Conducteurs verdeelt als volgt : By yder der 6 Canons 1, By yder der 3 Veltſtucken 1, By de Affuyten en Voorwaghens 1, om aen en af te rijden.

2 Capiteynen vande Pioniers, Ian Melchiorſz, en Ian Meliſſz.

100 Pioniers, elc Capiteyn 50.

Capiteyn vande Mineurs Gille Louet.

25 Mineurs.

4 Scheeps Capiteynen.

240 Maetrooſen, elc Capiteyn 60.

M E R C T.

IN zulcke leden als deſe Liſte der Artillerie verdeelt is, en zoodanich vervolch de partijen daer in hebben, dergelijcke wort ooc verſtaen datſe hebben zullen inde Liſten die daer na alle jare of zoo dicwils alſt valt ghemaect worden, want dat bequamer is dan die zonder zeker vervolgh te ſtellen, zoo wel om nieuwe Liſten te maken met minder moeyte, en meerder verzeketheyt van alles daer in te brengen, als om de ghene diert aengaet met lichticheyt te moghen deurzien de overeenkoming van een Liſte des teghenwoordighen tijts met een voorgaende, te weten of alle noodighe partijen daer in komen zonder yet te ghebreken, ofter niet te veel gheſtelt en is, of de menichte van kruyt, koghels, en ander nootlichkeiten, ghenomen is na den eyſch vande teghenwoordighe ſtucken Gheſchuts, ghelijc op ander jaren met goede voordacht ghedaen wiert, ooc of bedocht is daer in te brengen tghene men de voorgaende reyse bevant te ghebreken, al twelc deur zulc ghe-lijc vervolgh der partijen veel lichter valt dan anderzins deur moeylicke punctue- ring t'onderzoeken ofment al heeft.

Merct noch dat hoewel hier ghezeyt is alle volghende Liſten een oorden te zullen hebben als deſe, zoo en is daer by niet te verſtaen datſe al de partijen vande voorgaende zouden moeten hebben, want hoewel datter veel mochten ghebreken (ghelijc in ettelicke Liſten nootzakelic weſen moet) zoo kunnen de zelve dieder zijn haer vervolch hebben ghelijc deſe, zoo verre alſt ſtreckt : Ooc wort verſtaen de verbetering des oordens van tvervolgh der leden en haer partijen altijt vry te ſtaen.

Zulcx als hier ghezeyt is op de Liſte der Artillerie, dergelijc verſtaet hem ooc op de volghende Liſten der munitie van Oorloogh, der Waghens, Schepen, en ander daer veel verſcheydenheden in vallen.

- Master Gunner Joos de Nol. ¹⁾
 36 Gunners.
 Master Artificer, together with two Conductors.
 Petardeer.
 2 Battery-masters.
 Master Carpenter Proot ¹⁾.
 His Lieutenant Symon Gerbrantsz.
 12 Carpenter's mates.
 2 Wheelers.
 2 Farriers.
 1 Gabionmaker.
 2 Harniquers or Waggon-greasers.
 1 Cooper.
 Provost of the Ordnance and his Assistants.
 Surgeon detailed to the Ordnance.
 Surveyor of the Draught-horses.
 His 11 Conductors ²⁾ distributed as follows: 1 to each of the 6 Cannons,
 1 to each of the 3 pieces of Field-Ordnance, 1 to the Carriages and
 Limbers, 1 to come and go.
 2 Pioneer-Captains, John Melchiorsz, and John Melisz ³⁾.
 100 Pioneers, to each Captain 50 men.
 Miner-Captain Gille Louet ⁴⁾.
 25 Miners.
 4 Naval Captains.
 240 Sailors, to each Captain 60 men.

NOTE.

The sub-division of this Artillery-List in its articles and its continuation also holds good for the Lists that are to be drawn up in the years to come or at any time, that they are needed. In this manner it is possible to draw up new Lists with less trouble and more certainty that all the necessary things are being included and that for all the persons concerned it will be easy to examine if the present-day Lists fully correspond with the preceding ones, viz. that not any parts are being left out or that too many things have been included and that the quantities of gun-powder or cannon-balls and other accessories are according to the requirements of the ordnance of the times, just as this has been deliberately carried out in previous years, also that care should be taken that all that was found missing at the previous time has been included now.

¹⁾ In the *State of War*, 1609 we find: Joost Nolde, Master Gunner and Everard Cornelisz. Proot, Master Carpenter of the Army (cf. also fol. 26, 29).

²⁾ The number of 11 conductors is not clear; according to the 1st list of the Artillery there were not 6 but 12 cannons and according to the French edition there was one conductor for the gun-carriages and limbers and one to come and go.

³⁾ For the captains of the pioneers John Melchiorsz. and John Melisz of Groningen, cf. also *St. Leger* III, p. 16.

⁴⁾ For the captain of the miners Gille or Gilles Louet see also Mascheck, *Geschiedenis van het Korps Nederlandsche Mineurs en Sappeurs*, Zaltbommel 1853, p. 227; and D. van den Berg, *Geschiedenis van de Mineurs, Sappeurs en Pioniers, met name in de Nederlanden tot in de tijd van Prins Maurits* (publ. Inspection of the Dutch Military Engineers 1953) pp. 66, 67.

All this will prove to be more easy when the same order will be adopted than otherwise would have been the case, if one has to check everything in order to ascertain, whether it has already been noted.

It should further be noted, that although we have stated that all the following Lists are to be drawn up on the same lines as the one under discussion, it should not be understood, that they are to comprise all the articles of the previous Lists, for although there might have been many omitted (which, in various Lists, must necessarily occur), yet, the ones that are there may be of the same order and arrangement as this one, as far as it has been drawn up. Moreover it should always remain free to suggest any improvement in the method of the continuation of the sections and their parts.

That which has been said about the Artillery-List, this is also applicable to the following Lists, such as those of the War-munition, the Waggon, Vessels and others containing a great variety of subjects.

5 L Y S T E,
Vande munitie van Oorloogh.

Kruyt, Loot, en Lonten.

45000 ⌘ kruyt van Musquetten.
45000 ⌘ ghegoten Musquetkoghels.
45000 ⌘ Lonten.

Gheweer.

200 Musquetten.
800 langhe Spiessen.
50 halve Spiessen.
50 Rondassen.

Handtreetschap.

10000 Spaden.
2000 Schuppen met yfer beslaghen.
1000 Hauweelen.
500 Picken.
1200 Bijlen.
600 Handbijlen.
600 Hachmessen.
4 yfer Handboomen.

Hout.

1600 Delen.
25 deurzaeghde Delen.
1500 Kapravens.
100 Balcken van 10 ellen.
100 Balcken van 12 ellen.

Naghels.

2000 van 7 duym.
2500 van 6 duym.
3000 van 5 duym.
20000 dobbel Middelnaghels.
20000 enckel Middelnaghels.
10000 Lascyfers.
10000 Schotspijckers.

Licht.

100 ⌘ Keerffen.
8 houten Lanteeren.
2000 stucx Turcken.
6 Lampetten.

Verscheyde

LIST 5.
Of the War-munitions 1).

Gun-powder, balls and matches.

45,000	pounds of gun-powder for Muskets.
45,000	pounds of cast Musket-balls.
45,000	pounds of Matches.

Small arms.

200	Muskets.
800	Pikes.
50	half Pikes.
50	Targes.

Hand-tools.

10,000	Spades.
2,000	Shovels mounted with iron.
1,000	Pickaxes.
500	Picks.
1,200	Axes.
600	Hand-axes.
600	Slash-knives.
4	iron Hand-spikes.

Wood.

1,600	Boards.
25	Boards sawn in two.
1,500	Cross-beams.
100	Beams of 10 yards.
100	Beams of 12 yards.

Nails.

2,000	seven-inch Nails.
2,500	six-inch Nails.
3,000	five-inch Nails.
20,000	double Middle-nails.
20,000	single Middle-nails.
10,000	Welding-irons.
10,000	Timbering-nails.

Lighting.

100	pounds of Candles.
8	wooden Lanterns.
2,000	Torches or "Turcken".
6	small Lamps or "Lampetten".

¹⁾ The "Munitie van Oorloogh" (War ammunition) has been (combined with the Artillery) fully dealt with, inter alia, in the works of Hondius and Wijn (p. 182-242).

Verscheyden dinghen.

1000 Kordewaghens volkomen.
 100 Spillen in voorraet.
 30 Biesbrugghen mette koorden van dien.
 50 hayren deefels.
 100 vierkante Mandekens.
 600 Aertsackkens.
 30 Scheepscatrollen.
 100 Quartierstocken.
 10 Treclijnen om de munitie op te trecken.
 1200 Koorden van alle soorten van sacbant opwaert.
 8 Vormen van 12 garen tot Musquetten.
 8 Looilepels om te gieten.

Officieren vande munitie van Oorloogh.

Den Commis Bom.
 20 Conducteurs.

6 L Y S T E,

Vande VVaghens.

IN dese verdeeling wort ghevolgt d'oorden der voorgaende Lijsten, te weten
 eerst de waghens voor de Officieren van't Legher: Ten tweeden voor her Voet-
 volc: Ten derden voor de Ruyterie: Ten vierden voor de Artillerie: Ten vijfden
 voor de munitie van Oorloogh: Ten zeften voor de Vivres.

Waghens voor de Officieren van't Legher.

Voor syn Vorstelijke Ghenade.	66
Graef Heyndric van Nassau Generael vande Ruyterie.	30
Syn Lieutenant Marquette.	6
Sergant Major generael Sedleniski.	3
Commissaris generael vande Ruyterie Stakenbroec.	2
Quartiermeester generael Solem.	2
Provoost generael.	3
Advocaet Fiscael en Greffier.	2
Commis van't ghekt.	2
Waghemeester generael Doublet synen Lieutenant, Conducteurs, Radcmakers, Smeden en Touwerc.	7
Quartiermeester generael vande Ruyterie Lieven Cijp.	1
Den Provoost van't Water.	1
Twee Chyrurgijns van't Legher.	2
Drie Predicanten.	3

Somme der waghens vande Officieren van't Legher. 129

VVaghens

Various objects.

1,000	Wheelbarrows complete.
100	Axles in stock.
30	Bridges of rushes with their ropes.
50	Covers made of hair.
100	square Baskets.
600	Sacks to be filled with earth.
30	Ship's pulleys.
100	Quarterstakes.
10	Pulling-ropes to pull up the ammunition.
1,200	pounds of all kinds of Canvas-yarn from string upwards.
8	Moulds with 12 holes for Muskets.
8	Casting-ladles (for lead)

Officers of the War-munitions.

20	Commissary Bom ¹⁾ .
	Conductors.

LIST 6.

Of the Waggon.

In this classification the order of the previous Lists is adopted i.e. firstly the waggons for the Officers of the Army-Camp; secondly those for the Infantry; thirdly those for the Cavalry; fourthly those for the Artillery; fifthly those for the War-munitions; sixthly those for the Viduals.

Waggon for the officers of the Army camp ²⁾ ³⁾.

For his Princely Grace	66
Count Henry of Nassau, Cavalry General	30
His Lieutenant Marquette	6
Sergeant Major General Sedleniski	3
Commissary general of the Cavalry Stakenbroec	2
Quartermaster general Solem	1
Provost marshal	3
Judge Advocate general and Clerk of the Court	2
Pay-master	2
Waggon-master general Doublet, his Lieutenant,	
Conductors, Wheelers, Farriers and Ropes	7
Quartermaster general of the Cavalry Lieven Cijis	1
Provost of the Vessels	1
Two surgeons of the Army Camp	2
Three Chaplains	3
Sum total of the number of waggons of the Officers of the Army Camp	129

¹⁾ Peter Bom, also mentioned on fol. 27, line 16, joined Maurice's campaigns of 1614, 1621, 1622 together with his waggons carrying "de ammunitie van oorloghe"; he is said to have died in the year 1622 (cf. *St. Leger* III, pp. 215, 232, 240, 249).

²⁾ The waggons for Count Ernest (Casimir) are lacking; according to the calculation of the front-side of his quarters (The Germans, fol. 17) he was encamped outside his regiment (as Infantry-General, see fol. 11).

³⁾ It also appears in comparison with list 1, that the "Medicijn van 't Legher" (Army-doctor) had no waggon at his disposal, whereas the two Army-surgeons had two waggons assigned to them.

L E G H E R M E T I N G.
Waghens voor het Voetvolc.

25

D En Colonel Chatillon.	6
Syn Lieutenant Colonel en Sergant Major.	2
Chirurgijn en Prevooft.	1
19 Capiteynen.	19
Den Colonel Bethune.	16
Syn Lieutenant en Sergant Major.	2
Chirurgijn en Prevooft.	1
19 Capiteynen.	19
Den Lieutenant Colonel van Graef Ernſe.	1
Sergant Major en Quartiermeeſter.	1
Chirurgijn en Prevooft.	1
6 Capiteynen.	6
Den Colonel Graef Ian Ernſt.	5
Syn Lieutenant Colonel.	1
Sergant Major en Quartiermeeſter.	1
Chirurgijn en Prevooft.	1
16 Capiteynen.	16
4 Capiteynen vande vier Garden.	4
Lieutenant en Vendrich vande Garde van ſyn <i>Vorſtelicke Ghenade.</i>	
Voor de vwapenen vande zelve Garde.	1
Den Lieutenant Colonel vande Vriefen.	2
Sergant Major en Quartiermeeſter.	1
8 Capiteynen.	8
12 Capiteynen van't regiment van Veer.	12
2 Capiteynen van't regiment van Ogle.	2
Den Generael Cecil.	12
2 Colonellen yder vier waghens.	8
3 Lieutenanten Colonels yder 2, komt	6
3 Serganten Majors yder 1, komt	3
3 Quartiermeeſters yder 1, komt	3
3 Prevooften yder 1, komt	3
2 Predicanten yder 1, komt	2
Chirurgijn Meeſter James.	3
52 Capiteynen.	52
Den Commiſſaris vande waghens.	1
Somme der waghens van't Voetvolc	<u>212</u>

Waghens voor de Ruyterie.

10 Colonels vande Ruyterie yder een wagen, komt	10
Lieutenant en Cornette der compagnie Ruyters van ſyn <i>Vorſtelicke Ghenade.</i>	1
Voor de Wapenen.	1
Somme der waghens voor de Ruyterie.	<u>12</u>

D **Waghens**

Waggons for the Infantry.

Colonel Chatillon	6
His Lieutenant Colonel and Sergeant Major	2
Surgeon and Provost	1
19 Captains	19
Colonel Bethune ¹⁾	6
His Lieutenant and Sergeant Major	2
Surgeon and Provost	1
19 Captains	19
Lieutenant Colonel to Count Ernest	1
Sergeant Major and Quartermaster	1
Surgeon and Provost	1
6 Captains	6
Colonel Count John Ernest	5
His Lieutenant Colonel	1
Sergeant Major and Quartermaster	1
Surgeon and Provost	1
16 Captains	16
4 Captains detailed to the four Guards	4
Lieutenant and Ensign to the Guard of his Princely Grace	1
For the arms of this Guard	1
Lieutenant Colonel of the Frisians	2
Sergeant Major and Quartermaster	1
8 Captains	8
12 Captains of Vere's regiment	12
2 Captains of Ogle's regiment ²⁾	2
General Cecil	12
2 Colonels four waggons each	8
3 Lieutenant Colonels, 2 waggons each	6
3 Sergeant Majors, 1 waggon each	3
3 Quartermasters, 1 waggon each ³⁾	3
3 Provosts, 1 waggon each	3
2 Chaplains, 1 waggon each	2
Master Surgeon James ⁴⁾	2
52 Captains ⁵⁾	52
Commissary of the waggons	1
Sum total of the number of waggons of the Infantry	212

¹⁾ The number of 16 waggons for Colonel Bethune should be 6, like that for Colonel Châtillon (this printer's error does not occur in the French and German editions, so that in the latter the addition to the total number of 212 perfectly tallies).

²⁾ The statement of 2 Captains attached to Ogle's regiment does not seem correct, as *St. Leger* III, p. 14 states sub e 11 companies instead of Hollis's number of 10, see also note 5.

³⁾ The 3 Quartermasters (mentioned together) must be those attached to Vere's, Ogle's (or Hollis's) and Cecil's regiment.

⁴⁾ As to the Master-surgeon James, the latter was surgeon to the English regiments in the year 1602 (R.G.P. 92, p. 194).

⁵⁾ The number of 52 Captains constitutes the difference between the number of 64 of the English and Scottish regiments as stated on fol. 17, 18 and the 12 Captains of Vere's regiments; so the 2 Captains of Ogle's regiment, stated in note 2 as mentioned before, have been counted twice.

Waghens voor de Artillerie.

40000	Buskruyt op yder wagen 4 tonnen, tzamen	59
800	heele Canonkoghels op elcke wagen 20, komt	40
1600	halve Canonkoghels op elcke wagen 40, komt	40
40	blecke Kogheldozen tot heele Canons.	2
60	blecke Kogheldozen tot halve Canons.	2
	Totte behoefen der drie Veltstucken van 12 yfers.	8
	Lepels, Wijschers, Aenzetters, Onderlaghen, houte en yfer Handboomen.	2
4	Bocken.	4
	Lamoentuych, Ghereelen en Strenghe.	4
	Haemkluppels, houte en yfer Handboomen.	2
	Touwer.	3
	Harniceure.	2
	Schuppen, Spaden, Bijlen, etc.	1
114	Swalpen.	14
40	vuyren Balcken.	4
50	Delen.	2
100	Hurden.	5
	Totte vyerwercken.	2
	Totte Petarts.	2

Somme der waghens voor de Artillerie 198

Waghens voor de Officiers vande Artillerie.

D	En Generael van't Gheschut Kessel.	4
	Syn Lieutenant Grenu.	2
	Controleur van't Gheschut.	2
	Commis van't Gheschut.	1
	Edellieden.	2
6	Ingenieurs elc 1, komt	6
2	Controleurs vande Fortificatien.	2
	Meeſter Conneſtabel.	1
12	Canoniers.	1
	Meeſter vyerwercker.	1
	Petardier.	1
	Baterijmeeſter.	1
	Meeſter Timmerman.	1
12	Timmerghezellen.	1
2	Rademakers.	1
2	Smits.	1
	Prevooft van't Gheschut.	1
	Chirurgijn van't Gheschut.	1
	Brugmeeſter.	1
	Commis vande Trecpeerden.	1
2	Capiteynen vande Pionniers.	2
	Capiteyn vande Mineurs.	1
4	Scheeps Capiteynen.	4

Somme der waghens voor de Officiers vande Artillerie 39Somme voor de Artillerie in alles 237

Waggons for the Cavalry.

10 Colonels of the Cavalry, one waggon each	10
Lieutenant and Cornet of the Cavalry squadron attached to his Princely Grace	1
For the arms	1
Sum total of the number of waggons for the Cavalry	12

Waggons for the Ordnance ¹⁾

40,000	pounds of gunpowder, each waggon carrying 4 tons, making together	59 ²⁾
800	Balls for Whole Cannons, each waggon carrying 20, makes	40
1,600	Balls for Demi-Cannons, each waggon carrying 40, makes	40
40	tin Cartouches for whole Cannons	2
60	tin Cartouches for Demi-Cannons	2
	Required for the three pieces of field-ordnance of 12 pounds of iron	8
	Ladles, Drags, Rammers, Wedges, wooden and iron Hand-spikes	2
4	Derricks	4
	Shaft-harnesses, Harnesses and Traces	4
	Studded yokes, wooden and iron Hand-spikes	2
	Ropework	3
	Greasers	2
	Shovels, Spades, Axes, etc.	1
114	Sleepers	14
40	deal Beams	4
50	Boards	2
100	Hurdles	5
	For the artificer's equipment	2
	For the Petards	2
	Sum total of the number of waggons for the Ordnance	198

¹⁾ The total quantities of gun-powder, cannon-balls etc. to be loaded into the waggons, does not tally with those mentioned in list 4 of the Artillery; here we do not see their purport unless they should be additional quantities.

²⁾ The number of 59 waggons in order to convey 40,000 pounds of gunpowder, 4 tons to each waggon, has been further explained to us by Prof. P. Huijter, actuary with the Dutch Patent-Office: "The price of gunpowder in those days was fixed at a quantity of 140 pounds by which presumably was meant the price per barrel; this could be proved by a contract dated January 1st, 1660, which has been reproduced on p. 18 of the memorial volume *Buiscruytmakers* by G. de Bruin (Amsterdam, 1952)". Hence by a number of 59 waggons $59 \times 4 \times 140 = 33,040$ pounds of gunpowder were conveyed at the time, leaving 6,960 pounds for the 236 empty barrels (or abt. 30 pounds a barrel).

Waggons for the Artillery Officers 1).

General of the Ordnance Kessel	4
His Lieutenant Grenu	2
Superintendent of the Ordnance	2
Surveyor of the Ordnance	1
Noblemen	2
6 Engineers, one each, makes	6
2 Superintendents of the Fortifications	2
Master Gunner	1
12 Gunners	1
Master artificer	1
Petardeer	1
Battery-master	1
Master Carpenter	1
12 Carpenter's mates	1
2 Wheelers	1
2 Farriers	1
Provost of the Ordnance	1
Surgeon of the Ordnance	1
Bridge-master	1
Surveyor of the Draught-horses	1
2 Captains of the Pioneers	2
Captain of the Miners	1
4 Naval Captains	4
Sum total of the waggons for the Artillery Officers	39
Sum total of the Artillery as a whole	237

the numbers of persons differ from those mentioned in the corresponding list nr. 4 or missing from them; so we find a number of 12 gunners instead of 36 in list nr. 4, one instead of two, etc.

Waghens voor de munitie
van Oorloogh.

20000 ƒ Kruyt.	20
20000 ƒ Looſt.	20
20000 ƒ Lonten.	20
Muſquetten mette fournituren, langhe Spieſſen, Rondaffen, Caſquet- ten, Vormen, Lepels.	7
9000 Spaden en 50 Schuppen.	20
400 Hauweelen, 200 Picken, 400 Bijlen, 300 Handbijlen, 300 Hachmeſſen.	6
Spijckers van alle ſoorten.	1
100 ƒ Keerſſen, 12 Lanternen, 2000 Turcken, 6 Lampetten.	2
100 Kordewaghens.	4
10 Biesbrugghen met haer koorden.	5
100 vierkante Mandekens en 100 Quartierbaken.	1
Voor den Commis B om en ſyn Conducteurs.	2
Somme der waghens vande munitie van Oorloogh.	108

Waghens voor de Vivres.

Voor de Vivres.	242
Den Commis vande Vivres Kien.	1
Syn Conducteurs.	1
Somme der waghens vande Vivres	244

Somme der Sommen vande vvaghens.

Vande Officiers van't Legher.	129
Van het Voervolc.	212
Vande Ruyterie.	12
Vande Artillerie.	237
Vande munitie van Oorloogh.	108
Vande Vivres.	244
Somme van al de waghens	942

7 L Y S T E.

Vande Schepen.

IN deſe verdeeling wort ghevolgt d'oorden der voorgaende Liſten : Te weten
leerſt de Schepen voor de Officiers van't Legher: Ten tweeden voor het Voet-
volc : Ten derden voor de Ruyterie : Ten vierden voor de Artillerie : Ten vijf-
den voor de munitie vande Artillerie : Ten zeften voor de munitie van Oorloogh :
Ten zevenden voor de Vivres : Ten achtſten de Brugſchepen : Ten neghen
Schepen tot verſchevden dinghen.

Waggons for the War-munitions ¹⁾).

20,000	pounds of Gunpowder.	20
20,000	pounds of Lead (to cast musket balls).	20
20,000	pounds of Matches.	20
	Muskets and accessories, Pikes, Targes, Casques, Moulds, Ladles.	7
9,000	Spades and 50 Shovels.	20
400	Pickaxes, 200 Picks, 400 Axes, 300 Handaxes, 300 Slash-knives	6
	All kinds of Nails.	1
100	pounds of Candles, 12 Lanterns, 2,000 Torches ("Turcken"),	
	6 small Lamps ("Lampetten")	2
100	Wheelbarrows.	4
10	Bridges of rushes with their ropes.	5
100	square Baskets and 100 Quarter-beacons	1
	For Surveyor Bom and his Conductors	2

Sum total of the waggons for the War-munitions 108

Waggons for the Victuals

For the Victuals	242
Surveyor of the Victuals Kien ²⁾	1
His Conductors	1

Sum total of the waggons for the Victuals 244

Sum total of the sums of all the Waggons.

Of the Officers of the Army Camp.	129
Of the Infantry	212
Of the Cavalry	12
Of the Artillery	237
Of the War-munitions	108
Of the Victuals	244

Sum total of all the waggons 942

LIST 7

Of the Vessels.

In this classification the order of the previous Lists is to be followed: i.e. firstly the Vessels for the Officers of the Army Camp; secondly those for the Infantry, thirdly those for the Cavalry; fourthly those for the Artillery; fifthly those for the Artillery-munitions; sixthly those for the War-munitions; seventhly those for the Victuals; eighthly the pontoons; ninthly Vessels for various purposes.

¹⁾ Almost all the quantities stated are found to be smaller than those given in the lists numbered 5.

²⁾ The Commissary of the vivres in the field Nicasius Kien, thus recorded in the State of War of 1609 (being in many respects similar to that of 1610) was also present with his train in Maurice's campaign of the year 1622; in that of the year 1624 he had already been succeeded by his son Nicholas (cf. *St. Leger* III, pp. 240, 249).

Schepen voor de Officiers van't Legher.

SYN Vorstelijke Ghenade.

Graef Heyndric zoo Schepen als Schuyten.	20
Den Wachtmeester generael Sedleniski.	12
Quartiermeester generael Solem.	1
Prevoost generael met syn Dienaers en de Maetroosen.	1
Den Advocaet Fiscael metten Greffier vanden Krijchraet in een Munitieschip.	1
Den Commis van't ghelt.	1
Den Waghemeester met syn Conducateurs.	1
De twee Chirurgijns van't Legher en Apothecaris.	1

Somme der Schepen vande Officiers van't Legher 38

M E R C T.

D Aer zijn noch Officiers als vande Artillerie, vande munitie van Oorloogh, vande Vivres, en vande Schepen, maer want henlien die behelpen inde Schepen gheladen mette goeden daer sy't bewint af hebben, zoo en behoeven die gheen ander eyghen Schepen.

Schepen voor het Voetvolc.

Voor twee regimenten Fransoysen elc drie Schepen, komt	6
Het regiment Duytschen van Graef Ernst.	1
Het regiment vande Walen.	2
Het regiment vande vier Garden.	1
Voor de wapenen en bagage vande Garde.	1
Het regiment Vriesen.	1
Het regiment Enghelschen.	2
Enghelschen marcherende met Graef Heyndric.	2
Het regiment Schotten.	2
Het regiment vanden Lieutenant Colonel Meetkercken.	1

Somme der Schepen van't Voetvolc 19

Schepen voor de Ruyterie.

Elf regimenten Ruyters elc een Schip, komt	11
Voor de wapenen en bagage vande Ruyterie van syn Excell. compagnie.	1

Somme der Schepen vande Ruyterie 12

Schepen voor de Artillerie.

Dese Schepen zijn drierley : Ten eersten voor de Officiers resorterende onder de Artillerie : Ten tweeden voor de metale Stucken met haer Affuyten en Gheschutwaghens : Ten derden voor de munitie vande Artillerie.

Schepen

Vessels for the Officers of the Army Camp.

His Princely Grace	20
Count Henry Ships as well as Barges.	12
"Wachtmeester"-General Sedleniski ¹⁾	1
Quartermaster-general Solem	1
Provost Marshall together with his Assistants and Sailors.	1
Judge Advocate General together with the Clerk of the Court on a Vessel carrying Ammunition.	
Paymaster.	1
Waggon-master with his Conductors	1
Two Surgeons of the Army Camp and Dispenser ²⁾ ³⁾ .	1
Sum total of the Vessels of the Officers of the Army Camp	38

NOTE

There are still other Officers, such as those of the Ordnance, the War-Munitions, the Victuals and those detailed to the various Vessels. However as the latter manage with the Vessels loaded with the goods controlled by them, they need not have other boats of their own.

Vessels for the Infantry.

To two regiments of French soldiers three Vessels each, makes	6
To the regiment of Germans of Count Ernest	1
To the regiment of the Walloons	2
To the regiment of the four Guards	1
To the arms and baggage of the Guard ⁴⁾	1
To the regiment of Frisians	1
To the regiment of the English	2
To the English marching with Count Henry ⁵⁾	2
To the regiment of the Scots	2
To the regiment of Lieutenant Colonel Meetkercken ⁶⁾	1
Sum total of the Vessels of the Infantry	19

¹⁾ Sedleniski is here named "Wachtmeester"-General and in list 1 (fol. 16) Sergeant-Major-General; for further explanation see *Wijn*, p. 34.

²⁾ The Dispenser (Apothecary) does not occur in the respective lists 1 (fol. 16) and 6 (fol. 24); yet he does figure all the same in the *State of War of 1609*, also as an Army-doctor.

³⁾ Why are here the chaplains lacking?

⁴⁾ By "the arms and baggage of the Guard" are meant those belonging to prince Maurice's Guard; the latter comprised an Infantry company of 250 men (*St. Leger* II, p. 149, see also *State of War of 1609*).

⁵⁾ Which infantry are meant by the "English marching with Count Henry" is not clear to us; this Cavalry General was actually in command of a Dutch infantry company (cf. *St. Leger* III, 15, sub K) and according to the *State of War of 1609* this company comprised 200 men.

⁶⁾ Lieutenant Colonel Adolph van Meetkercken was Lieutenant Colonel to Colonel Horatio Vere (see *St. Leger* III, p. 180 and *State of War of 1609* "Tractementen op Holland").

Schepen voor de Officiers refterende onder de Artillerie.

Den Generael van't Gheschut.	1
De Ingenieurs, Controlleurs, en Conducteurs vande Fortificatien en van de wercken.	1
Den Ingenieur Arent Arentsz.	1
Meeſter Conneſtabel met al de Canoniers.	1
Meeſter Timmerman generael voor hem en al ſyn Timmerlieden.	1
Commis vande Trecpeerden met ſyn Conducteurs en ghereetſchap.	1
Rademakers, Hoefſmeden, Lijndraeyers met haer materialen.	1
Twee Capiteynen vande Pioniers, Vyerwerckers en Petardijs.	1
Somme der Schepen vande Officieren refterende onder de Artillerie	8

Schepen voor de metale Stucken met haer Affuyten en Gheſchutvaghens.

Deſe Stucken met haer Affuyten en Gheſchutvaghens worden gheleyt inde Brugſchepen, die hier na int naeflaetſte lidt deſer Liſte der Schepen zullen beſchreven worden.

Schepen voor de munitie vande Artillerie.

960 tonnen Kruyt in vier Kerveels, komt	4
3000 Koghels van 48 π in vier Damloopers.	4
6000 Koghels van 24 π in vier Damloopers.	4
Voor de Petarts en toebehoorende ghereetſchap een Damlooper, komt	1
Voor het Touwerck, Lonten, blecke Kogheldoozen en ander dinghen een Kerveel komt	1
Voor 500 Horden en eenighe Mandekens een Kerveel, komt	1
150 Swalpen en eenighe Manden een Kerveel, komt	1
200 Delen 200 Kapravens een Schip, komt	1
Voor eenich Touwerck, Gareelen, Lepels, etc. een Schip, komt	1
1200 Koghels van 12 π een Kaghe, komt	1

Somme der Schepen voor de munitie vande Artillerie 19

Somme der Schepen voor de Artillerie in alles 27

Schepen voor de munitie van Oorlogh.

45000 π Buskruyt.	
45000 π ghegoten Muſquetkoghels.	
45000 π Lonten.	
50 hayren Kleeden.	
8 Vormen.	
8 Lepels.	
Altwelc is gheladen gheweest in 4 Schepen elc van 20 Laſt, en een Damlooper, tzamen	5

D 3

200 Muſ-

Vessels for the Cavalry.

To 11 Cavalry-regiments one Vessel each, makes	11
To the arms and baggage of his Excellency's Cavalry squadron ¹⁾	1
Sum total of the Vessels of the Cavalry	12

Vessels for the Artillery

These Vessels are of three kinds: firstly those for the Officers belonging to the Artillery; secondly those used for the metal Guns with their Carriages and Artillery-waggons; thirdly those for the munitions of the Artillery.

Vessels for the Officers belonging to the Artillery ²⁾.

General of the Ordnance	1
Engineers, Superintendents and Conductors of the Fortifications and the works ³⁾	1
Engineer Arent Arentsz	1
Master Gunner together with all the Gunners	1
Master Carpenter general ⁴⁾ and all his Carpenters	1
Surveyor of the Draught-horses together with his Conductors and tools	1
Wheelers, Farriers, Rope-makers with their working-stock ⁵⁾ ⁶⁾	1
Two Pioneer-Captains, Artificers and Petardeers	1
Sum total of the Vessels of the Officers belonging to the Artillery	8

Vessels for the Metal Guns with their Carriages and Artillery-waggons.

These Guns together with their Carriages and Artillery-waggons are put on the Pontoons ⁷⁾, which will be described in the last section but one of these Lists of Vessels.

¹⁾ For the "Cavalry of his Excellency's squadron" see Wijn, p. 44 (Cavalry), with reference to *St. Leger* II, p. 109, Genealogy of the companies.

²⁾ The arrangement of the lists of the vessels for the Artillery is different to that of the corresponding lists of the waggons (compare fol. 26); in both cases however the means of conveyance for the Officers and those for the "Ammunition" have been divided.

³⁾ "Works" (as stated for the first time in the lists, presumably as a distinction from the existing fortifications), may also refer to the works of attack at Juliers. About the latter there has been preserved, inter alia, a writing, entitled: "*Discours, Condiitien und Bestechen*" by Hillebrant Smits (Archives Council of State; no. 1226 in General State Archives).

⁴⁾ The title "Master-Carpenter-General" appears to be a little exaggerated (see fol. 22, 26).

⁵⁾ The farriers are presumably the 2 "Smits" stated on fol. 22, 26 in the original edition.

⁶⁾ Could it be that the Rope-makers have been forgotten in lists 4 and 6?

⁷⁾ For "Brugschepen" (Pontoons) cf. inter alia Wijn, p. 243-251, in which the art of building bridges is dealt with, which at the time came under Artillery (cf. also fol. 31).

1

2

3

4

5

6

7

Vessels for the Artillery-munitions.

960	tons of Gunpowder in four Caravels, makes	4
3,000	Cannon-balls of 48 pounds ²⁾ in four "Damloopers" ¹⁾	4
6,000	Cannon-balls of 24 pounds ²⁾ in four "Damloopers"	4
	For the Petards and accessory tools one "Damlooper", makes	1
	For the Ropes, Matches, tin Cartouches and other utensils	
	one Caravel, makes	1
	For 500 Hurdles and a few Baskets one Caravel, makes	1
150	Sleepers and a few Baskets one Caravel, makes	1
200	Boards, 200 Crossbeams one Vessel, makes	1
	For some Rope-work, Harnesses, Ladles, etc. one Vessel, makes	1
1,200	Cannon-balls of 12 pounds ²⁾ one Ketch (flat-bottomed boat), makes	1
Sum total of the Vessels for the Artillery-munitions		19
Sum total of the Vessels for the Artillery as a whole		27

Vessels for the War-munitions.

45,000	pounds of Gunpowder	
45,000	pounds of cast Musket-balls	
45,000	pounds of Matches	
50	Covers made of hair	
8	Moulds	
8	Ladles	
	All this has been loaded into 4 Vessels with a loading-capacity of 20 "Last" each and one "Damlooper", together	5

¹⁾ A "damlooper" used to be a small inland-vessel, suitable to be hauled over dams (*Woordenboek der Nederl. Taal*, 3rd volume, 2nd part, 1916, 2260); Wijn describes its use, and that of Caravels, in his book on the siege of Haarlem in the year 1572-73, pp. 100, 101. In the French edition the word "damlooper" has not been translated, in the German edition we find "Damlouper".

²⁾ Cannon-balls of 48 pounds are those meant for "whole cannons" (see fol. 19), cannon-balls of 24 pounds are for "demi-cannons". This is shown, inter alia, by the *Mil. Diet.* of 1745 under Bullet, Ball or Shot viz.: "That of the Royal or whole Cannon, weighs 48 lb." and by Wijn, p. 187: the "kanonnen" or "kartouwen" were represented by three types, viz. whole, demi- and quarter-kartouw (resp. 48, 24 and 12 pounds)."

30

LEGHERMETING.

200 Musquetten.

800 Spiessen.

50 halve Spiessen.

50 Rondassen.

12 Lanteernen.

100 Keerssen.

6 Lampetten.

2000 Turcken.

Alderley Spijckers.

100 Quartierbaken.

600 Aertsacxkens.

10 Treclijnen.

12000 Touwerc.

30 Scheps Catrollen.

100 vierkante Mandekens.

Altwelc is gheladen gheweest in een Damlooper, komt

3

30 Biesbrugghen mette woorden daertoe behoorende, gheladen in een Schip
van 20 Last, en een Damlooper, komt tzamen

2

10000 Spaden.

2000 Schuppen.

1000 Hauweelen.

500 Picken.

1200 Bijlen.

600 Handtbijlen.

600 Hacmessen.

Altwelc gheladen is gheweest in 3 Damloopers, komt

3

10000 Kordewaghens.

100 Wielen.

100 Spillen.

25 Deurghezaeghde Delen.

Altwelc gheladen is gheweest in 3 Schepen elc van 20 Last, komt

3

1500 Delen.

1500 Kapravens.

200 vuyren Balcxkens.

10 Treclijnen.

4 yfer Handtboomen.

Altwelc gheladen is gheweest in 3 Schepen elc van 20 Last, komt

3

Somme der Schepen voor de munitie van Oorloogh 11 van
20 Last en 6 Damloopers tzamen

17

Schepen voor de Vivres.

Defc Schepen waren

66

Brug-

200	Muskets	
800	Pikes	
50	half-pikes	
50	Targes	
12	Lanterns	
100	pounds of Candles	
6	small Lamps ("Lampetten")	
2,000	Torches ("Turcken")	
	All sorts of Nails	
100	Quarter-beacons ¹⁾	
600	Sacks to be filled with earth	
10	Haulage-ropes	
12,000	pounds of Rope-work	
30	Ship's Pulleys	
100	square Baskets	
	All this has been loaded into one "Damlooper", makes	1
30	Bridges made of rush together with their accessory ropes; all this loaded into a Vessel of 20 "Last" and one "Damlooper" makes together	2
10,000	Spades	
2,000	Shovels	
1,000	Pickaxes	
500	Picks	
1,200	Axes	
600	Hand-axes	
600	Slash-knives	
	All this has been loaded into 3 "Damloopers", makes	3
10,000	Wheelbarrows ²⁾	
100	Wheels	
100	Axles	
25	Boards sawn in two.	
	All this has been loaded into 3 Vessels of 20 "Last" each, makes	3
1,500	Boards	
1,500	Cross-beams	
200	small deal Beams	
10	Haulage-ropes	
4	iron Hand-spikes	
	All this has been loaded into 3 Vessels of 20 "Last" each, makes	3
	Sum total of the Vessels for the War-munitions, 11 of 20 "Last" and 6 "Damloopers" together	17

Vessels for the Victuals.

These Vessels amounted to 66

¹⁾ For the number of 100 Quarter-beacons, also figuring on fol. 27, see note 1 to fol. 36.

²⁾ This number of 10,000 wheel-barrows should be 1,000, as it is also found in the French edition (cf. the number of 1,000 on fol 24 and of 100 on fol. 27).

Brugſchepen.

Zeventien Ponten tot het Gheſchut met ſyn ghevolgh, komt	17
Een groote Veerpont, komt	1
Een kleene Veerpont.	1
Zes Aecken vande kleene Brugghen met haer waghens en Peerdentuych.	6
Een Paetſchip om de Aecken, Waghens, en reedſchap te laden.	1
Somme der Brugſchepen	<u>26</u>

De Perſoonen der Brugſchepen die hun altemael behelpen op haer Schepen, zijn als volcht : Den Brugmeester : Syn Lieutenant : 83 Pontgaſten aldus verdeelt : Op 15 groote Ponten yder 4 : Op 2 minder Ponten yder 3 : Op de groote Veerpont 3 : Op de kleene Pont 2 : By yder der 6 Aecken 1 : Opt Paetſchip 3 Schipſtimmerlieden 3.

Schepen tot verſcheyden dinghen.

Den Commis vande Schepen met ſyn Conducateurs.	1
Een Schip en vier Kaghcn voor de Conducateurs vande Schepen en Commiſen, met bedachte en onbedachte voorvallende zaken.	5
Zes Kaeghſchuyten om aen en af te varen voor Boden en ghequeuſte Soldaten.	6
Somme der Schepen tot verſcheyden dinghen	<u>12</u>

Somme der Sommen vande Schepen.

Vande Officiers van't Legher.	38
Van het Voetvolc.	19
Vande Ruyterie.	12
Vande Artillerie.	27
Voor de munitie van Oorloogh.	17
Voor de Vivres.	66
Brugſchepen.	26
Van verſcheyden dinghen.	12
Somme van al de Schepen	<u>217</u>

M E R C T.

B Eneffens de voorgaende Liſten die in deſe zake tot genoegzaam voorbeeld konnen verſtrecken, zijnder noch wel eenige meer, maer ſchijnen onnoodich hier int bezonder te beſchrijven, en ghenoech te weſen daer af te doen dufdanich vermaen:

Eerſtelic zoo wordet Legher ghemeenelic in drien ghedeelt, als in voortocht, middeltocht, en natocht, die elc haer Liſten behoeven van Voetvolc en Ruyterie, welcke ooc zomwijlen zoo wel int marcheren, reysen oft vertrecken, als int belegghen en beſluyten der Steden yder een ghedeelte hebben van't naghevolgh, als Artillerie, munitie van dien, munitie van Oorloogh, en vande Vivres, metgaders Officiers van zulcke ghedaente ghelijc over het heel Legher zijn : Als over elcken tocht onder anderen een Leghermeter met ſyn hulpters, die ghekoren worden uyt de Ingenieurs, aen welcke men levert Liſten daer ſy hun na te rechten hebben, welcke

Pontoons 1).

Seventeen Pontoons to be used for the Ordnance together with train, makes	17
One large Pontoon for crossing the Rivers, makes	1
One small Pontoon, makes	1
Six Barges belonging to the small Pontoons with their waggons and Harnesses	6
One "Paetschip" 2) for loading the Barges, Waggons and tools	1
Sum total of the Pontoons	26

The Crew of these Pontoons, who are all lodging on their Vessels, consists of: the Bridge-master, his Lieutenant, 83 men on the Pontoons, distributed as follows: on 15 large Pontoons 4 men each; on two smaller Pontoons 3 men each; on the large Pontoon for crossing the Rivers 3 men; on the small one 2 men; with each of the six Barges 1 man; on the "Paetschip" 3 men; 3 ship's Carpenters.

Vessels for various Purposes.

The Surveyor of the respective Vessels and his Conductors	1
One Vessel and four Ketches for the Conductors of the Vessels and Surveyors to be used for special purposes and circumstances beyond one's control	5
Six flat-bottomed Boats (Ketches) to sail off and on for Messengers and wounded soldiers	6
Sum total of the Vessels for various purposes	12

Sum total of the Sums of all the Vessels.

Of the Officers of the Army Camp	38
Of the Infantry	19
Of the Cavalry	12
Of the Artillery	27
For the War-munitions	17
For the Victuals	66
Pontoons	26
For various purposes	12

Sum total of all the Vessels 217

¹⁾ See note 7 to p. 335. Wijn copies this list in his book on Prince Maurice (pp. 250, 251) and also that of the personnel involved and gives them as an example of the composition of a bridge-train, namely that of the expedition to Juliers in the year 1610.

²⁾ In the 17th century a "paetschip" used to be a kind of freighter in the provinces of Brabant and Limburg. (*Woordenboek der Nederl. Taal*, 12th volume, first part, 1931, 110; cf. also *Gr. Placaatboek*, vol. 4, fol. 652a, Ao. 1612). The notation: "Paelschip", as in Duyck, *Journal*, I, p. 672 (1595) and Wijn p. 244, appears not to be correct; in the French and German editions of the *Legermeting* we find respectively "Paetschip" and "Paet-schiff." The word may be derived from the French and Spanish "patache" and this again from the Arabic "batas", signifying a (rapid) vessel with two masts. In the *Woordenboek der Nederl. Taal* is also found "patas". (Communicated by Dr. R. van der Meulen).

NOTE.

Apart from the preceding Lists, which can serve in this matter as an adequate example, there are still a few more, which however need not be described in detail here; it will therefore suffice to utter in this respect the following warning:

Firstly any Army is generally divided into three bodies, such as the advance-guard, the main-guard and the rear-guard, each requiring their respective Infantry- and Cavalry-Lists, which at times, both when marching and travelling or departing as well as when besieging or investing towns might include part of the military train, such as the Artillery and their ammunition, the war-munitions, the victuals, together with the Officers in such quality as they are detailed throughout the Army Camp.

Thus each body has inter alia a Castrametator and his assistants, who are chosen from the Engineers to whom the respective Lists are handed out, to which they

welcke van form zijnae ghelijc de voorgaende, en is niet noodich die int langhe te beschrijven. Noch isser een Lijste vande fouriering der Perfoonen die het Hof volghen, met noch twee ander vande Waghens en Schepen van syn *Vorstelijke Ghe-nade*, Maer om kortheyts wille zijn inde ghemeene Lijste der Wagens en Schepen alleenlic ghestelt de Sommen van dien, als hier voren te zien is. Noch zouder na tghem en ghebruyc van Leghers een Lijste zijn vande Vivres, maer wanter by ons zeer groote roevoering is van Soetelaers en Kooplien met Schepen, en datmen zich boven dien noch verlact op tghene men weet te zullen ghekreghen worden wt de naefte Steden, alst noot is, zoo en vallen hier vande Vivres gheen Lijsten die weerdich zijn te beschrijven.

3 H O O F T S T V C,

Vande teyckening of meting des Leghers.

KORTBEGRYP DESES 3 H O O F T S T V C X.

Dit 3 Hoofstuc zal 6 Leden hebben.

Het 1 Lidt vande teyckening der vierhoeckighe quartieren des Leghers op pampier, om dat inde teyckening op't landt na te komen.

Het 2 Lidt vande meting der vierhoeckighe quartieren des Leghers op't velt, twelc ghedaen wort door den Leghermeter met syn helpers.

Dit volbrocht zijnde, zoo moet de verdeeling vande rijen der hutten en straten geteyckent worden by elc Quartiermeester in syn regiment, want dat aen den Leghermeter onmoghelic zoude zijn oordentelic te doen op zoo korten tijt als hier toe vereyscht is, zulcx dat daer af dit 3 Lidt beschreven zal worden:

Het 3 Lidt vande meting der plaetsen dier noodich zijn totte rijen der hutten en straten daer tusschen, twelc ghedaen wort by elc Quartiermeester in syn regiment.

Dit volbrocht zijnde, zoo moet de verdeeling der hutten inde rijen gheteyckent worden by elc Sergant in syn Vendel, want dat aenden Quartiermeester onmoghelic zoude zijn oordentelic te doen op zoo korten tijt als hier toe vereyscht is, zulcx dat daer af dit 4 Lidt beschreven zal worden.

Het 4 Lidt vande verdeeling der hutten in haer rijen by elc Sergant in syn Vendel.

Het 5 Lidt vande teyckening der alarmplaets, kielspitting des grachts, en berekening hoe veel yder regiment graven moet.

Het 6 Lidt inhoudende vermaen om tghene wel gheteyckent en ghebout is, in goede oorden te onderhouden.

Vande

have to direct themselves and which are of similar form to the preceding ones, so that I need not give a lengthy description of them.

There is still a List of the foraging of the Persons following the Court together with two other Lists of the Waggon and Vessels of his Princely Grace. But for the sake of brevity there has only been included in the general Lists of the Waggon and Vessels the Sum Total of them, as can be seen heretofore ¹⁾.

According to the general custom of the Army Camps there should also be a List of the Victuals, however, as with us there happens to be a considerable supply by Sutlers and Merchants with their Vessels (apart from the things one expects that are still to be had from the nearest Towns, in case of need) thus there are not any Lists of the Victuals worthy of description here.

CHAPTER 3

Of the drawing or the staking out of the Encampment.

SUMMARY OF THIS 3rd CHAPTER

This 3rd Chapter will have 6 Sections.

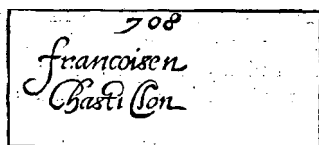
- Section 1 deals with the drawing of the quadrangular quarters of the Encampment on paper, in order to follow this in the drawing in the field.
- Section 2 deals with the staking out of the quadrangular quarters of the Encampment in the field, which is carried out by the Castrametator and his assistants.
This being done, the distribution of the rows of huts and streets is to be staked out by each Quartermaster in his regiment, for it would be impossible for the Castrametator to carry this out in an orderly manner within the short time available, thus it will be described in this Section 3.
- Section 3 deals with the measurement of the spaces required for the rows of huts and the streets in between, which is carried out by each Quartermaster in his regiment.
This being accomplished, the distribution of the huts over the rows must be staked out by each Sergeant in his Company, for it would be impossible for the Quartermaster to carry this out in an orderly manner within the short time available, thus it will be described in this Section 4.
- Section 4 deals with the distribution of the huts over their rows, which is carried out by each Sergeant in his Company.
- Section 5 deals with the plotting of the alarm-post, the tracing of the ditch and the calculation as to which part of the digging has to be carried out by each regiment.
- Section 6 contains a warning to keep in good repair all that has been carefully drawn and built.

¹⁾ The sum total of the Waggon and the Vessels in behalf of the "foraging of the Persons following the Court" are the 66 waggons stated on folio 24 and the 20 vessels stated on folio 28 destined for His Princely Grace.

I L I D T,

*Vande teykening der vierhoecckighe quartieren des Leghers op pampier,
om dat inde teykening op't landt na te komen.*

A Engesien in dit Leger byden anderen te voegen zijn veel verscheyden quartieren, te weten elf vande 11 hoopen Voetvolc, en noch 11 vande regimenten Ruyterie, zoomen zien mach inde 1^e en 2^e Lijste des 2 Hooftstucx, met noch d'ander quartieren daer by behoorende: zoo zoudet moeyelic werc vallen die metter haest in goede oorden op pampier te teyckenen, her teyckenen, en by den anderen te voeghen, zooder niet eenigen bequamen reghel toe veroordent en waer, voornamelic alst haestelic gheschien moet, ghelijc dicwils ghebeurt, dat na de bezichting der plaets de logiering terstont moet ghedaen zijn: De reghel hier toe ghevonden is dusdanich: Men teyckent elc der voorschreven quartieren op een bezonder vierhoeccken van kaertspel blaren, welcke zoo ghesneden worden datse hebben de ghemeene langde van 300 voeten, en breede ghelijc de Lijste uytwijst. Als by voorbeelt van het regiment vanden Heer van Chastillon, hebbende 300 voeten langde, en 708 breede, men snijdt een vierhoeccken van die langde en breede, volghens zeker kleene voetmaet, twelc daer op gheschreven wort metten



naem des Colonels als hier nevens: En alzo met d'ander. Dese pampierkens der quartieren aldus altemael ghesneen en toebereyt zijnde, men leghetse en herleghetse tot datmen die ziet na syn begheeren: En om dat met noch meerder bequaemheyt te doen, zoo teyckent men op een pampier zeker evenwijdige linien,

tusschen welcke begrepen zijn de gemeene langden van 300 voeten, mette straten van 50 voeten, ghelijc de volghende form aenwijst, om daer op de bovenschreven quartieren oordentelic te legghen.

E

Dit aldus

SECTION 1.

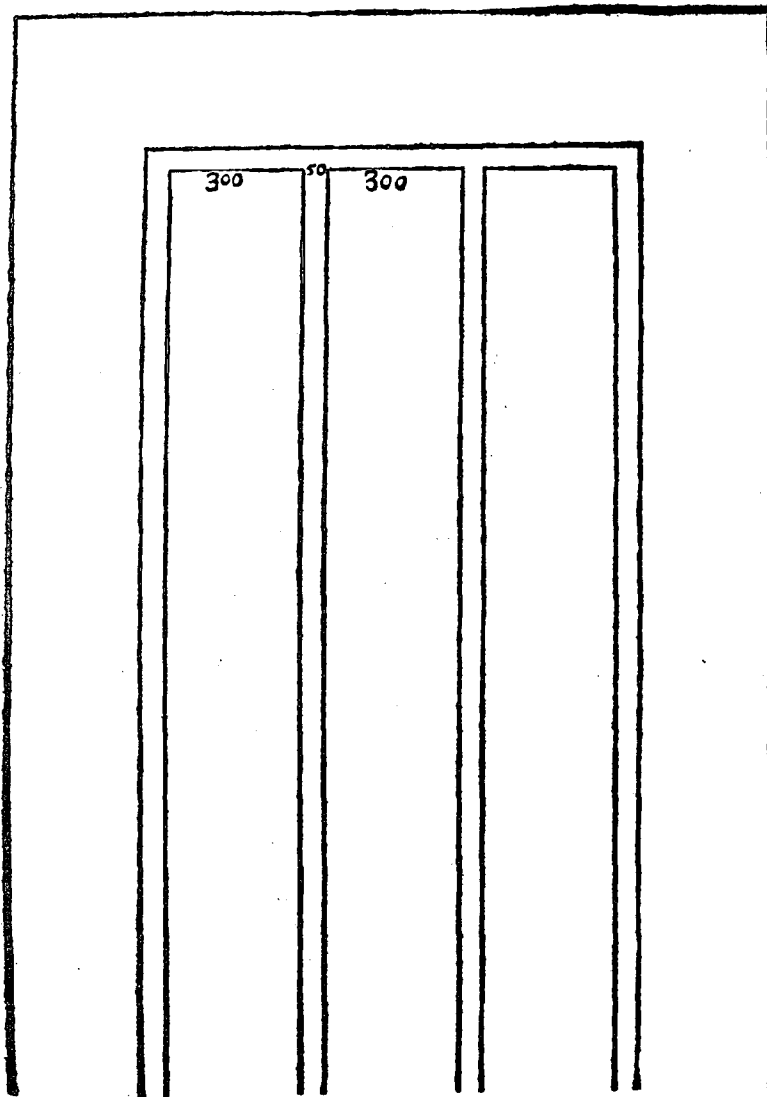
Of the drawing of the quadrangular quarters of the Encampment on paper, in order to follow this in the drawing in the field.

As in this Encampment there are a great many separate quarters to be annexed to the others, namely eleven of the 11 Infantry bodies, and again 11 of the Cavalry regiments, which can be seen from the second and third List ¹⁾ in Chapter 2, with again other quarters belonging to them; thus it would be a very difficult task to draw them hastily in good order on paper, to redraw them again and to annex them to the others, if this was not subject to any adequate rule, particularly so, when this has to be carried out in great haste, as it often occurs that after surveying the camp-site the lodging has to be effected at once. The rule to be adopted here is the following:

Every one of the afore-mentioned quarters is drawn in a particular quadrangle made from playing-cards, which are cut in such a manner that they have an equal length of 300 feet and a width as shown in the respective List. For instance, if Chatillon's regiment proves to have a length of 300 feet, and a width of 708 feet, then a small quadrangle of this length and width is cut according to a particular reduced foot-measure, being indicated thereon together with the Colonel's name, as shown in the adjacent figure.

This is being equally done with the others. When all these pieces of card-paper, representing the various quarters, are all cut to measure and prepared, they are shifted about and reshifted until they have obtained the desired order. In order to achieve this in a more appropriate manner a number of parallel lines are drawn on a piece of paper, at a distance of the common lengths of 300 feet, together with the streets of 50 feet, as is shown in the following figure, in order to locate the above-mentioned quarters therein in an orderly manner.

¹⁾ "1st and 2nd List" should be read: "2nd and 3rd List".



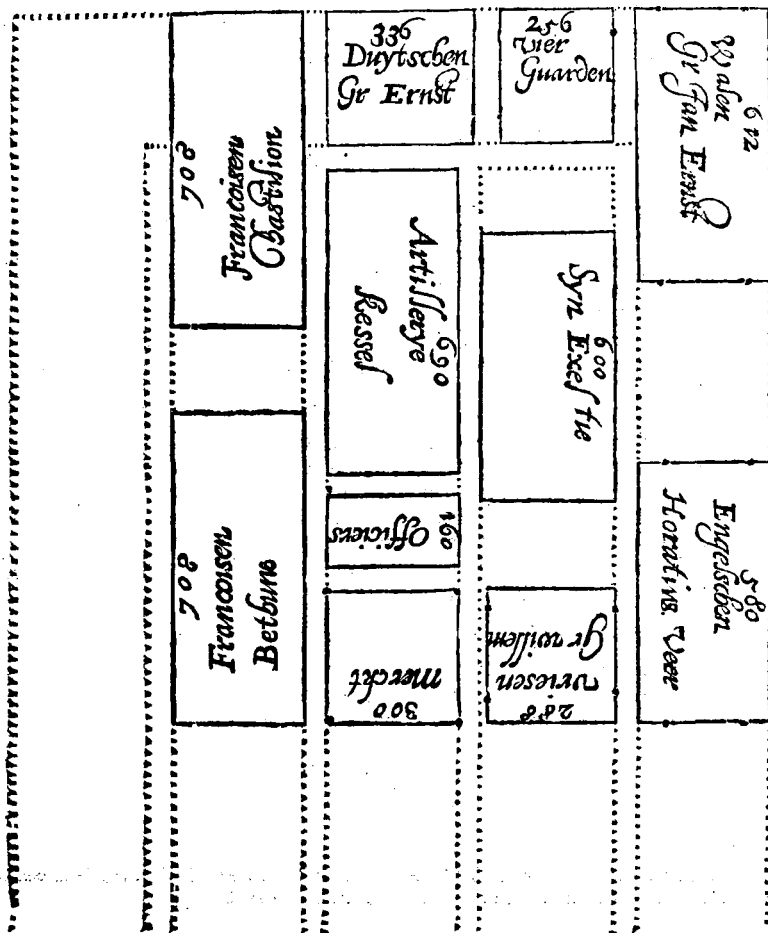
Dit aldus bereyt zijnde, ic zal nu komen totte teyckening op pampier, nemende tot voorbeeld de teyckening dieder ghedaen wiert om het Legher voor Gulich, alwaer de plaets int veldt bezichticht wesende, syn *Vorstelicke Ghenade* nam besluyt vande Ruyterie, mette waghens, ooc mette Enghelschen, en Schotten, onder den Generael Cecil, buyten dit Legher te logieren, zulcx dat de pampiere vierhoeckens van die quartieren daer uyt gelaten zijnde, zoo wiert de rest op't bovenschreven

This being accomplished, I shall now come to the drawing on paper, taking as an example the drawing that was made of the Army Camp before Juliers, where his Princely Grace, after having surveyed the camp-site, decided to lodge the Cavalry and their waggons, including the English and the Scots under General Cecil ¹⁾, outside this Encampment, causing the paper quadrangles of the respective quarters to be omitted, thus the remaining quarters were orderly arranged on the

¹⁾ "The English and the Scots under General Cecil" is not correct; Sir Edward Cecil was only General to the English during the expedition to Juliers (*St. Leger* III, 179).

ven ghereghelt pampier in oorden gheleyt, en aen syn *Vorstelike Ghenade* vertoont, welcke die wat verlegghende na syn goetduncken, sy laghen voor besluyt in oorden als hier onder.

Doch staet hier noch te aenmercken, datmen int legghen en veroordenen deser quartieren, zomwijlen bevint dat zoo eenighe der zelve wat breeder of smalder waren dan de teyckening op de pampierkens mebrengt, dat de veroordening des Legers gheschieder zoude moghen komen: In zulcken ghevalle machmen eenighe quartieren, die lijden moghen, wel wat breeder of smalder nemen, als vande Wagghens, Marct, Artillerie, Vivres, vreemde Heeren, en ledighe plaets voor het quartier van syn *Vorstelike Ghenade*, want die niet zoo heel van passe berekent en zijn datse niet wat breeder of smalder en zouden moghen wesen: Maer de regimenten van't Voetvolc en Ruyterie, de quartieren van syn *Vorstelike Ghenade*, en van den Generael der Artillerie, willen op haer ghestelde maet bliiven.



above-mentioned ruled paper and shown to his Princely Grace, who, after shifting them a little at his will, finally they were situated in the order as shown below.

Yet it should be observed, that in the location and arrangement of these quarters one sometimes finds, that if some of them were a little wider or narrower than it was found in the drawing on the pieces of paper, this might prove to be more suited to the arrangement of the Camp. In such cases one may take some quarters, that might afford it, a little wider or narrower, such as those of the Waggon, the Market-place ¹⁾, the Ordnance, Victuals, foreign Gentlemen and the empty space before the quarters of his Princely Grace, as they have not been calculated for so exact a measure, that they could not be a little wider or narrower. However, the Infantry- and Cavalry regiments and the quarters of his Princely Grace, and the Artillery General's quarters want to be kept to their fixed dimensions.

¹⁾ The width of the market-place in the drawing on this folio is 300 feet, just as on folio 15, yet on folio 13 this respective width is 400 feet. So in the camp before Juliers the market-place was taken smaller than the normal.

En volghens de voorgaende oorden vande pampierkens alzo ligghende, wiert doen de teyckening op pampier gedaen, met alarmplaetsen buyten om het Krijchsvolc, welke doen was ghelijc de form des 11 Lids van't 1 Hoofstuc.

Merct noch dat aenghezien dese manier van teyckening haest ghedaen is, zoo doet syn *Vorsfelicke Ghewade* op elcken tocht van te voren bereyt maken verscheyden teyckeninghen, d'eene met Ruyterie en al de rest, d'ander zonder Ruyterie, ten eynde op datmen of tbesluyt zoo viel, daer af voorzien zoude zijn, van welke formen hiet noch eenighe zouden moghen ghestelt worden, maer achtende de zake deur voorgaende ghenoech verstaen te wesen, ic zal't daer by laten blijven.

2 LIDT.

Vande meting der vierhoeckighe quartieren des Krijchsvolcx op't velt, rrvvelc ghedaen wort door den Leghermeter met syn hulpers.

DEur de voorgaende grontteyckening op pampier bekent zijnde hoedanich de teyckening op't landt zal moeten wesen, zoo begintmen eerst de teyckening der vierhoecken vande regimenten of quartieren des Voetvolcx, tot welcken eynde ter plaets op't velt meghebrocht worden ontrent de 150 quartierbaken, of zoo veel alsmender ziet van doen te zijn, wesende gheschilderde stocken byde 9 voeten lang, elc met een vaenken daer boven aen, om die te stellen op de hoecken der quartieren: En wort by Trommelslach afgheroepen en op lijfstraffe verboden die uyt te trekken, want doenmen over eenighe jaren dat niet en dede, het was onmoghelic de teyckening der quartieren te blijven, om dat elc tottet maken der hutten alsdan hout van doen hebbende, zoo wierden ander ongheteyckende stocken uytghetrocken. Ooc mede wort yghelic verboden tot die plaets te komen ter wijle men de quartieren teyckent, uytghenomen de ghene dieder bescheyden zijn, want doen eertijts zulcx onverboden was, men konde gheen behoorlicke teyckening doen, om tbelet van menschen, waghens, peerden, stroo en hout, datter meghebrocht wort om te hutten.

Merct noch datmen noodich bevonden heeft int Legher een algheemeene mate te ghebruycken, te weten een roe ghedeek in haer voeten en duymen, diemen de veldtmaat noemt, uyt oorzaec dat d'Aennemers van wercken, Ingenieurs, Controleurs van Fortificatien, Timmerliën, en ander uyt verscheyden Steden en Landen komende, elc een maat mebrocht, die in haer Stadt ghebruyct wiert, van malkander veel verschillende, daer verscheyden ongheschiedheden uyt volchden.

Noch wort den Leghermeter ghevolcht van al de Quartiermeesters der regimenten, op dat een vierhoec gheteyckent zijnde, aen elc die dadelic ghewesen worde.

Dit zoo zijnde, de vierbaken van elc regiment worden op't landt ghestelt, na den eysch vande voorschreven teyckening op pampier, begriipende vierzijdighe rechthoecken lanc van voren tot achter 200 voeten, om het Krijchsvolc, dat ghedaen wort door't behulp des Meterskruys, en meting der langden na ghemeene Landmeters wijze, twelc aende Ingenieurs ghenoech bekent zijnde, en behoef hier geen naerder onderrichting: alleenlic mochtmen wat vermaen doen van lichteicheyt, te weten datmen vande vier zijden der vierhoecken maer een en behoef te meten, of twee daer een zijde des Leghers beghint, want de rest gheschiet bequamelicker deur driebacking en tbehulp des Meterskruys, zoo henliën kennelic is.

Merct noch dat elcke vier baken eens regiments gheteyckent worden met ghetallen diemen op debaeckstocken sijdt, met ghetal-letters van I V en X, die met rechte

Thus, according to the afore-mentioned order of the pieces of paper thus situated, the drawing was traced out on paper with the alarm-posts round about the soldiers similar to the figure in the 11th Section of Chapter 1.

It should further be observed, that since this manner of drawing is being accomplished easily, his *Princely Grace*, in each campaign, orders various drawings to be made in advance, one including the Cavalry and all the rest, one excluding the Cavalry in view of the fact, that whatever decision was made, adequate diagrams should be available, which might have been given in a few additional figures, however, as I am of the opinion that the matter will have been sufficiently understood by the preceding figure, I shall leave it at that.

SECTION 2.

Of the staking out of the quadrangular quarters of the soldiers in the field, which is carried out by the Castrametator and his assistants.

As by the preceding ground-plan on paper we are able to determine the lay-out in the field, thus one first starts with the staking out of the quadrangles of the regiments or quarters of the Infantry, for which purpose about 150¹⁾ quarter-beacons are carried along to the space in the field or as many as prove to be necessary, consisting of poles, that are painted, about 9 feet in length, each bearing a small pennon at the top to be put up at the corners of the quarters. And it is called out while beating the drums and strictly forbidden to pull them out under penalty of corporal punishment, for, when some years ago, one did not take these measures, it proved to be impossible to maintain the ground-plan of the quarters, because any one building his hut and wanting wood would pull out other poles, that had not been marked. Besides it is forbidden for any one to come to these grounds while the quarters are being marked out, except for those, who are engaged in the work, for in earlier days, when this order had not been issued, it was found to be impossible to make a proper lay-out on account of the men interfering with their waggons and horses, straw and timber, they are carrying with them for building their huts.

It should also be observed, that it proved to be essential to use in the Army Camp a standard measure²⁾, namely a rod, divided into feet and inches, which is called the field-measure, due to the fact that the Contractors of works, Engineers, Superintendents of the Fortifications, Carpenters and other men coming from various Towns and Countries, every one of them produced measures used in their Towns, all mutually different, resulting in many inconveniences. Moreover all the Quartermasters of the respective regiments follow the Castrametator in order that any quadrangle, that has been drawn, could be assigned at once to every one of them.

This being so, the four beacons of each regiment are put up in the field according to the requirements of the ground-plan on paper, comprising a number of quadrilateral rectangles, measuring from the front to the back 200 feet in

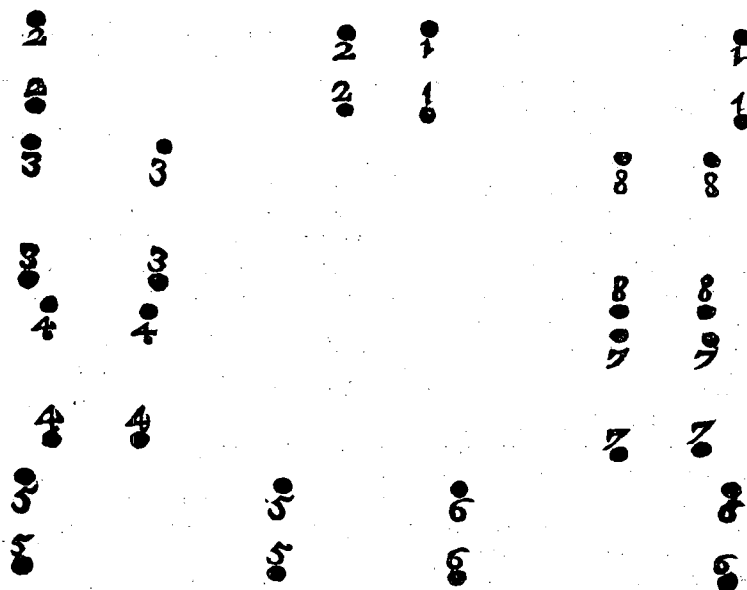
¹⁾ The number of 150 quarter-beacons appears to be too large, since for the 11 "quarters" of the Camp there were merely required 44 (see the figure on fol. 37 and the number of 100 beacons stated on fol. 27 and 30).

²⁾ For the standard or "field-measure", according to Stevin's proposal being "the rod divided into feet and inches", see *Gen. Introduction*, p. 24.

rechte snekens heeft ghekerst zijn, te weten de vier baken van het regiment datmen eerst afsteekt elc met I, van het tweede elc met II, en zoo voorts met d'ander: Twelc ghedaen wort om verscheyden swaricheden te voorkomen, eensdeels deur dien de Quartiermeesters zelf om de groote menichte der baecken zomwijlen in twijffeling en met malkander in gheschil gheraken, van hun eyghen quartieren. Ten anderen, dat den Leghermeter (die op elc quartier des pampiers zulcke ghetalen teyckent als de quartierbaecken hebben) na een quartier ghevraecht zijnde, dat stracx weet aen te wijfen, zonder ter plaets te moeten komen.

Zoo haest een regiment alzo gheteyckent is, men toonet aen syn Quartiermeester om dat te bewaren.

Maer al de quartierbaecken van't Krijchsvole deses voorgenomen Leghers ghestelt zijnde, sy komen te staen in zulcken oorden als de volghende form uytwijft, alwaermen byder ooghe zien mach, hoe noodich de voorichreven teyckening der ghetalen op de baecstocken is, om elc quartier zekerlic te kennen.



3 LIDT.

Vande meting der plaetsen die der noodich zijn tot rijen der hutten en straten daer tusschen, welc ghedaen wort by elc Quartiermeester in syn regiment.

DEs Leghermeters meting ghedaen zijnde als voren, zoo volghen der Quartiermeesters metinghen elc in syn regiment, twelcals ghezeyt is int Kortbegrip deses Hoofstuckx, by den Leghermeter onmogelic is oordentelic ghedaen te worden, op zoo korten tijt als hier vereyscht is.

Den Quartiermeester dan zal by hem hebben een grontteyckening syns regiments,

length ¹⁾ round about the soldiers, which is done by means of a surveyor's cross ²⁾. The respective lengths are measured according to the general practice of the surveyors, being adequately known to the Engineers, so that this need not be further explained here, except for a few minor points that should be observed, namely, that out of the four sides of a quadrangle only one has to be measured, or two, where one side of the Encampment is started, the rest getting better accomplished by means of three beacons ³⁾, and with the aid of the surveyor's cross, as is common knowledge to them.

It should further be observed that each of the four regimental beacons are marked with numbers, which are carved into the beacon-stakes, with numbers in Roman characters such as I, V, and X, which are being carved in straight notches, viz. the four beacons of the regiment, that is first marked out, each with I, those of the second regiment each with II and likewise all the others. This is being done in order to prevent various inconveniences, partly because the Quartermasters themselves often get into a muddle or fall into disputes about their own quarters on account of the large amount of beacons. And partly that the Castrametator, (drawing in each quarter on the pieces of paper the numbers marked on the quarter-beacons) when asked after a particular quarter, will presently be able to point this out off hand, without it being necessary for him to go there.

As soon as the regimental lodgings are thus drawn, these drawings are shown to the respective Quartermaster to be kept by him.

So when all the quarter-beacons of the soldiers of the intended Army Camp have been put up, they are found to be arranged in such order as has been indicated in the following figure, from which one can clearly see why it is absolutely essential that the numbers are being carved into the beacon-stakes, so that each quarter can be exactly identified.

SECTION 3.

Of the measurement of the spaces required for the rows of huts and the streets in between, which is being accomplished by each Quartermaster in his regiment.

When the Castrametator has accomplished his measuring task as before, then the Quartermasters take on their measuring-tasks, each in his regiment, which, as has been stated in the Summary of this Chapter, cannot be properly executed by the Castrametator within the short time available here.

Therefore the Quartermaster must carry a ground-plan of his regiment with

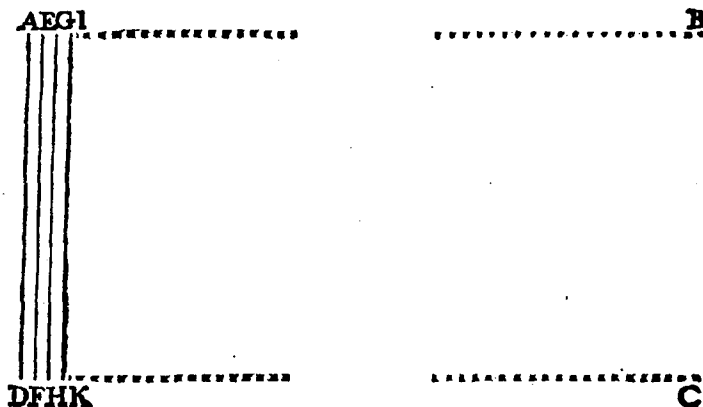
¹⁾ The dimension of 200 feet round about the soldiers has naturally been measured within that of the 300 feet available for the regiment in question, according to the figures on fol. 7 and 8, respectively for the Infantry and Cavalry.

²⁾ For the "Surveyor's cross" the reader is referred to the notes to fol. 27 and 28 of the *Sterckenbouwing*, in which the "Landtmeters rechtcruijs" is dealt with. See also Vol. II A, 429 and Vol. II B, 765.

³⁾ By "driebacking" is meant the staking out of a direction or line by pointing from a beacon across two other beacons. (cf. *Vant Beleggen* p. 435: "Ick driebaeck daer na op HF...").

ments, als die van't 3 Lidt des 1 Hooftstucx, om daer op alle noodighe langden te vinden zoo hy die niet ghenoech int hooft en hadde, ooc een vektmaet lanc ten minsten 8 voeten, en zeker toukens om die te ghebruycken zoo gezeyt zal worden.

Wesende hier me aldus voorzien ter plaets syns quartiers, twelc ic neem te wesen tusschen de vier baeckens A B C D, beteyckenende den vierhoec van der Krijchslin logijsten, zoo verdeelt hy langs een ghespannen touken de langde A B van 8 tot 8 voeten ghelijc syn grontreyckening uytwijst, stekende tot elcke plaets een stoccken of taccken zoo aengewesen wort mette tippelingen tusschen A en B staende: Dergelijcke verdeeling doet hy ooc aen't achterste eynde als van D tot C.



Dit zoo verre ghedaen zijnde, zoo restet nute doen de verdeeling der hutten van't Krijchsvolc door de Serganten daer int 4 Lidt af ghezeyt zal worden. Maer daerentusschen gaen de Quartiermeesters voort mette teyckening van der Capiteynen logijsten voor het Krijchsvolc, en vande Soetelaers hutten achter het Krijchsvolc, ghelijc de voorschreven teyckening des 3 Lidts int 1 Hooftstuc uytwijst.

4 L I D T.

Vande verdeeling der hutten inde rijen, by elc Sergant in syn vendel.

DEr Quartiermeesters metinghen ghedaen zijnde als voren, zoo volghen der Serganten verdeelinghen vande hutten elc in syn vendel, twelc als ghezeyt is int Kortbegrijp deses Hooftstucx by den Quartiermeester onmoghelic is oordentelic ghedaen te worden, op zoo korten tijdt als hier vereyscht is.

Den Sergant behoort bekend te zijn (daer den Quartiermeester ooc de hant aen moet houden) hoe veel hutten dat syn vendel behoeft, twelc hy weten kan deur voorgaende logiering, of zoo't d'eerste mael waer deur ondervraging der Soldaten, wie alleen of met malkander logieren willen; Alwaer te ghedencken staet datmen elc Soldaet of cameraetschap zoo veel breede gheeft als sy begheeren, maer inde langde, dats van voren tot achter, en moghen haer hutten niet langher noch korter zijn dan 8 voeten: En wort hier deur metter daet ghemeenelic bevonden, dat 100 Soldaten aen twee rijen hutten genoeg hebben, alzo sy niet gheern meerder hutten en maken dan sy behoeven: Doch zoo't in eenighe vendels anders viel (ghelijc deur

him, like the one given in the 3rd Section of Chapter 1, in order to find all the necessary lengths indicated thereon, in case he does not know them so well from memory, also a field-measure of at least 8 feet in length and several cords, the use of which will be explained later.

Being thus provided on the site of his quarters, which I take to be situated between the four beacons A B C D, signifying the quadrangle of the soldiers' lodgings, he now divides along a stretched cord the length AB from 8 to 8 feet, following the indications in his ground-plan, and puts up in each spot a small stick or twig, as it is indicated by the dotted line between A and B. A similar partition is also made at the rear-end such as from D to C.

This being accomplished so far, there still remains to make the distribution of the soldiers' huts by the Sergeants, which will be explained in Section 4. But meanwhile the Quartermasters proceed with the drawing of the Captains' lodgings in front of the soldiers and of the Sutlers' huts at the back of the soldiers, as it has been indicated in the drawing, previously described in the 3rd Section of Chapter 1.

SECTION 4.

Of the distribution of the huts over the rows, by each Sergeant in his company.

The Quartermasters having accomplished their measuring-tasks as before, the Sergeants start the distribution of the huts, each Sergeant for his own company, which, as has been explained in the Summary of this Chapter, cannot be properly carried out by the Quartermaster within the short time available here.

The Sergeant should know (and the Quartermaster should keep a strict hand upon it) how many huts are wanted in his company, which he may know from a previous encampment, or, if it happens to be the first time, by interviewing the Soldiers in order to find out which of them either want to lodge by themselves or share their lodgments. Here it should be borne in mind, that every soldier or group of soldiers is given as much width as they desire, yet as to the length, i.e. from the front to the back, their huts should neither be longer nor shorter than 8 feet. Consequently it is indeed generally found, that for 100 Soldiers two rows of huts will suffice, as they do not want to build more huts than they require. Yet, if in some companies it should turn out to be otherwise, (which might occur because many soldiers have their wives and children with them) one is free to give less space to those demanding too much, or, in case of emergency, to assign to them another row of huts. Now as to the number of huts that is found to be there, this number is to be divided in two, bringing to each side about an equal number of huts,

deur veel Soldaten die wijs en kinders hebben ghebeuren mocht) men mach de ghene die te veel plaats eysschen minder gheven, of zoo't den noot vereyscht henlien een rijt hutten meer veroordenen. Nu dan tghetal der hutten datmen alzo bevint zalmen in twee deelen, brengende op elcke zijde omtrent evenveel hutten, en die op zulcken verheyt van malkander veroordenen, dat de ledighe plaatsen daer tusschen vallende bykans even wijd zijn, welverstaende dat op elc uiterste eynde der rijen alijt een hutte moet komen, op dat de form van elc vendel en ooc des heelen regiments alijt een vierzijdich rechtshoec zijn op dat de straten daer langs henen streckende, evenwijd en recht loopen. Het wort ooc verstaen dat de twee voorste hutten van elc vendel zijn voor den Lieutenant en Vendrich, te weten des Lieutenants op de rechter zijde, d'ander op de sincker, en de twee achterste hutten voor de twee Serganten, op dat ghelijc int reysen of voorttreden de laetste des vendels zijn, hier int logieren ooc de laetste hutten hebben.

Aende Serganten aldus bekent zijnde waer op sy acht moeten nemen, zoo gaet haer teyckening der hutten aldus toe: Elc van henlien die twee rijen hutten heeft, stelt vier ghespannen toukens tusschen de teyckens by den Quartiermeester gheschenken, daer de hutten tusschen komen moeten, als inde voorgaende form des 3 Lids de vier toukens A D. E F. G H. I K. En om elc hutte te beteyckenen steect hy vier stocxkens, bediende haer vier hoeftijlen, waer me des Sergants teyckening ghedaen is. Na de voorschreven dinghen wort noch vereyscht dat elc Sergant in syn vendel wel toezie en syn best doe, dat de Soldaten buyten de gheselde teyckens niet en bouwen: En den Quartiermeester dat elc Sergant behoorlic opzicht draghe: En elc Capiteyn dat syn vendel wel oordentelic ghelogiert zij: En elc Colonel dat syn regiment tot voorbeelt van al d'ander mach verstrecken: want daer me kan't int gheheel oordentelic toe gaen, tottet welcke de bovenschreven Amptlien te meer behooren gheneycht te zijn, om dat elc van henlien hoopt of behoort te hopen totten hoochsten trap te gheraken, waer toe men kennis der oordentelike logiering zoo noodich houdt als voren ghezeyt is.

Deur tghene tot hier vande meting en teyckening eens regiments Voetvolcx beschreven is, kanmen ghenoech verstaen de meting en teyckening der regimenten vande Ruyters. Aengaende de teyckening van d'ander quartieren, als van syn *Vorselicke Ghenade*, Generael vande Artillerie, Officieren van't Legher, Waghens, en Marct, diens formen int 6, 7, 8, 9, en 10 Lidt des 1 Hoofstucx verklaert zijn; Aenghezien van elcx maer een form te teyckenen en is, die luttel wercx in heeft, en dat daer toe gebruyt worden verscheyden Ingenieurs elc haer stuc verstaende, en ghedaen konnen hebben zoo haest of eer datmen de teyckening der quartieren van't Krijchvolc volbrocht heeft, zoo ist onnoodich daer af hier onderrichting te beschrijven.

De meting aldus volbrocht wesende, zoo wort aen volc des Leghers datmen verboden hadde daer by te zijn, aenghezeyt elc te moghen komen zien na syn plaats.

5 L I D T.

Vande teyckening der alarmplaats, kielspitting des grachts, en berekening hoe veel yder regiment graven moet.

DEse teyckening vande alarmplaats mette kielspitting wort ghedaen deur een Ingenieur met syn Conducteurs, by hem noch hebbende 50 of 60 Pioniers, die de kielspitten steken langs ghespannen lonten, te weten twee rechte linien

which are being arranged at such distance from each other that the empty spaces in between are found to be almost of the same width, that is to say that at every rear-end of the rows there must always be a hut in order that the shape of each company and also that of the whole regiment should always form a quadrilateral rectangle and that the streets running along them will always have the same width and run straight. It is also to be understood, that the two foremost huts of each company are meant for the Lieutenant and the Ensign, viz. the Lieutenant on the right side and the other on the left side and the two hindmost huts for the two Sergeants, in order that, like when marching off they are the last of the company, they also have the end-huts in the camp.

So as the Sergeants know what they have to mind, the drawing of the huts is carried out in the following manner: every one of them, having two rows of huts at his disposal, suspends four cords, stretched tightly between the marks put up by the Quartermaster where the huts have to come in between, as has been shown in the preceding figure in Section 3 by the four cords AD, EF, GH, and IK. And in order to mark out each hut he puts up four small sticks, indicating its four corner-posts, after which the Sergeant's drawing has been finished. After the afore-mentioned tasks, it is still required that every Sergeant exercises close supervision in his company and takes good care, that the Soldiers do not built outside the marks that have been put up. The Quartermaster again has to see that each Sergeant exercises due supervision and each Captain sees to it that his company is orderly lodged and each Colonel makes his regiment set an example to all the other regiments, for this will highly contribute to the good order in the whole camp, to which the above-mentioned Officers should be all the more disposed, as each of them strives or should strive to rise to the highest rank to which the knowledge of an orderly lodgment is highly essential, as has been mentioned before.

By all that has been described so far about the marking out and drawing of an Infantry regiment the tracing out and drawing of the Cavalry regiments will be adequately explained. As to the drawing of the other quarters, such as those of his *Princely Grace*, the Artillery General, the Officers belonging to the Army Camp, Waggon and Market-place, these figures have been explained in Chapter 1, Sections 6, 7, 8, 9 and 10.

Seeing that of each quarter one has only to draw one figure, which is not much work, this work being in the hands of various Engineers, who are each well posted in this kind of work and could have carried this out as soon as or before the drawing of the Soldiers' quarters has been accomplished, therefore it is unnecessary to describe an instruction for it here.

After the marking out has thus been fully accomplished, the soldiers of the Army Camp, who were not allowed to be present, are now told, every one of them, to come and see his space.

SECTION 5.

Of the plotting of the alarm-post, the tracing of the ditch and the calculation as to which part of the digging has to be carried out by each regiment.

This plotting of the alarm-post together with the tracing of the ditch is carried out by an Engineer and his Conductors with an additional number of 50 or 60 Pioneers, who are digging the grooves along matches, that are stretched, namely in

te linien 6 voeten van malkander voor breedte des grachts, daer af de binnenste is 206 voeten vande logijften der Capiteynen, zulcx dat de 200 voeten blijven voor breedte der alarmplaats, en 6 voeten voor de dicke des borstweers. Merct noch dat hoewel hier voren het volc des Leghers aenghezejt is elc na syn plaats te moghen komen, zoo en doet dat gheen bezonder verhindernisse tot dese teyckening, aenghezien het niet en zijn dan twee rechte linien die verre ghenoech van't Krijchsvolc komen.

De voorfchreven kielspitten alzo ghefteken zijnde, daer rest rekening te maken hoe veel voeten grachts elc regiment zal uytgraven, twelc in de *Hoochmoghende Heeren Staten* Leghers door't Voetvolc by ghemeenen reghel moet ghedaen worden, zonder daer voor yet te betalen. Tot desen eynde zien ic inde voorgaende teyckening op pampier des 1 Lidts deses Hoofstucx, (twelc noch klaerder staet in de form des 11 Lidts van't 1 Hoofstuc) hoe lanc die kielspitten vallen, en wort bevonden de twee langste zijden elcke van 2000 voeten, en de twee kortste elcke van 1750, tzamen 7500 voeten, waer toe zijn 8560 Soldaten, te weten in elc regiment als hier onder, twelc ghetrocken is uyt de 2^e Lijste des 2 Hoofstucx:

Chastillon	1660
Bethune	1660
Vriesen	760
Veer	1320
Graef Ian Ernst	1310
Vier Garden	800
Graef Ernst	1050
Somme	8560 Soldaten hebben te graven 7500 voet.

Hier me zegh ic na de manier der reghel van Compaignie:

8560 Soldaten, moeten graven 7500 voeten, waer 1660 Soldaten van Chastillon? komt 1454 voet, die ic stel nevens Chastillon, en doende dierghelijcke met d'ander regimenten, zoo staet de form der berekening, en komt voor elc als hier onder:

Chastillon	1660 Soldaten hebben te graven	1454
Bethune	1660	1454
Vriesen	760	666
Veer	1320	1157
Graef Ian Ernst	1310	1148
Vier Garden	800	701
Graef Ernst	1050	920
	8560 Soldaten hebben te graven	7500 voet.

De langde der voeten die elc regiment toekomt, teyckentmen buyten den uitersten kant des uitersten kielspils met een kruys in d'aerde ghegraven. Laet tot voorbeeld van dien inde form des 11 Lidts van't 1 Hoofstuc zoodanighe teyckening beghinnen aenden hoec H, alwaer gheteyckent zijnde een kruys, men meet van daer af 1454 voeten voor het regiment van Chastillon, die strecken neem ic tot I, daer ooc een kruys ghestelt wort, en 'sghelijcx ghemeten 1454 voeten voor Bethune, sy komen neem ic tot aen't kruys K: En zoo voortgaende, het laetste overschietende deel is voor het regiment van Graef Ernst, twelc (zoo inde mate niet ghemist en is) op't landt moet bevonden worden van 920 voeten, waer me volbrocht is de

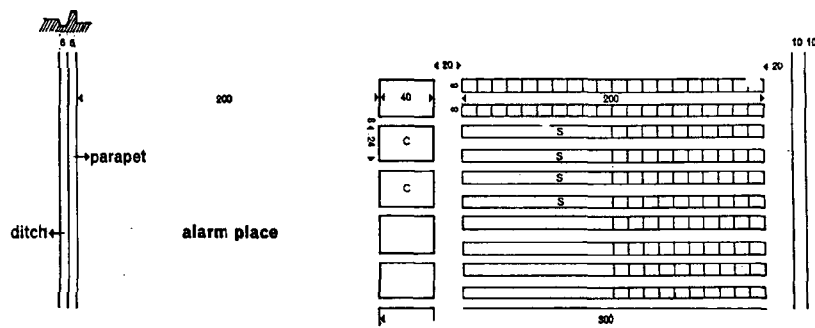


Fig. 5. Plotting of the Alarm-Post.

two straight lines at a mutual distance of 6 feet for the width of the ditch, the inner groove being situated at a distance of 206 feet from the Captains' lodgings, thus leaving 200 feet for the width of the alarm-place and 6 feet for the thickness of the parapet¹⁾. It should further be noted that, although the soldiers of the Camp have been told beforehand to come to their respective space, this does not cause any particular inconvenience to the plotting to be accomplished, as here it is merely a matter of two straight lines being far enough away from the Soldiers.

Now that the afore-mentioned grooves have been cut, there remains the calculation to be made as to how many feet of the ditch each regiment is to dig out, which according to the general rule, in the Armies of the States General has to be carried out by the Infantry, without receiving any payment for it. With regard to the latter I see from the previous drawing on paper in the 1st Section of this Chapter (which is found more clearly in the figure of the 11th Section of Chapter 1) how long these grooves are, and it is found that the two longest sides have 2000 feet each and the two shortest sides 1750 feet each, together 7500 feet, for which a number of 8560 Soldiers is available, namely for each regiment as it is shown below, which has been derived from the 2nd List of Chapter 2:

Chatillon	1660
Bethune	1660
The Frisians	760
Vere	1320
Count John Ernest	1310
Four Guards	800
Count Ernest	1050
Sum total	8560

Soldiers have to dig 7500 feet

¹⁾ In the accompanying drawing fig. 5 the arrangement and situation of the alarm-post has been more clearly indicated than on fol. 15.

1. The first part of the report deals with the general situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study. The second part of the report deals with the economic situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study. The third part of the report deals with the social situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study.

2. The second part of the report

deals with the economic situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study. The third part of the report deals with the social situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study. The fourth part of the report deals with the political situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study.

The fifth part of the report deals with the cultural situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study. The sixth part of the report deals with the legal situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study.

3. The third part of the report

deals with the social situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study.

By this I mean that according to the rule of Compaigny ¹⁾: 8560 Soldiers have to dig 7500 feet, that is for 1660 Soldiers from Chatillon's regiment 1454 feet, which I put next to Chatillon, doing the same with the other regiments, thus the order of calculation for each regiment is as below:

Chatillon	1660	Soldiers have to dig	1454
Bethune	1660		1454
The Frisians	760		666
Vere	1320		1157
Count John Ernest	1310		1148
Four Guards	800		701
Count Ernest	1050		920
	8560	Soldiers have to dig	7500 feet.

The length in feet, allotted to each regiment, is being marked outside the outermost side of the exterior groove by means of a cross outlined in the earth ²⁾. Let us take as an example the figure shown in the 11th Section of Chapter 1 starting with the angle H, where a cross has been drawn, from this point one measures 1454 feet for Chatillon's regiment, this space I take on to I, where there is again a cross being drawn and here we measure in the same way 1454 feet for Bethune, going up, I assume to the cross K. And while thus continuing, the last remaining part proves to be for Count Ernest's regiment, which, (that is to say, if there have not been any mistakes in the measures stated) is found to be 920 feet in the field, by which the drawing or measurement of the Encampment has been accomplished, which I had intended to describe in this Chapter 3.

¹⁾ For the rule of Compaigny cf. also: *Pratique d'Arithmétique* in Volume II-B, 711.

²⁾ "Kielspil" should be "Kielspit" (groove); in what manner were the crosses H, I, etc. indicated in the figure on fol. 15, outlined in the earth? Would not a stake and cross-lath have been more appropriate?

is de teyckening of meting des Leghers die ic in dit 3 Hooftstuc voorghenomen hadde te beschrijven.

6 LIDT.

Inhoudende vermaen, om tghene veel gheteyckent en ghebout is, in goede form te onderhouden.

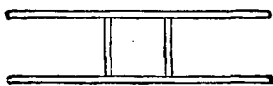
Tot hier toe vande teyckening des Leghers ghezeyt zijnde, zoo refter noch wat aen te roeren van tghene de Quartiermeesters elc in hun quartier daer benevens hebben gade te slaen, om tghene wel gheteyckent en ghebout is, in goede oorden te onderhouden.

Ten eersten, dat gheen Soldaten, hun vrouwen, kinderen, of ymandt van harent wegghen, binnen de regimenten byde Soldaten en zulten moghen tappen, goet ver-
kooppen, of zoetelen, want voor zulcke de Soetelaers hutten achter de regimenten veroordent zijn.

Ten tweeden, dat de Quartiermeesters op de alarmplaetsen en straten elc voor, achter, of nevens syn quartier gheen kooopputten, dobbel tafels, noch ander putten en laten graven, om dattet by doncker zorghelic is over zulcke wegghen te gaen, in perijckel van menschen en peerden, hals en beenen te breken, voornamelic ten tijde van alarmen die inde duyfter nacht komen, twelcmen te meer met reden verbiet, om dat achter alle hutten der Soetelaers, plaets veroordent is om kooopputten te maken buyten zulcke wegghen.

Ten derden, dat de Quartiermeesters op de voorschreven alarmplaetsen en wegghen elc voor, achter, of nevens syn regiment, niet toe en laten eenich ghebou van hutten, stelling van tenten of kramen, verkooping van goeden op waghens of karren, of anderszins voortstaende, maer bevelen die na de marct te gaen.

Ten vierden, aenghezien de Vleeschslachters hier toeghelaten wort te logieren inde hutten achter de regimenten, en dat van't inghewant der gheslaghen beesten een groote vuylcheyt en stanc komt, zieften veroorzakende, daer af in eenige onse voorgaende Leghers, ghelijc ooc in ander, ghebrec gheweest heeft, zoo wort daer teghen nu voorzien met in d'aerde diepe putten te graven, daermen op leght stercke houten, en daer op tacken met blaren, of stroo, doch gade slaende dat int midden



blijve een gaetken daermen een cassijnken of raemken op leght, van form als hier nevens, met een vierkant deurken daer in van ontrent 16 of 18 duyn, daer na leghtmen hier op de aerde die uyt de put ghekomen is, doch zoo

dattet voorschreven deurken vrijelic mach open en toe gaen voor de ghene die het inghewant daer in te worpen hebben, waer uyt dan gheen stanc en komt, ghelijc metter daer bevonden is, tottet welc ooc naerder reden kan verwoecht worden, te weten dat der menschen doode stinckende lichamen begraven inde kerchoven ja in besloten kercken, gheen stanc en gheven. Meret noch dat, al worden dese putten in straten of wegghen ghegraven zoo zijns zonder perijckel van menschen of beesten des nachts daer in te vallen, ghemerct sy boven ghestopt zijn. Zulcken put of putten zal elc Quartiermeester den Vleeschslachters doen maken die in hun quartier willen logieren: Sy worden ooc bequamelic ghebruyct by de keuckens van groote Heeren Hoven, die anderszins ghemeenelic met stanc ghequollen zijn.

Ten vijften zal den Quartiermeester door de Pioniers een greppe doen graven van twee voeten breed, twee voeten diep, ten eynde der tien voeten die achter de

F

Soetelaers

SECTION 6.

Containing a warning to keep in good repair that which has been well drawn and built.

After having spoken so far about the drawing of the Encampment there are still a few things to be touched upon concerning that which the Quartermasters, each one in his own quarters, have to observe as well in order to keep all that has been well drawn and built in good repair.

Firstly, that the Soldiers, their wives, children or anybody related to them, are not allowed to retail beer, to sell goods or sutlery with the Soldiers inside the regiments, since for these people the Sutlers' huts are ordered behind the regiments.

Secondly, that the Quartermasters are not to allow any cooking-pits, gambling-tables or other pits to be dug in the alarm-places and in the streets situated in front, at the back or alongside their quarters, as it is very precarious to walk these roads in the dark so that men and horses are in peril of breaking their necks and legs, particularly during the alarms, when given in the dark night, which is prohibited all the more on reasonable grounds, because at the back of all the Sutlers' huts there is a special space assigned to make the cooking-pits outside such roads.

Thirdly, that the Quartermasters are neither to allow the erection of huts, tents or booths in the afore-mentioned alarm-places and roads, in front, at the back or alongside their regiments, nor the sale of goods from waggons or carts or otherwise, but should order them to go to the market-place.

Fourthly, since the Butchers are allowed here to occupy the huts at the back of the regiments and the entrails of the slaughtered animals cause much garbage and stench bringing about diseases, and since in some of our previous Encampments as well as in others there have been infections, precautionary measures have now been taken by digging deep pits into the earth covered by strong pieces of wood with boughs and leaves or straw on top of them, taking good care that there remains a small hole in the middle, which is covered by a casement or frame, as shown in the adjacent figure, with a small, square shutter or door measuring about 16 or 18 inches, then this is covered with the earth, that has come from the pit, in such manner that the afore-mentioned small door can freely open and shut for those, who have to throw the entrails into it, so that it does not give off any foul smell. This has indeed proved to be effective and the reason why follows also from the fact that men's dead and stinking bodies, buried in cemeteries, even in closed churches, do not give out a foul smell either. It should be borne in mind, that although these pits are dug into the streets and roads they are without any peril of men or animals falling into them at night, because they are covered on top. Every Quartermaster will therefore instruct the Butchers, wanting to lodge in their quarters, to make a similar pit or pits like these. They are also effectively used near the kitchens of grand Seigniors, who could otherwise be greatly annoyed by their foul smell.

Fifthly, the Quartermaster is to order the Pioneers to dig a furrow of two feet in width and two feet in depth at the far end of the ten feet of empty space at the back

Soetelaers hutten tot open plaets ghegheven zijn, en dat om henlien daer binnen te doen blijven, want anders gheraken de kooopputten die d'een voorder van syn hutte stelt als d'ander, op de groote ghemeene straet te komen, metter onghemac daer voren af ghezeyt is, ooc veroorzakende kromme ongheschiede straten: Al twelcmen voorkomt mette bovenschreven greppe.

Ten zeften is te weten, datter eenighe hun voor Kooptien of Soetelaers uytgheven, en gheen en zijn, welcke int beghin als men de plaetsen uytdeelt de beste bespreken; maer alzo die daer na blijven ledich staende, en gheen goet daer in en komt, en dat sy daghelick zegghen alle ure dat te verwachten, zoo houden sy dat zoo langhe sleypen tot dat sy die plaetsen aen ander Kooptien daer na komende, ten diersten verkoopen. Om dit ongheval te voorkomen, zoo deelt men de plaetsen uyt, op zulcke voorwaerde, dat by aldien een ander komt diese begheert, en syn goet byder hant heeft, datse den zelve zal ghegheven worden, en tgebou van hutting dat sy tot decmantel moghen begoft hebben, zal verbeurt zijn, zonder van hun arbeit yet te moghen eyschen, noch ooc vande stoffe, want als syse op't lande ghehaelt hebben, zoo en behoortse henlien niet toe: Aengaende hun ydel tenten of kramen die sy mebrenghe en hun eyghen zijn, die moghen sy wech nemen.

4 HOOFTSTVC,

Van tghene, myns ghevoelens, oorboor en noodich zoude zijn totte gheduerighe form eens Leghers, die alrijt de zelve mocht blijven.

KORTBEGRYP DESES 4 HOOFTSTVCX.

Hier zullen in zijn drie Leden van zulcken inhoud als volgt:

- 1 Lidt, waerom inde voorgaende manier der Leghermeting de Romeynsche wijze niet zoo zeer naghekomen en is als men wel zoude hebben kunnen doen.
- 2 Lidt, inhoudende voorflach van tcyckening eens Leghers, diens form langduerlic de zelve mocht blijven.
- 3 Lidt, vande verdeeling des Krijchsvolcx die totte gheduerighe oordentelicke Leghermeting noodich is.

1 LIDT.

Vaerom inde voorgaende manier der Leghermeting de Romeynsche wijze niet zoo zeer naghekomen en is als men wel zoude hebben kunnen doen.

Het wort na tgevoelen van velen daer voor ghehouden, de Leghermeting der Romeynen zeer bezonder gheweest te hebben, zulcx dat hun vyandt den Koninc Pirrus (zoo Plutarchus verhaelt) hem daer in verwonderde, zeyde dat de oorden van Barbarische niet Barbarisch en was: Als men ooc inzielt de form van dien na Polybius beschrijving (welcke hier voren ghestelt is int 1 Lidt des 1 Hooftstucx) men bevint daer in benevens de bequaemheyt ooc naghevolcht te zijn de lijczijndicheyt, daer de oude * Boumeesters in gheslachten ernstelic op letteden.

of the Sutlers' huts, distributed to them, in order to keep them within this space, for otherwise these cooking-pits, that one man erects further from his hut than the other, will get on to the wide public road, causing the afore-mentioned inconvenience and also crooked, unsuitable streets. All this is being prevented by the above-mentioned furrow.

Sixthly, it should be known, that some people pass themselves off as Merchants or Sutlers without practising these trades, and at the outset, when the respective space is being allotted, will reserve the best. However, when shortly after, this space remains unoccupied and they do not bring their goods in it, while daily saying that they may expect these goods any time, thus they let this drag for such a long time, that they can sell these places at high prices to other Merchants coming after them. In order to prevent such mishaps, the space available is being distributed on such terms, that should there be any one desiring it and having his goods at hand, this space will be allotted to him, whereas the huts, that they have started to build as a disguise, will be confiscated, without there being any provision for claiming an allowance neither for their work nor for the material used, for if the latter has been obtained in the field, it does not belong to them.

With regard to their empty tents or booths, which they bring along with them and are their own, these things they may take away.

CHAPTER 4

Of that which, according to my opinion, would be useful and necessary to a permanent form of Encampment, which should always remain the same.

SUMMARY OF THIS 4th CHAPTER

This shall comprise three sections of the following contents:

- Section 1 explains, why in the preceding method of Castrametatio the Roman manner has not been followed as strictly as it could have been done.
- Section 2 contains a suggestion for the drawing of an Encampment, whose form could remain for a long time the same.
- Section 3 deals with the distribution of the soldiers required for a permanent and orderly Castrametatio.

SECTION 1.

Why in the preceding method of Castrametatio the Roman manner has not been followed as strictly as it could have been done.

Many people are of the opinion, that the Castrametatio of the Romans has been of a very peculiar character, so much so that their enemy, King Pyrrhus (as has been narrated by Plutarch ¹⁾) had been surprised, and said that the order of the Barbarians was not barbaric at all. Now if one further considers the figure of it as it has been described by Polybius (which has been previously represented in the 1st Section of Chapter 1) it is found, that apart from its proficiency, its symmetry has also

¹⁾ Plutarchus, *Pyrrhus* XVI. 5 (Loeb Classical Library):

"When he learned that the Romans were near and lay encamped on the further side of the river Siris, he rode up to the river to get a view of them; and when he had observed their discipline, the appointment of their watches, their order, and the general arrangement of their camp, he was amazed, and said to the friend who was nearest to him: "The discipline of these Barbarians is not barbarous; but the result will show us what it amounts to".

letteden. Ooc hadde het Legher op verscheyden plaetsen altijt een zelve form, zulcx dat waer het gheslegghen was, elc wist yghelcx logijst terstont te vinden, al oft zonder verandering altijt op een zelve plaets waer ghebleven, twelc ontwijffelic groot gherief veroorzaecte: Inder voeghen, dat die manier met recht aen velen wel bevalt en zeer ghepresen wort. Dit zoo zijnde, ymant mocht dencken waerom syn *Vorstelike Ghenade* die niet t'oenmael ghevolcht en heeft, of immers meer dan gheschiet is: Waer op tot antwoord dient: Eerstelic, d'oorzaec waerom in ons Leghers de bovenschreven ghelijcheyt der form niet ghebeuren en kan als by de Romeynen, is dat sy niet alleen en hadden ghelijcheyt van volc in vendels en regimenten die sy manipulen en cohorten noemden, maer ooc in noch twee trappen hoogher, te weten in Legioenen en Leghers, daer af intvolghende 3 Lidt onder des Krijchsvolcx verdeeling der Romeynen eyghenlicker zal ghezeyt worden, welcke volle onderhouding meerder vermoghen vereyscht, d'ander nu ter tijdt by eenige krijchvoerende Vorsten of Ghemeenten schijnt bevonden te worden. Ooc houdt syn *Vorstelike Ghenade* daer voor, dat de Romeynsche Leghers niet altijt zoo heel volkomen oordentelic gheweest en hebben als menighe hun wel inbeelden, om verscheyden redenen. Ten eersten, datmen niet overal, maer zelden (ghelijc hem door veel verscheyden ervarighen ghebleken is) velden ontmoet totte 2000 voeten lanc en breed, daer in niet eenighe onbequame hoochten, diepten, morafschien, of ander onbelogierlicke plaetsen en vallen: twelc ghebeurende, daer moet groote verandering der form en onoordeelen uyt volghen. Ten anderen, in beleggering van Steden, daer de cohorten en legioenen moesten verdeelt worden na den eyfch vande besuyting der plaetsen, en konde de bovenschreven oordentelike logiering niet gheschien. Ten derden, om dattet ghetal van het Voetvolc der *Evocati* onzekker was, en dicwils meerder dan de plaets na den ghemeenen reghel gheteyckent begripen konde. Ten vierden wiert het Krijchsvolc zomwijlen op de marct ghelogeert, en daerom de marct in *quasitoriam* verleyt. Ten vijfden zoo ghebeurder dicwils op korten tijt groote vermindering des Krijchsvolcx, dat wech liep, van ziele sterf, gheslaghen wiert, ooc datmen in ghewonnen Steden en Sterften leyde tot bewaring van dien, zulcx dat de manipulen, cohorten en legioenen dicwils metter haest niet weerom en konden vervult worden: waer toe ooc dient tghene *Cesar* schrijft int 5 Boec, te weten dat hoewel het Legher kleyn was, nauclcx van zeven duysent mannen, en zonder bagage, zoo heeft hy dat deur vernauwing der wegghen vermindert zoo veel hy mocht. Ten zefsten zeght Polybius, dat de legioenen voller zijnde, zoo wierden langde en breedde vermeerderd na den eyfch: Deur alle welcke dinghen de Leghermeting niet altijt op een zelve wijse en konde ghedaen worden volghens de maten by ghemeenen reghel ghestelt, maer moestmen nieuwen overslach, rekening, en teyckening doen na den eyfch: Doch ist daer voor te houden, dat sy de reghel zoo na quamen als sy konden, zulcx dat daer deur tgherief der straten en de vinding van elcx logijst lichtel viel dan sy anders zouden ghevalen hebben. Wijder staet te aenmercken, dat den Romeynschen * Veltoverst op * *Prator*. d'een zijde des Leghers logierde, verre buyten tmiddel, en de groote menichte des Krijchsvolcx als de twee legioenen Romeynen mette *Socij* al by den anderen, vervullende zulcken grooten plaets des Legers als inde form des 1 Lits van't 1 Hoofstuc te zien is: Van welcke dinghen sy hun besondere redenen moghen ghehad hebben, maer die overgheslegghen, zoo schijnt beter datmen volghen den ghemeenen reghel van Xenophon, te weten dat den Veltoverst metter nagevolgh int midden van't Krijchsvolc logere, ghelijc daer af voorbeelt ghestelt zal worden int volghende 2 Lidt. Ooc en schijnt int Legher na Polybius Leghermeting gheen plaets veroordeent gheweest te zijn voor machinen, waghens, lastdraghende beesten, ma-

been followed, which the ancient architects paid particular attention to in their buildings ¹⁾.

Furthermore, the Encampment, in various places, had always the same shape, to the effect that wherever it happened to be situated, it was possible for every man to find at once his own lodgings, as if it had always remained in the same place without any change, causing, no doubt, great convenience, so that this manner of Encampment, with good reason, has suited a great many people and has been much praised. This being so, one might think why his Princely Grace has not altogether followed this method, or in any case more so than it has been done. To which one should answer: first, the reason why in our Encampments the above-mentioned similarity of form, just as with the Romans, could not occur, is, that the latter did not only have a fixed number of soldiers in their companies and regiments, which they called maniples and cohorts, but also in two higher grades, i.e. Legions and Armies, of which we shall really say more hereafter in the following 3rd Section under the Army Organization of the Romans, the full maintenance of which requiring a greater power than in these days appears to be found with any belligerent Monarchs or Republics. Furthermore his Princely Grace is of the opinion, that the Roman Encampments have not always been kept as orderly as a great many people imagine them to be, due to various reasons. First, that not everywhere, in fact that only rarely (as a great many experiences have shown to him) grounds are found having up to 2,000 feet in length and width in which there do not occur some awkward elevations, depths, marshes or other places unfit for encampment. Where this occurred it naturally followed that this caused a considerable change and dissimilarity in the form of the Encampment.

Secondly, in case of besieging towns, when the cohorts and legions had to be divided according to the requirements of the investment of the place, an orderly encampment, as has been described above, could not be realized. Thirdly, because the strength of the Infantry, called *Evocati* was uncertain and often exceeded the number, which the respective space, drawn according to the general rule, could contain. Fourthly, the Soldiers were sometimes lodged in the market-place causing the market to be removed to the *quaestorium*. Fifthly, it often happened, that, within a short period of time the number of soldiers decreased to a considerable extent owing to desertion, or death caused by diseases or defeat; moreover because soldiers were laid in garrison in towns and fortifications that were conquered, in order to occupy them, with the result that the maniples, cohorts and legions could very often not be quickly recompleted; to which also applies that which *Caesar* describes in Book 5 ²⁾, i.e. that although the Camp was small, scarcely fit for seven thousand men, and without baggage, he managed to reduce it as much as he could by a narrowing of the roads. Sixthly, Polybius states, that in proportion as the

¹⁾ As to Stevin's utterance with regard to the symmetry in the architecture of the Greeks and the Romans, cf. also Dijksterhuis pp. 264, 337 and Isaac Beeckman's comment: "the Romans kept in their encampment good order and also minded the symmetry as it is equally maintained in buildings and always adhered to one manner of encampment" (fol. 218-ro).

²⁾ *Caesar, Gallie War* V. 49 (Loeb Classical Library): "Caesar halted therefore, and proceeded to entrench his camp in the most favourable position to be found; and small as was the camp itself; as it was for scarce seven thousand men, and those, too, without baggage; he nevertheless compressed it by narrowing the streets (roadways of the camp) as much as possible, with the object of incurring the utmost contempt on the part of the enemy." Here is meant Caesar's army camp near Namur in the year 54 B.C., that was pitched in order to repulse the allied Gauls and then to defeat them.

gazzinen van krijchtuych, magazinen van leeftocht, en fourage, noch voor buytendienstich volc, als Kooplien, Herbergiers, Ambachtslien, en Soetelaers, die de Romeynen volghens hun ghebruyc by het Krijchsvolc niet en vermengden: alle welke partijen groote plaets moesten hebben, waer toe zoomen meent hun voorburghen dienden, die *proestria* hieten, daer sy eyghen wacht by stelden om die te bewaren. Maer het schijnt datmen die altemael met beter reden na de bovenschreven ghemeenen reghel van Xenophon int Legher veroordent, want mette breedde van dien alleenlic 200 voeten langher te maken, zouden se ghekreghen hebben de vermeerdering eens percx breed 200 voeten, en lanc 2000, en dat alleenlic met 400 voeten borstweers meer te maken, zulcx dat daer me de voorschreven dinghen met minder bezetting van wacht, minder kost en moeyte, binnen het Legher kunnen vervanghen worden, en ooc met meerder gherief en verzeketheyt dan daer toe bezonder voorburghen te maken.

Al welke redenen oorzaec gheweest hebben, waerom syn *Vorselicke Ghenade* in de voorgaende maniere van Leghermeting de Romeynsche wijze niet zoo zeer naghekomen en heeft, als men wel zoude hebben kunnen doen, twelc myn voornemen was in dit 1 Lidt te verklaren.

2 LIDT.

Inhoudende voorflach van teyckening eens Leghers, diens form langduerlic de zelve mocht blijven.

Hoewel gheen teyckening en kan ghedaen worden, die altijd de beste blijft, ofte alwaert doenlic dattet onbewijflic is gedaen te wesen, zoo mach nochtans elc syn ghevoelen verklaren van tghene hem teghenwoordelic tbeste dunct om langhe te blijven, en gheduerlic te moghen verbeterd worden: Met zulcke meyning stel ic de volghende form, waer in A bediet het quartier des Veltoversten, B een ledighe plaets daer voor, dienende tot vergaring der ghene die daghelix by hem te doen hebben, C de markt achter 't quartier des Veltoversten, D verscheyden quartierien tot Amptlien, grofgheschut, krijchtuych, leeftocht, waghens, fourage, vreemde Heeren, en zulcke meer alser in een Legher moghen noodich vallen: De verbruynde vierkanten rontom al dese quartierien bedien regimenten Ruyters, en daer rontom de regimenten Voetvolc gheteykent met E, diens nauwer verdeelinghen om de kleenheyt der plaets wille ongheteykent blijvende, verstaen worden zoo ghedaen te wesen, als int 3 en 5 Lidt des 1 Hoofstucx verclaert is: Buyten het Voetvolc komen de alarmplaetsen F, alle straten zijn evenbreec van 50 voer.

Om het ghene tot hier ghezeyt is noch eens te verhalen, met woorden uyt welke men zoo de form misteykent waer, een ander nieuwe zoude kunnen maken beter dan uyt de voorgaende woorden, zoo zegh ic dit Legher ~~zoude~~ zonder alarmplaetsen te begripen 70 vierkanten, 10 inde langde, 7 inde breedde, daer af de 30 buytenste gheteykent E zijn voor het Voetvolc, de 22 verbruynde daer teghen aen gherakende zijn Ruyters, de twee middenste t samen geteykent A zijn voor den Veltoverst, de 2 vierkanten daer voor t samen gheteykent B, zijn de ledighe plaets, de 2 met C t samen zijn de markt, de 12 met D, te weten aen elcke zijde 6 zijn voor den * nasleyp. Maer dat de teyckening hier af op't velt licht zoude vallen, is by het oogh te mercken. Hier me zoude naghekomen zijn de voorverhaelde ghemeenen reghel van Xenophon, te weten dat den Veltoverst met Amptlien, bagage, en naghevolgh, int midden t samen omvanghen zijn vande Ruyterie,

en om

Legions were more complete the respective lengths and widths were to be equally increased according to the requirements. Through all these motives the Castrametatio could not always be effected in the same manner and according to the measures laid down by the general rules, but one had to make a new estimation, calculation and drawing, as it might be required. Yet one should take it, that the rules were being as strictly followed as it could be done, namely in such manner that the convenience of the streets and the identification of each lodgment was found to be more easy than it should have been otherwise.

Further it should be noted, that the Roman Commander (Praetor) lodged on one side of the Encampment, at a great distance from its centre, and the large body of Soldiers, such as the two Roman legions with the *Socii*, with all the others thus occupying such a large space of the Encampment as has been shown by the figure in the 1st Section of Chapter 1¹⁾.

In matters like these, they will have had their special reasons, but leaving these out, it appears to be better to follow Xenophon's general rule, to wit that the Commander and train be lodged in the centre of the Soldiers, which will be shown in the following 2nd Section. Moreover in the Camp according to Polybius' Castrametatio there does not seem to have been distributed any space whatever to machinery, waggons, pack animals, store-houses of war-munitions, victuals and forage, nor to outsiders, such as merchants, inn-keepers, artisans and sutlers, all of which the Romans, according to their custom, did not mingle with the soldiers. All these people had to have a considerable amount of space, for which purpose their suburbs were supposed to serve, which they named *procestria*, to which they put special guards to protect them. However it was found, that after Xenophon's general rule, as mentioned above, they could all be accommodated in the encampment, and for better reasons, for by merely increasing the width by 200 feet they would have equally increased the camp with a park of 200 feet in width and 2000 feet in length, and this by merely lengthening the parapet by 400 feet, thus causing the afore-mentioned items to be kept within the encampment with less strength of the guard, at less cost and with less trouble and also with greater convenience and security than when building special suburbs for them.

All these motives have been the reason why his Princely Grace in the preceding method of Castrametatio has not followed the Roman manner as strictly as it could have been done, which has been my intention to explain in this 1st Section.

SECTION 2

Containing a suggestion for the drawing of an Encampment, the form of which could remain the same for a considerable length of time.

Although it is impossible to make a drawing that will always remain the best, or, even if it were practicable it could not be determined as such, nevertheless it is free to every one to explain his ideas as to what he would consider best these days to be maintained for a considerable length of time and still remain liable to improvement. According to this opinion I take the following figure, in which A

¹⁾ The army camp according to Polybius has been represented on fol. 5; except for the two Roman legions it included the so-called *Auxilia* (*Socii*, *Evocati*, *Ablecti* and *Extra-ordinarii*, see fol. 47 and Polybius, *The Histories* III, p. 329-353 Loeb Classical Library; cf. note 23 of the Introduction). Of these the legions were lodged within the rectangle DEFG as shown in the figure on fol. 5, which has been expressly recorded in the French edition.

en om de zelve het Voetvolc. Tot het ghene ghezeijt is dient de volghende form, daer opmen nauwer letten zoude, als de zake metter daet op zulcken voet moeft int werc ghesfelt worden, waer me ic achte myn meyning van dat 2 Lidt genoegh ver- klaert te wesen.

[illegible]

stands for the Commander's quarters, B for an empty space in front of these, serving as a gathering-place for those having to see him every day, C for the market-place situated behind the Commander's quarters, D for various quarters for Officers, ordnance, military utensils, victuals, waggons, forage, foreign Lords, and other matters, that are likely to be required in an Army Camp. The hatched squares round about all these quarters indicate the Cavalry regiments, and again round about the latter there are the Infantry regiments marked with E, the particular partitions of which not having been drawn on account of the minuteness of the respective space, are meant to be similar to the explanation given in the 3rd and 5th Section of Chapter 1.

The alarm-places F are plotted outside the Infantry; all the streets have an equal width of 50 feet.

In order to narrate again all that has been said up to now by means of words by which, better than by the previous words, in case the figure should have been drawn badly, it would be possible to make another, so I say, that this Encampment without the alarm-places is ¹⁾ to comprise 70 squares, 10 lengthwise and 7 broadwise, of these the 30 outer squares, marked E, are meant for the Infantry and the 22 hatched ones joining them, are those for the Cavalry, the two middle ones, taken together, marked A, are for the Commander, the 2 squares before them, taken together, marked B, are the empty space, the two together with C are the market-place, the 12 squares marked D, i.e. 6 on either side, are intended for the Train. But that this drawing could be easily marked in the field, can be clearly perceived by the eye. This method should completely fulfil Xenophon's general rule, as mentioned before, i.e. that the Commander and his Officers, baggage and train are together in the centre surrounded by the Cavalry and the latter again by the Infantry. The following figure serves the purpose of all that has been said so far and one should have a good look at it, if things should actually be carried out on such footing, by which I consider to have adequately explained my view of this 2nd Section.

¹⁾ The word "zoude", in the 10th line from the bottom, should be omitted.

3 L I D T,

Vande verdeeling des Krijchs volcx, die totte gheduerighe oordentelike logiering noodich is.

OM een Legher alijt oordentelic te logieren op een zelve form, zoo is daer toe noodich goede verdeeling des Krijchsvolcx, en want daer aen zeer veel gheleghen is, zoo wel om veel ander deelen des krijchshandels, als om de Leghermeting, zoo zal ic daer af hier wat breeder zegghen.

Verscheyden volcken hebben de verdeeling des Krijchsvolcx verscheydenlic ghedaen, elc na syn goetduncken, waer af ic hier eenighe vermaentste tot voorbeek stellen zal, te weten de verdeeling vande Hebreen, Griecten, Romeynen, en Tarters.

Krijchsvolcx verdeeling der Hebreen.

NA t'schrijven van Iosephus, zoo heeft Moyfes door den raet van Raguel syn Huyfrouwens Vader, Hooftmannen ghefelt over elcken hoop van duisdanighe menichte.

10000. 1000. 500. 100. 50. 30. 20. 10.

Krijchsvolcx verdeeling der Griecten.

DE Griecten hadden in hun verscheyden regeringhen, en op verscheyden tijden verscheyden verdeelinghen, die Patritius in syn 8 Boec vermaent, maer want inde verdeeling door Elianus beschreven, het meeste bescheyt is, zoo zal ic hier alleenlic den zin van dien int korte stellen. Sy hebben verkoren een gheduerighe tweeighe voortganc, beghinnende met een rijc van 16 Krijchslie, die den naem hadden van eerste, tweedde, derde, en zoo voorts totte zestiende: Int vendel waren 16 rijen, die elc een naem hadden van eerste, tweedde, derde, en zoo voorts totte zestiende: Over dese rijen en vendels ooc met tweeighe voortganc, stelden sy Beveelders met namen als volgt:

* Continuum
binaerian pro-
gressum.

	1 rijc van	16 mannen
Over	2 rijen van	32 mannen beval een Dilochita.
Over	4 rijen van	64 mannen beval een Tetrarcha.
Over	8 rijen van	128 mannen beval een Taxiarcha.
Over	1 vendel van	256 mannen beval een Sintagmatarcha.
Over	2 vendels van	512 mannen beval den Pentacosiarcha.
Over	4 vendels van	1024 mannen beval een Chiliarcha.
Over	8 vendels van	2048 mannen beval een Merarcha.
Over	16 vendels van	4096 mannen beval een Phalangarcha.
Over	32 vendels van	8192 mannen beval een Diphalangarcha.
Over	64 vendels van	16384 mannen beval een Tetrphalangarcha.

Aengaende zommighe mochten zeggen, dat de bovenschreven voortganc niet en behoort te beghinnen met 1 rijc van 16 mannen, maer volghens de meening van Elianus met 1 man, daer op zal ic hier na t'synder plaets antwoorden.

Krijchs-

SECTION 3.

Of the distribution of the soldiers, necessary for a permanent and orderly encampment.

In order to encamp an army always in the same orderly manner, it is necessary to have a good distribution of the soldiers and as the latter is highly important, both with regard to various other parts of the conduct of war as well as with a view to the *Castrametatio*, I shall now go further into the subject.

Several nations have effected the repartition (distribution) of the soldiers in different ways, each at his own discretion, of which I shall take as an example here some of the most famous, i.e. the distribution of the Hebrews, Greeks, Romans and Tartars.

Distribution of soldiers with the Hebrews¹⁾.

According to Josephus' writing, Moses by following the advice of Raguel, his housewife's Father, appointed Chiefs to each body of the following multitudes:

10,000. 1,000. 500. 100. 50. 30. 20. 10.

Distribution of soldiers with the Greeks.

The Greeks had in their various governments and at various times different forms of distribution, which Patricius²⁾ reports in his 8th Book; however, as in the distribution as described by Aelianus³⁾, we find a greater gradation, I shall merely confine myself to a brief statement of its significance. They have chosen a continuous dual progression, beginning with a file of 16 Soldiers, bearing the name of first, second, third, and so on up to the 16th (Soldier). A company consisted of 16 files, each bearing the name of first, second, third and so on up to the 16th (file). To these files and companies, also having a dual progression, they appointed Commanders bearing the following names:

¹⁾ Stevin has derived this distribution from two sources: *Exodus XVIII: 21* viz. Raguel's advice to Moses: "Moreover thou shalt provide out of all the people able men, such as fear God, men of truth, hating covetousness; and place such over them, to be rulers of thousands, and rulers of hundreds, rulers of fifties, and rulers of tens" (*King James's Bible*); and: Flavius Josephus, *Jewish Antiquities* III. 70-72, the same advice: "Follow but my advice on mundane matters, and thou wilt review thy army diligently and divide it into groups of ten thousand men, over whom thou wilt appoint selected chiefs, these into thousands; next thou wilt proceed to divide these into groups of five hundred, and these again into hundreds and fifties; "with the subsequent interpolation: "Thou shalt moreover appoint officers over these to marshal them in sections of thirty, of twenty and of ten all told." (communicated by Prof. R. J. Forbes).

²⁾ By Patricius' 8th Book is meant his *Paralleli Militari* (cf. also note 3 to fol. 4), of which 6 of the 16 chapters in the 8th book (1st part) deal with Greek distributions of soldiers.

³⁾ For Aelianus' distribution "with a greater gradation", cf. Hahlweg, p. 248-250 (extract MS. 128A-9^a, fol. 88 et seq. in Royal Library, The Hague).

	1 file	of	16 men	
To	2 files	of	32 men	there was in command a Dilochoit
To	4 files	of	64 men	there was in command a Tetrarch
To	8 files	of	128 men	there was in command a Taxiarch
To	1 company	of	256 men	there was in command a Syntagmatarch
To	2 companies	of	512 men	there was in command a Pentacosiarcho
To	4 companies	of	1,024 men	there was in command a Chiliarch
To	8 companies	of	2,048 men	there was in command a Merarch
To	16 companies	of	4,096 men	there was in command a Phalangarch
To	32 companies	of	8,192 men	there was in command a Diphalangarch
To	64 companies	of	16,384 men	there was in command a Tetrphalangarch

As some people might say that the above progression should not begin with 1 file of 16 men, but according to Aelianus' opinion with 1 man, I shall answer to this hereafter in its proper place ¹⁾).

Distribution of soldiers with the Romans.

The distribution of the Romans has altered somewhat in course of time, so that I shall only mention here the best known, i.e. at the time when described by Polybius ²⁾, when a Roman legion consisted of 4,200 Foot and 300 Horses; the Foot were subdivided into 10 regiments, which they named cohorts, each consisting of three companies, called maniples by them, which had two Captains each, named Centuriones. The cohorts or regiments did not have a Colonel of their own, but to the 10 regiments of the legion there were together six Officers in command, named Tribuni ³⁾. The first one of the three regimental companies comprised 120 Hastati, the second 120 Principes, the third 60 Triarii, all of them heavy-armed, and to each company also belonged 40 light-armed Lancers and Archers they named Velites, resembling our present companies of armed Pikemen and Musketeers. The companies were divided into files and ranks, the files consisting of 10 Soldiers, who, (the company being in battle-array) were being arranged on the lines from the front to the back and the ranks that were there on the lines from the right to the left side. Each one of the 10 Soldiers was named in his file, the first, second, third and so on, according to the place

¹⁾ By "this place" Stevin obviously means fol. 54.

²⁾ There is a 150 years' difference between the period described by Polybius and that of Caesar; Polybius lived from c. 202—120 B.C.; Caesar from 102—44 B.C. The 2nd Punic War, however, which lasted from 219—202 B.C., has also been described by Polybius (cf. also Introduction, p. 255, notes 23, 24). Concise descriptions of organization, armament and history of the Roman army (together with bibliography) inter alia in:

Stuart Jones, H., *Companion to Roman History* (Oxford, 1912).

Sandys, Sir John, *A Companion to Latin Studies* (Cambridge, 1943).

³⁾ For the *tribuni* cf. also note to the *Dedication to the States General*.

Krijchsvolcx verdeeling der Romeynen.

DEr Romeynen verdeeling heeft tot zommige tijden wat veranderings ghekreghen, zulcx dat ic hier alleenlic stellen zal de bekentste, te weten die des tijds daer Polybius af schrijft, in welcke een Romeynsch legioen was van 4200 Voetknechten, en 300 Peerden, de Voetknechten waren ghedeelt in 10 regimenten die sy cohorten noemden, elc van 3 vendels, by hunlien manipulen gheheeten, die elc twee Capiteynen hadden Centuriones ghenaemt. De cohorten of regimenten en hadden elc gheen eyghentlic Colonel, maer over de 10 regimenten des legioens bevalen zes Amptliet zamen, Tribuni geheeten. Het eerste der drie vendels eens regiments was van 120 Hastati; het tweede van 120 Principes; het derde van 60 Triarij, wesende altemael swaerghewapende, en elc vendel hadde tot hem 40 lichtghewapende Worpers en Schutters, die sy Velites hieten; twelc toeghinc ghelijcmen nu de vendels maect van ghewapende Pijckiers en Buschutters: De vendels wierden verdeelt in rijen en leden. Derijen waren van 10 Krijchslie dieder (het vendel in slachoorde wesende) stonden op de linien van voren tot achter, en leden dieder stonden op de linien vande rechter totte sincker zijde: Elc der tien Krijchslie wiert in syn tije ghezeyt, eerste, tweede, derde, en zoo voorts na dat syn plaets was. De rijen wierden in elc vendel ooc ghezeyt, eerste, tweede, derde, en zoo voorts totte laetste, twelc vande Hastati en Principes was totte twaelfde, en vande Triarij totte zeste. De voorschreven 300 Peerden wierden in 10 hoopen gedeelt elcke van 30, Turmae geheeten. De manipulen en cohorten hadden vanden totte teyckens, en de legioenen elc een zilveren Arent. Het Romeynsch Legher had twee legioenen, en ontrent noch eens zoo veel der ghene die gheen Romeynen en waren, als Socij, Evocati, Ablecti, en Extraordinarij, zulcx datter was van ontrent 16000 mannen, waer af een grontteyckening te zien is int 1 Lidt des 1 Hooftstuc: Alsin meer volcx behoefde, zoo warender twee Leghers, elc met syn Veltoverst van form ghelijc 'tvoorgaende, en ruggeling teghen malkander veroordent, twelc was mette zijden daer de Oversten by logierden.

Krijchsvolcx verdeeling der Tartars.

CAngio gheweest zijnde den eersten grooten Cam, zoo Aiton schrijft, heeft in syn Krijchsvolcx verdeeling ghebruyt de * gheduerighe tienighe voortganc met tien beghinnende, stellende Hooftmannen over 10. 100. 1000. 10000 mannen, welcke oorden noch gheduerde ten tijde van Tamerlan, die eenich inghebroken misbruyc dede verbeteren, en tot syn eerste form brenghen, zoo ghezeyt is int beghin des 1 Lidts van't 1 Hooftstuc.

*Continua
progressio de
natia.*

Tot hier toe zijn beschreven eenighe verdeelingen van ouden tijden. Aengaende de teghenwoordighe, ic en weet nerghens verdeeling na reghel veroordent, hoe noodich en oorboor die ooc is, maer worden in een zelve Legher wel vendels bevonden, zommighe van een, twee of drie hondert, ander van vier of vijf hondert mannen, meer of min, en 'sghelijcx mette regimenten, zulcx dat myn voornemen wesende hier te verklaren myn ghevoelen vande beste verdeeling, zoo en valter van die niet te zegghen: Wat d'ander voorschreven belangt, ic meyn de Hebreusch en Tartarische verdeeling een zelve te wesen, beyde bestaende in een gheduerighe tienighe voortganc met tien beghinnende, want hoewel Moyses tusschen 100 en 10 brocht 50. 30. 20. 'sghelijcx tusschen 1000 en 100 noch 500, hier in en gact niet teghen de reghel deses tienden voortganx: Om twelc by voorbeeld te verklaren,

assigned to him. The files in each company were also named first, second, third and so on up to the last one, which for the Hastati and Principes went up to the twelfth and for the Triarii up to the sixth. The afore-mentioned 300 Horses were being divided into 10 groups of 30 horses each, named *Turmae*. The maniples and cohorts carried pennons as signs and the legions each a silver Eagle. The Roman Army Camp contained two legions, and again an equal number of men, who were not Romans, such as the *Socii*, *Evocati*, *Ablecti* and *Extraordinarii* to such an extent that they comprised a total number of about 16,000 men, a ground-plan of which being shown in the 1st Section of Chapter 1. If more soldiers were required, there were two Camps, each with his Commander, of the same form as the one mentioned before and arranged back to back against each other, i.e. with the sides where the Commanders were lodged close by.

Distribution of soldiers with the Tartars.

Cangio¹⁾, who has been the first great Cham²⁾, as described Aiton, adopted in his distribution of Soldiers the continuous decimal progression beginning with ten, appointing Chiefs to a number of 10, 100, 1000 and 10,000 men, an order which still existed in the days of Tamerlan³⁾, who remedied some misuse that had cropped up and restored it to its initial form, as has been said in the beginning of the 1st Section of Chapter 1.

Up to now we have described some ancient organizations. As to the present manner adopted I do not know of any distribution subject to a definite rule, however necessary and useful this may be, yet in one and the same Army Camp there even have occurred companies several of which consisting of one, two or three hundred, others of four or five hundred men, more or less, and equally so in the case of the regiments, and though I had the intention to explain here my opinion about the best distribution there cannot be said anything about this one.

As to the other ones that have been described before, I think the distribution adopted by the Hebrews and the Tartars to be the same, both consisting of a continuous decimal progression beginning with ten; for although Moses inserted between 100 and 10 the numbers 50, 30 and 20 and equally so between 1000 and 100 another 500, this does not go against the rule of this decimal progression. In order to explain this, by way of example, if we take it that such a progression should refer to a similar distribution of soldiers in these days, in which a company of 100 men were to consist for one half of 50 Pikemen and for the other half of 30 Musketeers and 20 Harquebuseers⁴⁾ and that when fighting, there should be a Leader or Commander to each of these three bodies of soldiers, this were not to cause any disorder in the first stated decimal progression, which still remains essentially unaltered, no more than that a company additionally comprises a Lieutenant and his Sergeants, including an Ensign and Drummers, who are also leading the Soldiers to the enemy and elsewhere, the one by visible, the other by audible signs.

¹⁾ The name Cangio is: *Dzenghis Khan* and Aiton is: *Haythonus*; cf. note 22 to the Introduction.

²⁾ According to Oxf. Dict.: *cham*. Stevin mentions "*Cam*" (in Dutch text) meaning autocrat (obsolete form of *Khan*), supreme ruler of Turkish, Tartar and Mongol tribes (communicated by translator).

³⁾ For Tamerlan cf. fol. 4 and correction of the error occurring therein, see Note 22 to the Introduction.

⁴⁾ "*Busschieters*" according to the French edition (*Arquebousiers*) has been translated by *Harquebuseers* (as to its orthography see Hahlweg, p. 298).

verklaren, genomen datter met zulcken voortganc waer een verdeel^{ing} van Krijchsvolc deses tijds, in welcke een vendel van 100 mannen, hadde d'een helft van 50 Pijckiers, d'ander helft van 30 Musquettiers, met 20 Buschieters, en dat over elke dier drie hoopen int vechten waer een Aenleyder of Beveelder, dat en zoude inde eerst-ghestelde tienighe voortganc, die evenwel in wesen blijft, gheen ongheschied-heyte veroorzaken, niet meer dan dat boven dien int vendel noch veroordent worden Lieutenant en Serganten, metsgaders Vendrich en Tromslagers, die't Krijchsvolc ooc aenden Vyant en elders leyden, d'een met zienlicke, d'ander met hoorlicke reychens: En 'sghelijcx is me te verstaen van't vendel der 100 Hebreen, waar by aldien men neemt dat de 50 waren swaergewapende, d'ander 50 van 30 Schutters met 20 Worpers, ghelijc de Griecken, Romeynen, en meer ander ooc hun Schutters en Worpers ghehadt hebben, en ghelijc de natuerlicke reden zulcken manier van oordening ooc schijnt te willen, zoo zoude het syn bekende reden hebben waerom de Hebreusche verdeeling van 50. 30. 20 tusschen de 100 en 10 daer ghedaen is, zonder nochtans d'eerst-ghestelde tienighe voortganc te breken, om dat elc zoo wel Capiteyn als Rijeleyers over hun tien blijven bevelende ghelijc te voren. Zoo veel aengzet de 500 tusschen 1000 en 100, de ghene die verstaen den Lieutenant eens Colonels over syn heel regiment van 1000 mannen gheen tienighe voortganc te breken, de zelve zullen ooc diergheleijcke lichtelic verstaen van twee Lieutenanten, elc over de helft des regiments, ghemerct den Colonel en elc Capiteyn evenwel over hun tien blijven bevelende ghelijc te voren: Zulcx dat zoo ymandt zeyde de Hebreusche oorden te bestaen in tienighe voortganc van Hooftmannen over 10. 100. 1000. 10000 Krijchslie, hun eyghenschap zoude daer me verklaert zijn, want de ander tusschenstaende Amptlien (daermen noch Vendrichs en Tromslagers by mocht voegen) niet en zijn dan vermaen van't aenhancsel des zelsden tienighen voortgancx.

Belanghende dat ymandt mocht dencken waerom Moyfes de verdeeling tusschen 100 en 10 niet en dede van 50. 25 en 25, deelende de overschietende 50 in twee even hoopen, ghelijc de 100 in 50 en 50 ghedeelt wierden, en zoo hy ooc dede mette 1000 in 500 en 500: D'oorzaec schijnt dat met twee hoopen elc van 25, d'oorden der rijen ghebroken zoude zijn, overmits een Rijeleyder of Tienleyder onder hem zoude moeten ghehadt hebben 5 Schutters en 5 Worpers, 'twelc ongheschied had gheweest, waer deur de verdeeling van 30 en 20 beter was, om dat daer me alle Tienleyders heele rijen hadden van een zelve wapen: En of 'tghene ghezeyt is de rechte oorzaec niet gheweest en hadden, zoo mochtet evenwel oorboor zijn zulcx, daer't te pas mocht komen, na te volghen al oft zoo waer.

Noch zoude de vraghe moghen zijn, dat nadien Moyfes de tienighe voortganc wilde volghen, waerom hy niet een trap voorder en quam, te weten tot Hooftmannen over 100000, ghemerct het Legher boven de 500000 strijdtbaer mannen inhield: De reden daer af is, dat de Krijchslie verdeelt waren in elf gheslachten, elc met hun Overste, zulcx dat hy maer eyghen opzicht te nemen en had op die elf, en niet op een menichte van over de 50, diens doen en beleyt hy van elc int bezonder niet zoo en zoude hebben konnen gade slaen, ghelijc de zake vereyschte, maer zooder dat gheval dier elf gheslachten niet gheweest en had, het schijnt dat hy dien trap hoogher zoude ghekomen hebben, en Hooftmannen gheselt over 100000 mannen.

Aldus verklaert wesende dat de Hebreusche verdeeling bestaet in volkomen gheduerighe tienighe voortganc met tien beghinnende, ghelijc de Tartarische, zoo valter voorder te aenmercken dat de Hebreen eerst gheweest zijnde, en dat hun oorden langhe daer na vande Tartars ghevolcht wiert, billich te wesen, die daer't hier na te

In the same way one should understand the company of the 100 Hebrews, for if one assumes that the 50 men were heavily armed and the other 50 were to consist of 30 Archers and 20 Lancers or Throwers, just as the Greeks, Romans and several others also had their Archers and Throwers, and as the natural reason seems to indicate such an order as well, it will surely have been on account of well-known motives that the Hebrew repartition of 50, 30 and 20 inserted between the units of 100 and 10 has been effected here, yet without breaking the first stated decimal progression, because every one, both Captain and File-leaders, will continue commanding their unit of ten as before. As to the 500 between 1000 and 100, those who are aware, that the Lieutenant Colonel will not break the decimal progression in his whole regiment of 1000 men, those will easily understand a similar case of two Lieutenants, each in command of half the regiment, seeing that the Colonel and each Captain, however, continue commanding their ten as before; to the effect that, if some one should say that the Hebrew order were to consist of a decimal progression of Chiefs to a number of 10, 100, 1000, 10,000 Soldiers, its property would have been explained by it, for the other Officers coming in between (to which one may add the Ensigns and Drummers) are no more than an indication of the complement of the same decimal progression.

So whenever some one might wonder why Moses did not form the repartition between 100 and 10 by inserting 50, 25 and 25 and dividing the remaining 50 into two equal units, just as the unit of 100 had been divided into 50 and 50, and as has been equally done with the unit of 1000 into 500 and 500: the reason why seems to be, that two units of 25 each, would have broken the regular order of the files, because a File-leader or Ten-leader should have had 5 Archers and 5 Throwers under him, which would have been absurd, thus proving the repartition of 30 and 20 to be better, because in this way all the Ten-leaders had whole files belonging to the same arm. And, if all that has been said should not have been the real cause, it might nevertheless be useful to follow this up wherever it proves to be convenient, as if it were really and truly so.

Yet there still remains the question, that when Moses wanted to follow the decimal progression, why he did not take one step further i.e. to appointing Commanders to 100,000, taking into consideration that the Army Camp comprised more than 500,000 efficient soldiers. The reason why is, that the Soldiers were divided into eleven tribes¹⁾, each with their Commander or Chief, to the effect that he had merely to survey these eleven and not a multitude of more than 50, whose actions and comportment he could not have watched so individually as the situation demanded, yet, if there should not have been the fact of those eleven tribes, there is every possibility that he might have moved that grade higher and appointed Commanders to a number of 100,000 men.

Thus having explained that the Hebrew distribution consisted of a complete continuous decimal progression beginning with ten, similar to that of the Tartars, we may further observe that, since the Hebrews have been the first and that it was a long time before their order had been followed by the Tartars, it is only

¹⁾ What Stevin's idea could have been by the distribution of soldiers into "eleven tribes, each with their commander or chief", whereas he must have had certain knowledge, that twelve scouts were sent off (*Numeri* XIII: 2,4-16; Josephus, *Jewish Antiquities* III, 303), is not clear. So it explicitly says in Josephus: "These words of Moses (Let us then send scouts to mark the richness of the land. . .) were rewarded by the respectful attention of the people, and they selected twelve scouts from their most notable men, one from each tribe."

Ma te pas zal komen de Hebreëfche verdeling te hieten. Aengaende eenighe mochten willen staende houden, dat Moyses d'eerste niet en was diese int werc stelde, en dat Raguel, die hem den raet gaf, zulcx vande veelwetende Egyptenaers mocht gheleert hebben, daer en wil ic gheen harnas om aen trecken, maer ter wijle sy d'eerste is diemen by schrift vint, en dat tgebruyc mebrengt die de Hebreëfche te noemen, ic zal daer by blijven, en voorder zegghen datse my bevalt boven de Griecsche, Romeynsche, en alle ander verdeelinghen; ja zoo dat ic acht inder natuer gheen beter te bestaen: want hoewelmen al tghene menschen handen konstelic maken, niet zeggen en mach onverbeterlic te zijn, om datmen't niet bewijfen en kan, zoo ist hier me anders gheselt, ghenoechzaam daer me toegaende ghelijc met * wiskonstige voorstellen, daer af een zoo waerachtich besluyt is, datter gheen waerachtigher af en kan ghenomen worden. Om dan te komen tot verklaring der redenen, waerom ic acht gheen beter verdeling te konnen zijn dan dese, zoo is eerstelic te weten, dat nadiense bestaet in een gheduerighe tienighe voortganc, van wiens weerdicheyt en oorboor in smenschen handel ic, na myn vermoghen, een bezonder Boecxken gheschreven heb, zoo en ist niet noodich zulcx hier weerom te verhalen, te meer datter veel zijn die de tienighe voortganc niet alleen met woorden en schriften loven, maer ooc inder daet ghebruycken. Aengaende haren bezonderlicken oorboor in dese verdeling des Krijchsvolcx, die wil ic nu beschrijven, als volgt:

Voor al om myn meyning wel te doen verstaen, ic zal eerst nemē dat de Krijchslie in elcke rye (al zoo diergelijcke vande Grieken en Romeynen hier voren aengheroert is) ghenamt worden, eerste, tweede, derde, en zoo met d'ander totte tiende: Voort neem ic dat den naem des teyckens van elcke 100 Krijchslie zijn vendel, en van elcke 1000 wimpel, en van elcke 10000 standaert: Ooc dat de rye in elc vendel, de vendels in elc wimpel, de wimpels in elcke standaert, ghenamt worden, eerste, tweede, derde, en zoo voorts totte tiende: By aldien de menichte des Krijchsvolcx een trap voorder quam, dat's tot 100000 mannen, men zouder den naem van een vierde teycken toe verkiesen. De hoopen van 10. 100. 1000. 10000. 100000 mannen, worden ooc ghenamt * tienhoop, honderthoep, duy-
fenthoo, tienduyfenthoo, hondertduyfenthoo: En hun Beveelders of Leyt-
mannen * Tienleyder, Hondertleyder, Duyfentleyder, Tienduyfentleyder, Hon-
dertduyfentleyder: Twelc verstaen zijnde, ic zal nu zegghen vanden oorboor uyt
de Hebreëfche verdeling volghende.

* *Propositio-
bus mathema-
tica.*

* *Decuria
vel series,
Centuria,
Chilarchia.
* Decurio of
dux series,
Centurio,
Chilarchus.*

Ten eersten, dat elc Beveelder hoe groot een Legher is, maer eygentlic en heeft zorghe te draghen over tien mannen onder hem * onghemiddelt staende, gade
staende dat elc van dien syn ampt bediene na tbehooren, twelc om de kleene en be-
quame menichte hem moghelic is te doen, en daer me kan't overal wel gheregiert
zijn: Als by voorbeelt, elc Tienleyder heeft te letten op syn tien Krijchslie, elc
Hondertleyder op syn tien Tienleyders: Aengaende de ongheregheltheden of
swaricheden dieder vallen tusschen syn hondert Krijchslie in zaken die tot oordeel
der Tienleyders staen, daer in voorzien zy elc in haer rye, of zoo sy't niet en doen,
den Hondertleyder en heeft maer aen te spreken zoodanighe der tien Tienleyders,
als die't aengaet, en hunlien te vermanen of raden na tgene de zake vereyscht: s'ge-
lijcx heeft elc Duyfentleyder alleenlic acht te nemen op syn tien Hondertleyders:
Aengaende d'ongheregheltheden of swaricheden dieder vallen tusschen zijn hon-
dert Tienleyders in zaken die tot oordeel der Hondertleyders staen, daer in voor-
zien de Hondertleyders elc in syn vendel, of zoo sy't niet en doen, den Duyfent-
leyder en heeft maer aen te spreken zoodanighe der tien Hondertleyders, als die't
aengact.

* *Immediat.*

reasonable, that wherever hereafter it proves to be useful, to call this method the Hebrew distribution. As some people might want to maintain the opinion that Moses had not been the first to put this order into practice and that Raguel, who gave him the advice, might have adopted it from the versatile Egyptians, though I don't want to put on my armour for that, however, as it is the first that has been found in writing and as its application causes it to be called the Hebrew order, I shall stick to this and say further that I prefer it to the Greek, Roman and all the other distributions, as a matter of fact so much so, that I am of the opinion that there does not exist any better in nature; for although one should not say that all that human hands could work so cleverly, could not be improved upon, because this could not be proved, here we are having quite a different thing, which could be adequately compared with mathematical propositions, leading up to such evident conclusion, that a better one could not be found. Thus to arrive at an explanation of the reasons why I consider, that there could not be any better distribution than this, it should be known first of all that as it consists of a continuous decimal progression, about the value and utility of which in human negotiations I have written a special booklet, to the best of my ability ¹⁾, it is not necessary to explain this here all over again, the more so, as there are a great many people, who do not only praise the decimal progression in words and in writing, but who do actually use it. With regard to its particular utility in this distribution of Soldiers, I will now describe that as follows:

Particularly in order to make my view upon the matter quite clear, I shall first state that the Soldiers in every file (similar to those of the Greeks and the Romans as has been previously touched upon) are to be called first, second, third and so consecutively until the tenth. Further I assume, that the name of the sign for every 100 Soldiers is to be ensign, and that of every 1000 pennon and that of every 10,000 standard ²⁾.

Further that the files in every ensign, the ensigns in every pennon, the pennons in every standard are also to be called first, second, third and so on until the tenth. However, if the multitude of the Soldiers were to be moved one grade higher i.e. to 100,000 men one should choose the name of a fourth sign for it. The bodies of 10, 100, 1000, 10000 and 100000 men are also named: body of ten (*decuria*), body of hundred (*centuria*), body of thousand (*chiliarchia*), body of ten thousand, body of hundred thousand. And their Commanders or Leaders: Ten-leader (*Decurio*), Hundred-leader (*Centurio*), Thousand-leader (*Chiliarch*), Leader of ten thousand, Leader of hundred thousand. This being understood, I shall now speak of the utility resulting from the Hebrew distribution.

First, that each Commander, no matter the extent of the Army Camp, has merely to take care of ten men, placed immediately under him, watching that every one of them is doing his duty, as it should be done, which on account of the small and skilful body it is quite possible for him to do so and in this manner it

¹⁾ By "a special Booklet" Stevin apparently means his publication *De Thiende (The Tenth)*, printed, translated and discussed in Volume II-A, Mathematics, p. 371-455.

²⁾ As a translation for the names of the "teyckens" (signs) indicating 100, 1000 and 10,000 soldiers, we have chosen on the analogy of the names used in the French and German editions, respectively ensign ("vandel"), pennon ("wimpel") and standard ("standaert"). Dijksterhuis rightly points out (p. 244, note 2) that Stevin applies a somewhat different terminology when he describes the composition of the troop in the hierarchy of an army, viz. "vaen" (company) standing for 10 files, "banier" (banner) for 10 companies and "standaert" (standard) for 10 banners.

1

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can be easily controlled everywhere. For instance, thus each Ten-leader has to mind his ten Soldiers and each Hundred-leader (or Captain) ¹⁾ his ten Ten-leaders. As to the irregularities or difficulties that may occur among his hundred Soldiers with regard to the matters that have to be judged by the Ten-leaders, these are worked out by every one in his own file, or, if they should not do so, the Captain has only to address the men in question out of the ten Ten-leaders and to admonish or advise them as the situation may require. In the same way each Thousand-leader (or Colonel) ¹⁾ has only to regard his ten Captains. As to the irregularities or difficulties that might arise among his hundred Ten-leaders in those cases that are to be judged by the Captains, the latter see to this, every one in his company, or, if they should fail to do so, the Colonel has only to address those of the ten Captains concerned and to admonish or advise them as the situation may require and equally so in the case of the Leaders of ten thousand and those of hundred thousand.

Secondly in Camp-works such as entrenchment, cutting of branches, making of Fascines, Gabions and Hurdles, this way of distribution enables the men to accomplish a great deal in haste, as no one were to hide himself but with peril, since every 10 men are being controlled by a Ten-leader, who is continually watching them in their work, also because each one of these ten Ten-leaders is under the command of a Captain, who sees to it that they are performing their surveying tasks as they should. Moreover every ten Captains are equally controlled by a Colonel, and so on.

Thirdly, thus this manner of distribution does not need an elaborate explanation nor is it difficult to keep it in mind like the afore-mentioned Roman and several other distributions, for one has only to know that it has a decimal progression, and this will suffice; furthermore it greatly simplifies the financial Books that are kept of the Soldiers, their accounts and payments ²⁾. Besides this could also be a considerable aid to the musters, because it would enable the men in charge to observe daily, in a very adequate manner, what is found missing without collecting the Soldiers for inspection on account of the following reasons:

Being instructed in accordance with the general regulations that the companies, when marching or when forming up, are not to be mingled in their files and ranks i.e. every 50 Musketeers before or behind their 50 Pikemen, if one can only march five in front, but next to their Pikemen, if the width of the road should permit of it ³⁾, thus one sees at a glance whether they are all there, to wit, five files of Pikemen

¹⁾ The Latin counterparts in the margin for the Dutch names of "hoopen" (bodies) of 10,000, 1000 etc. and their "Beveelders" (Commanders) or "Leytsmannen" (Leaders): *Decuria*, *Centuria*, *Chiliarchia*, resp. *Decurio*, *Centurio*, *Chiliarcha* were gradually put out of use by Stevin himself (more so in the French edition than in the Dutch version) and replaced: *Centurio* (apart from Leader of 100) by Captain and *Chiliarcha* (apart from Leader of 1000) by Colonel (in the Dutch edition first mentioned on fol. 51). In the English translation this principle has also been followed.

²⁾ For the Financial Books that were kept of the Soldiers cf. *inter alia* Dijksterhuis p. 258, in which the "dispense" of the war-munitions are called a supplement to the *Castrametatio*. For the musters of the bodies of soldiers cf. *inter alia* the Introduction to the *Journal* by Anthonis Duyck (XC-CXXXIII) and Wijn, p. 10-16.

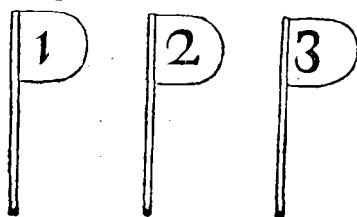
³⁾ Between the words "permit" and "thus one sees" there has been inserted in the French edition: "(permet) ce que requeroit aussi l'ordre de bataille des Romains, que je tien pour le meilleur, dont sera dit ailleurs (alors on voit)". To this addition Brialmont has drawn attention in his study of Stevin's *Théorie de l'art de la guerre* (in *Mémoire Steichen* of 1846) and meant to conclude that this "Théorie" had been written after the *Castrametatio*. At any rate the insertion is all the more evidence that Stevin *himself* must have been the author of the French edition.

aengaet, en hunlien te vermanen of raden na'tgene de zake vereyscht, en zoo voort met Tienduyfentleyders en Honderduyfentleyders.

Ten tweedden, in Legherwercken als graving, tachouwing, making van rijs, Schanskorven en Horden, kanmen door dese oorden metter haest veel doen, om dat zich niemant en versteect dan met perijckel, deur dien over elcke 10 een Tienleyder opzicht heeft diese int wercken gheduerlic gade slaet, ooc om dat over elcke dier tien Tienleyders een Hondertleyder beveelt, die acht neemt of sy opzicht hebben na't behooren, van welcke Hondertleyders over elcke tien ooc noch een Duyfentleyder Opziender is, en zoo voorts.

Ten derden, zoo en behoeft dese manier van verdeeling gheen moeyelicke verklaring, noch en is niet beswaerlic om onthouden ghelijc de voorgaende Romeynsche en meer ander, want allecnlic gheweten zijnde datse is van tienige voortganc, zoo is alles ghenoechzaam bekent, twelc ooc lichticheyt gheeft inde Boecken der Finance die ghehouden worden van't Krijchsvolc, van hun betalinghen en afrekeninghen. De monsterringhen konnen daer door ooc zeer bevoordert worden, om datmen alle daghe ghenoechzaam zien kan watter gebreeft zonder monstren, om dese redenen: Belast zijnde by ghemeenen reghel, dat de vendels int marcheren of voortreden onghemenghelt gaen in hun rijen en leden, te weten elcke 50 Musquetters voor of achter hun 50 Pijckiers als men maer vijf dic gaen en kan, maer nevens hun Pijckiers alst de breedte des weghs toelaet, zoo zietmen alsdan met een oogh-opflach ofter al is, te weten vijf rijen Pijcken met zoo veel Musquetters, en ymant ghebrekende, zoo kan den Hondertleyder eenich Monsterheer of ymant dieder last af heeft, vragen aen den Tienleyder in diens rije tgebrek valt, waer dien man ghebleven is, als wesende syn werc daer op te letten, en ghevraecht zijnde, bescheyt te gheven, daer af men ooc noch naerder onderzoec kan doen door den Krijchsmā die achter hem ghinc, ghehouden zijnde het bescheyt te zegghen dat hyder af weet, waer me bekent wort de ghedaente des misdaets, om die te straffen na de verdienst, en te voorkomen de swaricheden dieder zonder oorden vallen, als tbedroch der zolttrekking zonder daer voor dienst te doen, int reysen van't vendel wijcken, en de Boeren berooven, op den tocht na zorghelicke aenflaghen zich te verstecken, en dierghelijcke, twelcmen om de groote menichte der overtredders (dieder deur ghebrec van oorden noorzakelic vallen) onghestraft moet laten, of zomwijlen door grooten noot al te bitterlic straffen, zonder inzicht van oorzaken te moghen plaets gheven.

Ten vierden kan deur de tienighe verdeeling een groote bequaemheyt vallen in de Legherlogiering, tot welcx verklaring dient gheweten datmen inde wimpels en



vendels moet stellen de ghetalen haers oordens met groote letters, als het eerste wimpel met 1, het tweede met 2, het derde met 3, en zoo voorts tottet tiende, gelijk hier by voorbeelt deur drie gheteyckende formen aenghewesen wort. De vendels hebben twee ghetalen, het eerste bediet het hoemenichste datter is, het ander beteyckent tghetal des wimpels daer't onder ghehoort:

together with an equal amount of Musketeers, and should there be somebody missing, the Captain, a Commissary of the Musters or somebody else in charge, could make enquiries with the Ten-leader, in whose file there was somebody found missing, where this man could be, as it is his duty to mind this and to give an explanation when asked for it; this could also be further investigated by asking the Soldier, who was marching behind him and who is obliged to respond and to tell all he knows of it; by which the nature of the crime may be known and punished as it deserves and the irregularities resulting from a lack of order may be prevented, such as the deceit of receiving payment without doing military service for it, separation from the company while marching, robbing the peasants and hiding when marching into dangerous enterprises, and things like that, which on account of the large amount of trespassers ¹⁾ (who through lack of order are bound to occur) would have to remain unpunished, or at times, owing to the stress of the moment, get too severely punished, without a further insight into the causes being considered.

Fourthly, the decimal progression may be of great convenience with regard to the accommodation of the Camp, for the explanation of which it should be observed, that in the pennons and ensigns one should put the numbers of their units in large characters, such as in the first pennon (or small regimental flag) the number 1, in the second one the number 2, in the third one the number 3, and so on until the tenth, as it is shown for instance by the three figures, that are drawn here. The ensigns (or company-flags) have two numbers, the first one indicating the how-many-th company, the other the number of the regiment to which it belongs, as for instance this flag bearing the numbers 5.7 indicates, that it represents the fifth company of the 7th regiment, and in the same way with the others. These pennons in an army, that is encamped and always of the same shape and form, are each placed in an orderly fashion before the centre of its quarters, and each ensign before its company, so that everybody knows where to find this particular pennon or ensign, he may desire, without being obliged to ask for it, provided he has been informed about the afore-mentioned numbers. Moreover he knows where to find any Soldier lodged in it from the highest rank to the lowest, provided he has been informed about the two appropriate numbers, i.e. the one indicating the file, its how-many-th number in its company, the other that of the Soldier, the how-many-th number he is in his file. From the afore-mentioned reasons it is also apparent that from a whole army in the field, when drawn-up in battle-array, any man that is wanted, can be found without making enquiries, provided the afore-mentioned numbers required are known. However, should any one maintain, that it could happen that in a certain file somebody was found missing and that this had caused the regular order to be broken, to this one should say that such an exception is not to cause any trouble, for once that the man, who is looking about, has found the file to which the man that is wanted belongs, he can easily find him there.

¹⁾ About these trespassers Wijn also writes in his Comment on the "*Artikelbrief*" of 1590 (*Krijgswezen Prins Maurits*, p. 103).

5.7

hoort : Als by voorbeeld dit vendel met 5. 7 wijst aen dattet is het vijfde vendel van't 7 wimpel, en zoo voorts met d'ander. Dese wimpels in een ghelogiert Legher, dat altijd een zelve form heeft, oordentelic vervolgghens staende elc voor tmidden van syn quartier, en de vendels elc voor haer honderthoop, zoo weet yghelic zulcken wimpel of vendel te vinden als hy begheert, zonder daer na te moeten vrighen, mits dat hem bekent zijn de voorschreven getalen: Boven dien weet hy te vinden yder Krijchsmā daer in ghelogiert vanden hooghsten totten leeghsten, mits dat hem bekent zijn de twee behoorlicke ghetalen, te weten het een der rije, de hoemenichste sy in haer vendel is, het ander des Soldaers, de hoemenichste hy in syn rije is. Wt de voorgaende redenen is ooc openbaer, dat staende een heel Legher op't velt in slachorden, zoo kan elc man diemen begeert ghevonden worden zonder vrighen, mits bekent wesende de voorschreven noodige ghetalen. Aengaende ymant mocht voorwenden te kunnen ghebeuren, dat in een rije ymandt ghebreeft, en daer me d'oorden ghebroken te zijn : Hier op wort gheantwoort zulcke uytneeming kleyne swaricheyt te hebben, want den zoecker ghevonden hebbende de rije daer syn begheerde man in is, lichtelic kan hy hem inde zelve vinden.

Ten vijfdē kan deſe tienighe verdeling een bequaemheyt vallen int teycken des gheweers vande Krijchslie, als Pijcken, Muſquetten, en Wapenen, zulcx datmen onder veel duyſent ſtucken met een opzicht weet aen wien elc toekomt, als by voorbeeld een Pijcke gheteyckent met deſe vier getalen 8. 2. 7. 3 int hout ghebrant, of int yſer gheſtempelt, men zeght datſe toekomt den achtſten Soldaer, inde tweede rije, van't zevende vendel, des derden wimpels, en alzo met d'ander wapenen : De teyckening des gheweers van Tienleyders, Hondertleyders, en Duyſentleyders, is van drie, twee, en een ghetal, als by voorbeeld 7. 3. 5, dat is tgeveer des Tienleyders vande zevenſte rije, int derde vendel des vijfdē wimpels: Ten tweeden 5. 8, dat is tgeveer vanden Hondertleyder des vijfdē vendels, int achtſte wimpel : Ten derden 7. dat is tgeveer vanden Duyſentleyder des zevendē wimpels : Ten vierden 0. als beghin, dat is tgeveer vanden Voetvolc Overſt : En 'ghelijcx kan't toegaen mettet gheveer der Ruyterie. Hier me kunnen voorkomen tgheschild dat om tgheweers wille tuſſchen de Krijchslie valt: Ooc eenige van dien gheſtolen zijnde, den dief en derſſe niet verkoopen noch vertoonen, want men zoude terſtont den man wiſſen deſe toekomt, of zoo die inghebrande of gheſtempelde letteren uytghekreghen waren, dat gheeft vermoeden deur den vertoonder te moghen ghedaen weſen, en oorzaec van daer op onderzoec te doen. De Romeynſche Soldaten teyckenden wel hun wapenen elc met ſyn merc, maer dit heeft al een ander bequaemheyt.

Ten zeften kan deſe tienighe verdeling dienen om nieuwe aenkomende onbedreven Soldaten op zeer korten tijt den krijchshandel te leeren, als wel ſchieten, gebruyc der Pijcken en des hantgheweers, * de keeringhen, het ſchermuſen, de za-
ken vande Wacht, en al tghene Soldaten behooren te weten, en daer in zoo ervaren te maken al of ſy veel jaren gedient hadden, want elc Rijeleyer en zoude maer t'onderwijſen hebben de ghene die in ſyn rije nieu inkomen; ja al waert een ghemeente ic neem van 10000 Mannen in krijchshandel gantsch onervaren, die metter haest hun moeſten verweeren, ſy zouden op korter tijt tot kennis van dien kunnen gheraken, mits datter eenen wel ervarenen d'onderrichting dede aen 10 Colonellen, daer na elcken Colonel aen ſyn 10 Capiteynen, daer na elcken Capiteyn aen ſyn 10 Rijeleyders, daerna elcken Rijeleyder aen ſyn 10 Soldaten, waer me de leering aen die 10000 onervarenen op een zelve tijt ſpoedichlic zoude kunnen voortgaen

* Revolutiones

Fifthly, this decimal progression may be of convenience in the marking of the arms of the Soldiers, such as Pikes, Muskets and Armour¹⁾ so that one is able to ascertain at a glance, among many thousands of pieces, to whom each piece belongs; if, for instance a Pike should have been marked with these four numbers 8.2.7.3, being either burned into the wood or stamped into the iron, then it is said to belong to the eighth Soldier, in the second file, of the seventh company, of the third regiment, and equally so with the other arms.

The marking of the arms of File-Leaders, Captains and Colonels is consisting of three, two, and one number, such as for instance 7.3.5. These are the arms of the File-Leader of the seventh file, in the third company, of the fifth regiment. Secondly 5.8 indicate the Captain's arms of the fifth company in the eighth regiment. Thirdly, 7 these are the Colonel's arms of the seventh regiment. Fourthly, 0 (zero) to begin with, these are the Infantry-General's arms. And equally so it may be found with the arms of the Cavalry. This may prevent differences that may occur among the Soldiers on account of the arms. Also in case some of these are stolen, the thief dares neither sell nor show them, for one would at once point to the man to whom they belong, or, if the burnt or stamped characters should have been removed, this might lead to the suspicion that it has been done by the one producing it and then would be the cause of an investigation to be made. As a matter of fact the Roman Soldiers did mark their weapons, each one with their particular mark²⁾, but our method has much more convenience.

Sixthly, this decimal progression could very well serve to teach within a very short time newly arrived unskilled Soldiers the Art of War, such as shooting, the use of Pikes and Rapiers, turning, skirmishing, Guard-duties and all that Soldiers ought to know, and to give them so much experience, as if they had already joined the Army for years, for each File-Leader would have only to instruct the newcomers to his file; nay, even if a body of 10,000 men were to be quite inexperienced in the Conduct of War and should have to defend themselves in haste, they could manage to achieve full knowledge of it within a short time, provided that some one, well versed in the subject, were to instruct 10 Colonels, then each Colonel his 10 Captains, then each Captain his 10 File-Leaders, then each File-Leader his 10 Soldiers, by which simultaneously the instruction to the 10,000 unskilled ones could proceed quickly with very little difficulty, because each File-Leader has so few to instruct and further because of the fact that there are such Superintendents, as a Captain, a Colonel and a General, seeing to it that they are doing their duty as it is required from them.

Seventhly, this decimal progression could also be of great convenience in point of the waggons, which are being distributed as follows: 10 waggons under a

¹⁾ On the analogy of the French edition we have here translated "gheweer" by "arms" and "wapenen" (French: harnois) by "armour".

²⁾ By this marking of the armour is to be understood the tracing of the soldier's name in the back flap of his helmet either by scratching or by means of small dotted marks, generally also including the respective centuria. The latter has been found on many Roman helmets (communicated by the National Museum of Antiquities, Leyden).

met luttel moeyte, om datter elc Rijeleyder zoo weynich t'onderrichten heeft, en datter boven dien zulcke Toezienders zijn, als Capiteyn, Colonel, en Veltoverst, die acht nemen of hy hem daer in draecht na behooren.

Ten zevenden kan deur dese tienighe verdeeling een groote bequaemheyt vallen int stuc der waghens, die aldus verdeelende: 10 waghens onder een Tienleyder, 100 onder een Hondertleyder, 1000 onder een Duyfentleyder, en zullen gelijc voren van't gheweert der Krijchslie ghezeyt is, ghetcykent worden met vier ghetalen, gheschildert op zulcke blecke vaenkens ghelijcmen in zommige Leghers op de waghens stelt, als by voorbeeld, een vaenken met dese vier ghetalen 2. 7. 3. 2, beteyckent de tweede waghens onder den zevenden Tienleyder vande derde Hondertleyder des tweedden Duyfentleyders. Elcke eerste vaen van tien mach om zichtbaerlic uyt te steken grooter zijn als d'ander neghen: Desghelijcx mach elcke eerste van 100 grooter zijn dan elcke eerste van 10, en elcke eerste van 1000 grooter dan elcke eerste van 100. Yder Tienleyder is schuldich int reysen syn tien waghens oordentelic elc na hun ghetal malkander te doen volghen, en gheduerlic daer by blijven: Int stilligghen die oordentelic int waghens-quartier nevens malkander te doen staen: Syn tien Voerliën persoonlic wel te kennen, rekening en bescheyt te gheven vande afwesende, wanneer en waer sy hun verstoppen hebben, of waerom sy niet teghenwoordich en zijn: Al twelc om de kleyne menichte van tien henliën moghelic is te doen. Elc Hondertleyder zal bevelen over syn tien Tienleyders, en acht nemen dat elc syn ampt bedien na behooren, en oordeelen over de gheschillen die tusschen henliën vallen: Zal ooc int reysen altyt by syn 100 waghens blijven. En 'sghelijcx zal elc Duyfentleyder bevelen en acht nemen op syn tien Hondertleyders, en den Waghenoverst over de Duyfentleyders, en int ghemeen over allen. De bequaemheden en voordeelen hier uyt volghende zijn duidanich: Voor al nadien de plaets van elcke waghens bekend is, sy kan mette perfoonen en goederen daer op zijnde, zoo int reysen als stilligghen lichtelic ghevonden worden, zonder daer na te moeten vrighen, mits bekend wesende haer ghetalen, twelc is streckende tot groot gherief, niet alleen voor Amptliën int beleyt der krijchs zaken, maer ooc voor yghelic int bezonder.

Ten anderen kunnen de monsterringhen der waghens hier deur bevoordert worden, om datmen alle daghe zonder monstren ghenoechzaam zien kan ofter eenighe ghebreken, en zulcx ghebeurende, een Monsterheer of ymandt anders dieder last af heeft, kan vrighen aenden Tienleyder, in diens rije tgebrek valt, waer die waghens ghebleven is, daer af hy volghens syn aenneming gehouden is al bescheyt te zegghen dat hy weet.

Boven dien ist hier deur moghelic de waghens int stilligghen ghelijckelic te doen arbeiden, elc syn keer verwachtende, daer anderzins eenighe verschoont worden, hun verstoppen, of wel uyt het Legher trecken, en elders ghelt verdienen, en komt op d'ander Voerliën de swaricheyt aen, die hun Peerden doot arbeiden, en noch gheslegghen worden als Ezels, zulcx datter met veel waghens min uytgerecht wort dan anders met weynich, streckende tot groote kost des Landts, en dicwils oorzaec zijnde, datter om de groote menichte der waghens-peerden gheen fourrage voor de Ruyters en blijft, en dattet Legher met achterdeel moet opbreken.

Op aenslagghen daer het Voervolc op waghens de Ruyterie moet volghen en haestelic voorttrecken, daer en zouden men om de waghens te vergaren gheen verwitting van te voren moeten doen, om datse altyt ghereet zouden staen.

Aldus worden ooc voorkomen veel gheschillen dieder vallen met d'een waghens d'ander niet te willen wijcken, want begheerende elc eerst int quartier te wesen, sy

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File-Leader, 100 under a Captain, 1000 under a Colonel, and similar to that which has been previously said about the arms of the soldiers, they will be marked with four numbers, painted on such small tinplate ensigns (or vanes) such as in some Army Camps are fixed on the waggons, as for instance a pennon bearing these four numbers 2.7.3.2, meaning the second waggon under the seventh File-Leader of the third Captain of the second Colonel. In order to stand out more visibly every first ensign of 10 may be larger than the other nine. In the same way every first pennon of 100 may be larger than every first one of 10; and every first one of 1000 larger than every first one of 100. Each File-Leader, when travelling, is obliged to see to it that his ten waggons are orderly following each other according to their successive numbers, and he has to remain with them all the time. When camping they must be kept in the waggon-quarters standing orderly next to each other. He should know his ten Waggoners in person and account for those absent when and wherever they have stayed away, or why they have not been in attendance. All this can be easily carried out by them on account of the small body of ten. Each Captain shall command his ten File-Leaders and see to it, that every one is doing his duty, as it should be done, and judge the differences that may occur among them and, when marching, shall always stay with his 100 waggons.

And equally so each Colonel shall command and control his ten Captains and the Master-General of the waggons, the Colonels and in general all the personnel involved. The facilities and advantages resulting from this are of the following nature:

Particularly when the place of each waggon is known, it can be easily found with the men and the goods belonging to it, both when marching or camping, without having to make enquiries for it, provided their respective numbers are known, this being a great convenience not only for the Officers, when conducting their army affairs, but also to every one in particular.

Furthermore it could be of use to the musters of the waggons, as it enables one in a very adequate manner, to observe daily without mustering, whether there are any waggons missing, and if so, a Commissary of the Musters or somebody else in charge, may inquire with the File-Leader, in whose file the man lacking occurs, where this waggon has gone to, to which request, according to his commission, he is bound to give all the details known to him.

Moreover this makes it possible that the waggons, when lodged in a Camp, could be equally used, each awaiting its turn, as otherwise some of them are being spared or hidden, or removed from the Camp in order to earn money elsewhere, causing the other Waggoners to bear the difficulties, working their Horses to death and besides beating them like donkeys, to the effect that there is being less accomplished with many waggons than otherwise with a few, costing the Government large sums of money and often being the cause, that on account of the large number of waggon-horses, there is no forage left for the Cavalry, and that the Army Camp has to break up to its disadvantage.

In case of surprises, when the Infantry has to follow in their waggons the Cavalry and has to march in haste, one need not give any previous warning in order to collect the waggons, as they should be at all times ready for departure. Thus a great many difficulties are also being prevented owing to the fact, that one waggon would not let the other pass by, for as each one wants to arrive first in his quarters, they run as fast as they can, causing collisions, destroying the waggons

rennen om 'tzeerst, worpen malkander omme, brekende waghens mette goederen, en quetsende de menschen dieder op zitten. Daer de waghens met Ponten over de Rivieren moeten ghestelt worden, is ooc groot gheschil, willende elc d'eerste wesen, alle welcke swaricheden hier niet en ghebeuren, om dat elc Tienleyder gade slaet d'oorden van syn tien waghens, waer me ooc voorkomen kan zijn de schade van krijchstuych en ander goeden die vande waghens ghestolen worden, of verloren blijven, om datmen aldus weet aen te spreken den ghenen dieder alleenlic tien had gade te slaen. Men kan ooc om der ghetalen wille weten watter op elcke waghens gheladen is, stellende inde Lijste der lading nevens het goet alleenlic de ghetalen des waghens daer't op light.

Merô noch dat de waghens zonder oordentlicke verdeeling wesende, en datmen tot noodighe dinghen van doen heeft, zoo moet den Veltroversten de Amptliën van dien, alser ghebrek van waghens is, ontschuldighen datse daer afgheen bewijs noch rekening en doen, want hy ziet humliën zulcx om d'onoordens wille onmoghelic te wesen, waer me dan de deureghepent is, van elc vrymoedelic syn eyghen profijt te moghen bevoorderen tot des Landts schade.

Tot hier toe is gezeeyt van waghens in dienst wesende, maer men zoude zulcken oorden van tienighe verdeelinghe int reysen ooc konnen onderhouden mette buytendienstighe; doende de ghene die laetst aencomen altijt laetst voorttrecken, of zulcken reghel daer op stellende alfinen behoorlic verstonde.

Aengaende ymandt mocht zegghen de reghel des oordens dicwils te moeten ghebroken worden; eerstelic, om dat zomwijlen int reysen de waghens van eenige quartieren, als by voorbeelt der regimenten, elc haer regiment volghen, welcke waghens niet dan by ghevalle van effen heele rijen wesende, zoo zouden eenighe Tienleyders over meer of min dan tien waghens moeten bevelen, en by eenige niet teghenwoordich zijn: Ten anderen, om datter te velde int stilligghen ettelicke vvaghens int vvaghen-quartier niet ghelogiërt en vvorden, maer daghelicx vverc hebben by zeker persoonen diese besonderlic dienen, als die inde keuckens van groote Heeren daghelicx halen vvater, branthout, en alle behoeften, welcke vvaghens ooc niet dan by ghevalle van effen heele rijen zijnde, zoo zoude daer ooc splitting vallen der tien vvaghens daer een Tienleyder over beveelt, met meer ander diërgheelijcke ghevallen die de reghel des oordens zouden breken: Hier teghen zegh ic, datmen op elc van dien besonderlic zoude moghen antwoorden, maer ghemerô het niet en schijnt dat zulcx haest int vverc ghestelt zal vvorden, zoo en vvil ic met onnoodich schrijven den tijt niet verliefen, maer allenlic zegghen datter op ghedocht is, en daerentusschen machmen dit vermaen * spiegelincsche * *Theoric.* vvijsē nemen, dat moghelic is eens met verbetering inde * dact te gheraken. *Practi.*

Ten achtsten kan deur dese tienighe verdeeling int stuc van Schepen zulcke bequaemheyt vallen, als vande vvaghens ghezeyt is, vvant die alzo verdeelende, ooc daer over zulcke Amptliën stellende, en de Schepen van yder Tienleyder elc des daechs een vlaghe voerende met haer ghetalen, als ghezeyt is vande vvaghens, en des nachts lanteerens, diens licht de form van groote letters vertoonde, ghelijc ic zulcke ghezien heb, en voort zoo vvcl int varen als int stilligghen, daer me ghevolt een reghel als mette voorschreven vvaghens, zoo kanmen daer uyt genoegh verstaen de voordeelen diemen daer me krijghen zoude.

Ten neghenden kan deur tienighe verdeeling der Pioniers en Maetroosē of Gheschuttreckers ooc zoo goeden oorden ghehouden vvorden, datmen met min volcx meer vvercx zoude zoen, als anders met veel, hebbende boven dien elc beter vernoeging dan met onoorden, daermen breeder af zoude moghen schrijven, maer

and their goods, and hurting the people sitting in them. As the waggons have to be carried over the Rivers by means of Pontoons, this is also a cause for great differences, each one wanting to be first; however, difficulties of this kind do not occur here, because every File-Leader watches the order of his ten waggons, which could also have prevented the damage to the war-munitions and other goods that are being stolen from the waggons or remain lost, because here one knows, that one has merely to speak to the man, who had only to watch ten. Furthermore it is also possible to ascertain what has been loaded on each waggon by means of the numbers, by merely indicating, in the respective Loading-list next to the goods, the numbers of the waggons in which the goods are packed.

It should further be observed, that in case the waggons have no regular repartition and they should be wanted for urgent affairs, the General of the Camp must excuse his Officers, if there should be a lack of waggons that they could neither explain nor account for, since he is aware that it is impossible for them to do so because of the disorder, that might give ample opportunities for every one to promote freely his own advantage to the detriment of the Country.

Up to now we have talked about the waggons used in military service, but one could equally maintain a similar order of decimal repartition, when marching, with the ones out of service, either by making those which arrive last, always march in the rear, or by drawing up such rule for this, that one should be able to understand it properly.

If any one should say, that the rule of this order must often be broken, firstly, because at times, when marching, the waggons belonging to some quarters, for instance such as those of the regiments, each following their regiment and only accidentally forming complete files, some File-Leaders would have to be in command over a number of more or less than ten waggons and not be in attendance with some of them. Secondly, because when camping in the field, there are several waggons, that are not lodged in the waggon-quarters, but are daily working for certain persons to whom they render special services, such as to daily go and fetch water, fire-wood and all the other necessities in the kitchens of grand Seigneurs, which waggons forming also merely accidentally complete files, thus there would also occur a splitting up of the ten waggons of which there is a File-Leader in command, together with other and similar cases that would break the rule of the order. Against this I say, that I should like to reply to every one of those in particular, yet, seeing that this is not likely to be carried out in such haste, so I will not loose time by giving a superfluous description, but merely say that it has been well considered, and meanwhile one should take this warning theoretically, which may at one time be improved in practice.

Eighthly, this decimal distribution could equally be of convenience in the case of Vessels, as has been said about the waggons, for dividing them accordingly and also appointing similar Officers to them, and the Vessels belonging to every Ten-leader, each carrying a flag by day bearing its respective numbers, as has been said about the waggons, and carrying lanterns at night, the light of which showing the outlines of large characters, as I have seen them myself and further, when sailing as well as when lying in the harbour ¹⁾, following the rule, as adopted with the afore-mentioned waggons, so that the advantages, that were to be gained by it, could be adequately understood.

¹⁾ Here the French edition has been followed: "Navires, estant aux Havres".

vant zulcx ghenoech kan verstaen vworden deur ighene op dierghelijcke van't Krijchsvolc ghezeyt is, zoo zal ic't daer by laten blijven.

Tot hier toe verklaert zijnde myn voornemen vanden oorboor der gheduerighe tienighe voortganc met 10 beghinnende, zoo mocht ymant daer op zegghen dat de bovenschreven Griecsche verdeling van gheduerighe tweighe voortganc, met 1 rijen van 16 beginnende, haer bezonder voordeel heeft by verscheiden Schrijvers zeer ghepresen, 'twelc is datmen daer me deur gheduerighe halving der hoopen totte eenheyt komt, zulcx datmen se in twee even ghedeelten kan deelen, als 16 3 8 4 vande Tetraphalangarchia gheduerlic ghehalft totte rijen toe, sy wort van 16 bevonden, en de zelve gheduerlic in twee splijtende, men vint de helften van 8. 4. 2. 1 eyndende in eenheyt. Hier op machmen zegghen dese halving niet zoo volcomelic toe te gaen, noch totte eenheyt te komen als ghemeent wort, maer op te houden aen den Beveelder over 2 rijen van 32 Krijchsliden, om dese reden: Het eynde der deeling is, om over elc deel een ghestelt Beveelder te hebben, als by voorbeeld over 16 rijen beveelt een Sintagmatarcha, over de 8 een Taxiarcha, over de 4 een Tetrarcha, over de 2 een Dilochita, maer over d'een rijen van 16 mannen en is geen ghestelt Beveelder als voren: Tis wel waer, dat den eersten te weten den Rijeleyder daer voor ghenomen wort, maer hy beveelt alleenlic over 15, alzo hy zelf een der 16 is: De rijen in twee gedeelt, elcken hoop is van 8 mannen zonder Beveelders, of by aldienmen tot d'een helft neemt den eerste, tot d'ander den negenste Diomerita geheten, sy en bevelen elc maer over 7, en zoo voort mette Intergatores die over 3, niet over 4 bevelen, ooc mette Antistites die over 1, niet over 2 bevelen: Zulcx dat zoodanighe Amptlieden over gheen hoopen van tweighe voortganc en bevelen, als d'ander wel doen over de hoopen van 2 rijen opwaerts, ghelijc voorgenomen was te verklaren.

Datmen ooc zoude meynen mette halving die vande 16 3 8 4 totte 32 haer ghestelde Beveelders heeft, meer voorzien te wesen, om over alle deelen van hoopen een ghestelt Beveelder te hebben, dan deur de tienighe voortganc, dat en valt zoo niet: Als by voorbeeld den noot vereysehende, ghelijc metter daet dicwils ghebeurt, een Phalangarchia van 16 Griecsche vendels te moeten verdeelen in 9 en 7, of in 10 en 6, of in 11 en 5, of in 12 en 4, of in 13 en 3, of in 14 en 2, of in 15 en 1, daer en zijn over al gheen eyghentlicke Beveelders toe.

Benevens de voorschreven ongheschiedheden vallender noch by oneygen tienighe namen van hoopen en Amptlieden, daer gheen tienicheyt in en is, als den hoop van 16 noemen sy decuria, al oftse van 10 waer, en den Beveelder Decurio; Den hoop van 256 noemen sy centuria, al oftse van 100 waer, en den Beveelder Centurio; Den hoop van 1024 noemen sy Chiliarchia, al oftse van 1000 waer, en den Beveelder Chiliarcha: Welc misbruyc der namen eer vermoeden gheeft van groote oudheyt en weerdicheyt der tienighe voortganc, dan van wel naghevolcht te wesen.

Aengaende de Romeynsche verdeling hier voren verhaelt, die (benevens 'tmisbruyc van tienighe namen zonder tienicheyt) zeer onghelijc toegaet, zonder eenighe gheregheelde voortganc daer in gade gheslaghen te wesen, en beswaerlic om by ghedaecht te onthouden; tis wel zoo datse beter is, dan gheen zeker reghel te volgen, ghelijc nu inde weerelt toegaet, maer by de Hebreusche en is sy niet te vergelijcken: Aengaende hier op ghezeyt mocht worden, dat der Romeynen krijchsdaden ghenoech de goetheyt betuychden: Daer op machmen antwoorden, datse deur beter verdeling noch meer zouden hebben konnen uytrecten met beter oorden en minder moeyte, en dat bevestighen metter voorbeeld van Tamerlan, die
in krijchs-

Ninthly, by a decimal repartition of the Pioneers and Sailors or the men, who draw the Ordnance, an equally good order is to be maintained to the extent, that one should be able to execute more work with less soldiers, than would otherwise have been accomplished by a great many, besides giving to every man greater satisfaction than with disorder, about which one should write more elaborately, however, by all that has been said about the Soldiers in this manner, these things can be adequately understood, so I shall let things remain as they are.

Up to now I have explained my intention of the utility of the continuous decimal progression beginning with 10, and if any one should say to this, that the above-mentioned Greek repartition of the continuous binary progression beginning with one file of 16 men, were to have its particular advantage, it being highly praised by various authors, due to the fact, that owing to a continuous dividing of the bodies of soldiers into halves one arrives at the unit, so that one is able to divide them into two equal parts, such as 1 6 3 8 4 of the Tetrachalarchia, which, when being continuously divided into halves until the file, is found to be 16 and when again continuously splitting this up into halves one arrives at the halves 8. 4. 2. 1 terminating in the unit. To this one might say that this separation into halves is neither accomplished so completely nor does it arrive at the unit as it is meant to be, but is stopped at the Commander of 2 files of 32 Soldiers for this reason: The final object of this partition is to have a Commander appointed to each separate body, such as for instance a Syntagmatarch being in command of 16 files, a Taxiarch of 8 files, a Tetrarch of 4 files, a Dilocheit of 2 files, yet, there is no Commander appointed to the one file of 16 men, as before. It is true, that here one takes the first one for it, to wit, the File-Leader, but he is only in command of 15 men, he himself being one of the 16. The file when separated in two, gives two bodies of 8 men, without Commanders, or if one should include into the one half the first, into the other the ninth, called Diomerita, they have only 7 men each in their command, and so on with the Intergatores, who are taking command of 3, not of 4 and it is equally so in the case of the Antistites, who are taking command of 1, not of 2. Thus it is that such Officers do not command bodies of binary progression like the others do of bodies consisting of 2 files ascending, as I had intended to explain.

That by this separation into halves and by Commanders, appointed for all groups, from the group of 16384 until the groups of 32, one would better than by decimal distribution provide all fractional bodies by a Commander, this does not come true. If for instance necessity should demand, as indeed often happens, that a Phalangarchia of 16 Greek companies has to be divided into 9 and 7, or into 10 and 6, or into 11 and 5, or into 12 and 4, or into 13 and 3, or into 14 and 2, or into 15 and 1, then there are not everywhere the proper Commanders available.

Apart from the afore-mentioned absurdities there are still odd decimal names of bodies and Officers, in which there does not occur any decimality, such as the body of 16 they named Decuria, as if it were composed of 10, and its Commander Decurio; the body of 256 men they named Centuria, as if it were composed of 100 men and its Commander Centurio¹⁾, the body of 1024 men they named

¹⁾ The Greek name Centurio, used for the "Commander of a body of 256 men" does not tally with folio 46 (Syntagmatarch; cf. also Hahlweg p. 248).

in krijshandel meer uytgherecht heeft dan Romeynen, Griecken, of ymandt ter weerelt, daer ghedachtenis af ghebleven is; welcken Tamerlan in syn Keyserlic Legher de tienighe voortganc onderhielt; ghelijc voren ghezeyt is, int 1 Lidt des 1 Hoofstuckx, waer me ic besluuten zal, tghene myn voornemen was te verklaren, vande bequaemheyt des gheduerighen tienighen voortganx in verdeeling des Krijchsvolcx die totte oordentelicke Leghermeting noodich is.

E T N D E.



Chiliarchia, as if it were composed of 1000 men and its Commander Chiliarch. This abuse of names does give more a suggestion of the great age and value of the decimal progression, rather than that it has been accurately followed.

With regard to the Roman distribution, as has been explained before, which (apart from the abuse of the decimal names without decimality) is found to be very irregular, without any regular progression to be observed therein, and difficult to retain by memory; it is true that it proves to be better than when no definite rule is followed, as it goes in the world to-day ¹⁾, yet, it cannot be compared with that of the Hebrews. As one may say, that the Roman feats of war have adequately attested its rightness; to this one may reply, that by a better distribution they could have achieved still more with better order and less trouble, and this can be affirmed by the example set by Tamerlan, who has accomplished more in the conduct of war than the Romans, Greeks, or anybody else in the world, whose memory has been retained ²⁾. This Tamerlan maintained the decimal progression in his Imperial Army Camp, as has been said before in the 1st Section of Chapter 1, by which I shall conclude and which has been my intention to explain with regard to the utility of the continuous decimal progression in the distribution of the Soldiers, so essential to a regular Castrametatio.

THE END

¹⁾ What does Stevin mean by his saying that the Roman distribution "proves to be better than when no definite rule is followed, as it goes in the world to-day", unless this should merely refer to not using the decimal system?

²⁾ That Tamerlan in his military exploits should have achieved more than the Romans, Greeks or any other nation, is doubtful. Here we could refer, inter alia, to Toynbee, *War and Civilization*, Chapter 5 (Charlemagne and Timur Lenk) and to H. Desmond Martin's opinion on Tamerlan in comparison with Chengis Khan, turning out to the former's disadvantage: "A close rival as a soldier, he was far less successful as a constructive statesman" (*The rise of Chingis Khan and his Conquest of North China*. Baltimore, 1950, p. 323).

In note 22 of the Introduction we have already pointed out, that Stevin, with regard to Tamerlan, must have drawn from a non-objective source.

VANT BELEGHEREN DER
STEDEN EN STERCKTEN

OF BESIEGING TOWNS AND
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INTRODUCTION

This part of Stevin's military works must, like the former, be regarded as the fruit of the experience gained by him during Prince Maurice's sieges, together with his talent for improvement and systematizing. The link of modern warfare to that of the Ancients, which is so characteristic of the *Castrametatio*, is missing here, with the exception of the investment of the fortress. On the other hand, this study, left in manuscript copy ¹⁾, contains, more than the book, directions for carrying out works of attack, be it in a form which as regards the details is not always encountered in Prince Maurice's military operations ²⁾.

Nevertheless, also this treatise of Stevin's, with its many drawings and extensive (sometimes fairly voluble) elucidations, again bears the stamp of versatility and sense of criticism so characteristic of him. It is no doubt important to acquire knowledge of the siege of a fortress in Prince Maurice's time and in particular as regards the investment of the fortress and the attacks by trenches on it ³⁾.

Before discussing the contents of the manuscript it would not be superfluous to stress the great importance of the sieges in the Eighty Years' War. For, it was fully characterized by the attack and defence of the often politically and economically important towns and fortresses in the Republic, which, moreover, were invariably situated at military important points. The development of fortification in that period of history ⁴⁾ also called for a revision of the manner of approaching, shelling and assailing the objects to be conquered. It is therefore obvious that the Stadtholders Maurice, William Louis and Frederic Henry, well-acquainted as they were with this development, should be the very persons to have designed a new method of attack, which in the history of warfare has been called after them "the method of attack of the Princes of Orange". And, just as in the field of the *Castrametatio*, Stevin can again be regarded as the man who contributed his share to the necessary systematizing of the new demands of

¹⁾ In his *Materiae politicae* VIII. Section, *Of the Theory of War*, fol. 252-8, Hendrick Stevin had under the same title only an extract, without illustrations, printed; the manuscript, indeed, is due to his care; see also *General Intr.* pp. 9, 10.

²⁾ Compare the drawings of Stevin's redoubts, batteries and forts with those used in practice, for example those of the siege of Juliers by Hondius (reprod. by Wijn, p. 286), which show more conformity with Fig. 117, 143, etc. of Marolois.

³⁾ The time during which the original manuscript was written must be between 1608 and shortly after 1615. In 1608 it had not yet been completed (see *Gen. Intr.* p. 9 and note 24); on p. 450 it would seem that reference is made to the book *The Art of Fortification* of Marolois, fol. 70 (siege of Ostend), which was published in 1615.

⁴⁾ Introduction to Part I, p. 2, on Stevin and this development, according to Brialmont and Wauwermans.

attack. The method was afterwards further improved by Vauban, who, however, has taken much from his famous predecessors⁵⁾.

The present study of Stevin's originally belonged to his posthumous papers, which were perused by Isaac Beeckman⁶⁾ in 1624; among his many notes were also some on this part: a combination of important items and passages copied by him, with a single sketch, not more. Yet, Beeckman's extract is in a way more comprehensive than the one printed by Hendrik Stevin in the *Materiae politicae* of 1649⁷⁾. For, the technical aspect of an important part of the siege: the "approach" — with the exception of the contents of the propositions to be described below — has been completely omitted from the latter, whilst Beeckman, at least briefly, does include this aspect. The reason why Hendrik Stevin in his book was so incomplete, has been mentioned elsewhere⁸⁾; the more is it to be welcomed that as early as 1635 he had had his father's manuscript "of besieging" copied as completely as possible, and that this copy, with its many drawings, has been retained. That the original manuscript must then already have shown some gaps appears from remarks in the copy, which apparently originate from Hendrik. The principal of these are those on page 417: "The exact dimensions of these redoubts I have not found . . ."; page 418: "Here must follow investments of his Excellency; then investments of the Ancients" and the one on page 453: "This is what I have from my deceased father's writings on the approach through the moat; concerning the approach through the wall I have only found the following notes".

For the rest, it appears from many places in the manuscript that Stevin must from nearby have seen the works of attack described by him and perhaps has even checked their execution⁹⁾. Besides, the more or less casually mentioned sieges of Juliers (pp. 447 and 453), of Ostend (p. 451) and of the fort St. Andrew (pp. 423 and 467) suggest that he must have been acquainted with their details.

We will now proceed to a discussion of the manuscript, which comprises three "parts": the "Reconnoitring", the "Investment" and the "Approach" (the attack by trenches proper).

These three parts are, without any further explanation, mentioned in the preceding Argument, which by way of a note also contains a report of what a general should do in two cases of war, namely when his army is much stronger than the adversary's, or when the armies are about evenly matched.

In the former case he can conquer successively all the enemy towns, beginning with the weakest, which should be taken by force only when they offer resistance:

⁵⁾ Wauwermans' *Etude sur la bibliographie de l'Architecture militaire flamande au XVI^e siècle* (Bulletin van de Maatschappij der Antwerpsche bibliophilen, III, 1885), pp. 84-5, the part which begins as follows: "L'honneur revient incontestablement à Vauban d'avoir systématisé la méthode d'attaque moderne, mais pas plus qu'en fortification, il ne fut en cette matière inventeur".

⁶⁾ *Gen. Intr.* p. 8.

⁷⁾ Besides fol. 252-8, mentioned in note 1, see also fol. 143 at the end of the book (Titles and Arguments), where the contents of Stevin's eight propositions for approaching are given; they show that the town plan c.a. in proposition V must be from Stevin himself.

⁸⁾ *Gen. Intr.* p. 11.

⁹⁾ We derive this from what Stevin writes in proposition VI on "Superintendents of the fortification" and "Conductors", in connection with his function of Quartermaster-General.

"who do plant the guns"; those which surrender are looted and thus the stronger belligerent deters the weaker and obtains his objective with least trouble ¹⁰). In the latter case, the experience gained in all protracted wars shows that things do not run so smoothly; for then the attack on weak places invites a counter-attack, which may cause heavy losses without forcing a decision. Stevin probably wanted to say that in that case only important fortresses should be besieged and only then when they can be conquered without too heavy losses.

What is to be understood by the now following 1st part, Reconnoitring, is not quite clear from the wording of the manuscript. Judging from the order in which this military operation occurs, one would now call it observation or reconnoitring with light cavalry and clearing the field round the fortress from minor enemy detachments, as well as the "struggle for the fore-ground"; but, be it as it is, Stevin considers it advisable in these skirmishes to allow for the conditions of the troublesome obstacles in this fore-ground before deciding upon clearing them ¹¹).

The 2nd part, which deals with the Investment, attracted most attention from later authors ¹²), because it was almost entirely copied in the *Materiae politicae*, though without drawings. Fig. 1 gives a clear, but schematic picture of the lay-out of the circular lines of circumvallation and contravallation, with all the works pertaining to it. In the centre Stevin draws a regular bastioned hexagon (his type of fortress from the Art of Fortification of 1594!) and around it, with a radius of approximately 10,000 feet ¹³) or 3000 m, the two lines, 300 feet apart, comparable with the circumvallation and contravallation lines of the Romans ¹⁴). Besides, an important point is that Stevin starts from a "Heyr", the besieging army of 20,000 men, which he suggests to be divided over 3 "legers" or armies of equal strength; owing to their almost square shape we must regard them as the camps or quarters ¹⁵).

Between each two of them (for instance B and C), he places, to strengthen and flank the two parallel lines, 2 large bastioned square forts (E, F) and in the 9 interspaces thus formed each time 9 smaller forts: redoubts (L, M, N, etc.), called by him "Clapmutsen" or "bonnets", which are thus spaced at about 500 feet. The line of investment is completed by making from each camp in a direction away from the fortress a few parallel trenches, 2000 to 3000 feet long and spaced at 300 feet, with a large bastioned fort of rectangular shape at their ends (T, V, X). These "outworks", which actually existed, but mostly in the shape of hornworks with long wings, were intended to keep the enemy's artillery at a sufficient distance from the camp. Stevin leaves the possibility open for construct-

¹⁰) This strategy of conquest shows Stevin as a not very gentle person, in any case less humane than Prince Maurice in his campaigns, as may appear from many places in Duyck's diary (see also Wijn, p. 544).

¹¹) Beeckman (fol. 223, verso) quotes: "During reconnoitring one shall consider the circumstances and where necessary clear houses, fortresses, etc." See also Dijksterhuis, p. 246.

¹²) Brialmont, p. 150; Dijksterhuis, p. 246.

¹³) The scale of the drawing is not correct; the camps have not been drawn to scale either.

¹⁴) Plate 28 of the atlas belonging to the version of Caesar's *De Bello Gallico* or *Vie de César* by Napoleon III (1862): "Détails des travaux romains à Alésia", gives the profiles of the trenches, pl. 25 the lines themselves: Circonvallation et Contrevallation, at a short distance from each other. See also Wijn, p. 281 (Parma's siege of Maastricht, 1579).

¹⁵) For the strengths of the armies in Maurice's time, see Wijn, p. 417, and *Staatse Leger* I, p. 82, etc.; for the strengths of army camps see Wijn and the examples given in Part 2, p. 257.

ing more of such outworks, for instance from the square forts between the camps¹⁶). The general argumentation on investment is concluded by the logical remark that in certain cases part of it will suffice, for instance if the town to be besieged is situated on the sea side. Geertruidenberg, whose famous siege in 1593, also called "the Roman siege"¹⁷), will not have been unknown to Stevin, was at that time in a similar position. When we also allow for this probability, the lines at the head of fol. 28, quoted by us on p. 402, may puzzle the reader. If the author himself had intended to give illustrations of sieges by Prince Maurice and from Antiquity (in which connection we have specially Caesar's in mind), it is very much to be regretted that he has not done so. However, if the remark was actually made by Hendrik Stevin, it is very well possible that these illustrations had been made already, but have got lost under the circumstances known to us¹⁸). Instead of having these obviously very important data at our disposal we must now be satisfied with a — for the rest — good explanation of the "shape of the bonnets" on the folio mentioned before and the 2 drawings on folio 29. These drawings are details, on a scale of 1 : ca. 150; the redoubts are lozenge-shaped, from which the name of bonnet (i.e. a priest's cap) has been derived. The lozenge shape was to benefit the flanking of the line or trench in which these works were situated. As a special feature Stevin states that the parapet of the line behind the bonnets must not continue, but should be replaced by a gently sloping glacis: a broad shelving, thus not to afford protection to an assailant who has broken through the line. On this rear side is also the bridge giving admittance to the fort¹⁹). The other detail drawing (Fig. 3) represents a bonnet as constructed at an angle where two parapets meet. It does not appear what parapets are meant here; for, in those of the lines of circumvallation no angles occur.

The next part, which, by reference to Fig. 4 to 18, describes the Approach or attack by trenches, covers the rest of the manuscript (pp. 423-468). It is the most extensive, with a very systematic composition and is highly important, because here Stevin, better than Marolois and more clearly even than Freitag, is the first to lay down rules according to which the approach in all its phases, from afar off to close to the fortress, the "sapping work" or the "sapping", as it was afterwards

¹⁶) Stevin's system shows great differences from the practice of Maurice's sieges, both as regards the distribution of the army camps and the quantities of the various works of attack (see also note 2),

¹⁷) On the water-front the fortress was enclosed by a crescent-shaped line of vessels, anchored and connected by cables; for this siege see also Bosscha (*Heldendaden*, rev. ed. I, p. 227), from which it appears that Geertruidenberg was called a second Alesia. (See note 14).

¹⁸) See the enumeration of Stevin's posthumous manuscripts by Beekman (Gen. Intr. p. 8), for example "Various campaigns, observed on the spot . . . by him"; in addition, the remark in the Dedication of the *Materiae politicae*, that these manuscripts by Stevin's "untimely death have remained unshaped and afterwards, through another omission, have been screened from among many of the best".

¹⁹) The correctness of this construction is evident from a comparison with Fig. 117 in Marolois' *The Art of Fortification*, where there is no glacis at the back; Marolois wants to prevent a breach of the line by the construction of separate redans before the redoubts.

called more generally ²⁰⁾, was to be carried out to achieve the objective with the smallest possible losses. The Argument first sums up seven technical terms, which are then defined in as many "Definitions", some (trench, redoubt and battery) being illustrated. After these definitions come 8 "Propositions", the first 4 of which successively deal with: I. the construction of trenches, redoubts and batteries up to the counterscarp of the fortress; of these Stevin gives two examples, as well on the approach to a fortress without and on one with outworks. In the second example moreover sapping is included instead of "setting out a line" alone ²¹⁾; II. the particulars of sapping (see Fig. 12 on p. 445), being an explanation excelling by clarity and accuracy; III. the passage of the ditch ²²⁾; IV. some remarks on mining as one of the means by which a breach can be made in the wall and the final assault of the fortress started.

The four other propositions contain examples, doubtlessly derived from war practice, for the approach to a fortress under special circumstances, as well as indications of the means which can in general be utilised to promote this approach.

Proposition V in particular is again of great importance, because here Stevin shows the tactical insight by which he must have advised Prince Maurice on attacking towns of irregular shape; to this bear witness the various kinds of approaches shown in Fig. 14: those with oblique trenches or trenches zig-zag in trace according to proposition I (Fig. 9, 10 and 11) and directed to a sharp angle, with only two bastions, of the fortress and those running straight to a broad front of the fortress and which may be of different construction, namely with a traversed or a broken trace. The fortress in Fig. 14 is reminiscent of Bergen op Zoom and Bois-le-Duc, both of which were besieged only after Stevin's death, but for whose conquest, naturally, plans may have been made before already ²³⁾.

Proposition VI is the only one which, because there are no drawings belonging to it, has been printed in *Materiae Politicae* ²⁴⁾. It contains among other things,

²⁰⁾ There was a difference in the meaning of "sapping" in former and later times; in Prince Maurice's time one mostly spoke of "approaches" for the trenches, by means of which the fortress was approached from the quarters as closely as possible, after which sapping started: straight or almost straight to the fortress, by "covered digging" as Stevin calls it (p. 423, in margin: "sapping"). Another old-time meaning of sapping was the digging away of the enemy's wall or bastion (see Wijn's sketch on p. 301 and his quotation in this connection of the "Observations" by John of Nassau). Afterwards one called the former trenches: flying sapping and the other: full sapping; the former, like the old approaches, were as a rule made during the night only, the others also by day. A special manner of "flying sapping" was the one in which first a row of gabions was set up to cover the diggers; this procedure must have been applied already during the siege of Ostend (1601-1604) (Bosscha, loc. cit. part I, pp. 290-314) and was there indicated as "de vluchtige sappe" (the flying sap or "sape volante").

²¹⁾ We have never found the term "Uytsetten" for "blootgraven" (flying sapping) (p. 422 in margin) with old writers; however, it may relate to placing beacons beforehand in the direction of the trenches to be made (p. 435).

²²⁾ For further information consult the extensive and illustrated descriptions of the passage of the ditch by Marolois, John of Nassau and Freitag (see also Wijn pp. 297, 298).

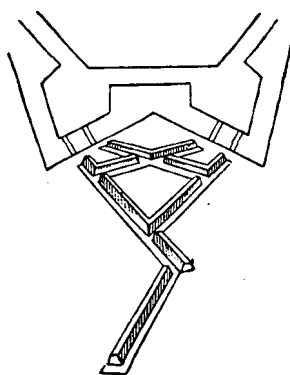
²³⁾ The similarity between Stevin's proposition V and the attack by trenches on Bois-le-Duc by Prince Frederic Henry in 1629 appears among other examples from a comparison of Fig. 14 with the illustrations in Daniel Heinsius' *Historia* of 1631.

²⁴⁾ *Materiae politicae*, fol. 257 (of the Theory of War).

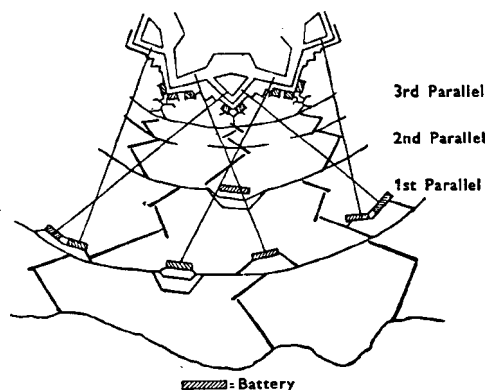
the not unnecessary hint by the author that the approach first of all calls for "brave and capable conductors" ²⁵). Proposition VII comprises, with 3 drawings (Fig. 15, 16 and 17), a special manner of approaching and crowning of the counterscarp; it is this proposition which, with Fig. 17, has been included somewhat more extensively by Beeckman in his — for the rest — brief extract.

In the last proposition (VIII) the illustration (Fig. 18) and a brief description have been retained for us as a manner of approaching, in this case a passage of the ditch, called by Stevin "Water trenches", and consisting of rows of pontoons or barges, which were to be laid both across the ditch and along the counterscarp of the fort St. Andrew to support the attack on it by Prince Maurice in May 1600. That this measure was prepared (but not carried into effect, because the fort was surrendered on May 8th) also appears from the following passage in Anthonis Duyck's *Diary*, part II, p. 599 (on May 7th 1600): "they thus availed themselves of all means to bring the ordnance at once before the enemy's nose and to try to come, with bridges, galleries or rafts into his counterscarp and ravelin". Marolois (Fig. 113) represents the fort with the counterscarp.

To conclude this introduction we refer to the beginning, where we mentioned Vauban, to stress the fact that this part of the art of war, be it in an improved form, has persisted very long, even in the first World War ²⁶).



Marolois' method of approach
(1614)



Methodical attack according to Vauban, with
parallels, zigzags, batteries, etc. (c. 1670-1700)

From Winkler Prins' Encyclopedia, 6th ed.

²⁵) Dijksterhuis, p. 246.

²⁶) Lazard, *Vauban* (Paris, 1934) p. 396; as late as in 1910 France had her handbook: *L'école de Sape*, and the Dutch *Handboek van den Sappeur* (*Manual of the Sapper*) for the Corps of Dutch Royal Engineers of 1895 was rewritten in 1913 in accordance with modern principles; however, much of the old sapping technique was retained. Even after World War I the booklet "*Mining and Sapping*" (for pioneers) was published in the Netherlands (Breda, 1933) as part of the series: *Voorschriften voor het Inrichten van Stellingen* (*Regulations for the Arrangement of Defensive Positions*).

The statement by French authors²⁷⁾, which cannot be denied a certain chauvinism, that Vauban introduced the methodical attack with parallels and zig-zags (see the sketch from *Winkler Prins' Encyclopedia*, 6th ed.) described in his *Attaque des Places*, to improve "des procédés qui, avant lui, étaient employés un peu au hasard"²⁸⁾, is in our opinion more applicable to Stevin's predecessors than to himself²⁹⁾.

When excluding Errard³⁰⁾ and Marolois³¹⁾ who, as contemporaries propagandized more or less the same system as Stevin, though less completely, we can reckon among these predecessors: Blaise de Montluc, who witnessed and described³²⁾ the siege of Thionville in 1558, Francesco de Marchi, who in 1565 finished his *Dell'architettura militare*³³⁾, Serbelloni, who in 1579 constructed the circumvallation line round Maastricht for Parma³⁴⁾, and particularly Speckle, whose *Architectura von Vestungen* of 1589 contains five illustrations of primitive works of attack. Pictures of such "Anciennes attaques" are also found in illustr. 45 in *Le parfait Ingénieur François* of the abbé Deidier of 1757. The last-mentioned illustrations have been taken over in the prize-winning *Verhandeling betreffende de vorderingen in den aanval en de verdediging der vestingen sedert het jaar 1629 tot op dezen tijd* by Lieutenant-Colonel engineer W. Valter (The Hague, 1823). As the title indicates, it mainly describes the later development of Prince Maurice's method of attack, starting from the siege of Bois-le-Duc by Frederic Henry in 1629. First of all, however, the author briefly sketches the changes in the attack and defence of the fortresses since the invention of gunpowder to the beginning of the 17th century. Then he explains (pp. 17 ff.) that since 1658 "it had been reserved for Vauban to bring about that memorable revolution in fortifying and besieging fortresses which was to characterize the end of the 17th century". Subsequently it is stated how in the 18th century underground war developed and in the early part of the 19th century the circumvallation and contravallation lines fell into disuse. In other respects, the "basic rules laid down by Vauban" remained the same and also after Valter's death this situation

²⁷⁾ In his book: *De la défense des places fortes* (Paris, 1812) Carnot, however, writes (p. 221) in connection with the siege of Candia by the Turks in 1667: "Ils firent pour la première fois des lignes parallèles dans leur tranchées, usage que nous avons pris d'eux, mais qu'ils tenaient d'un ingénieur italien". Also Lazard states (p. 396) that Vauban adopted the parallels.

²⁸⁾ Lazard, *Vauban*, pp. 394, 395.

²⁹⁾ Lazard, p. 396: "la méthode d'attaque pied à pied, due à Vauban".

³⁰⁾ Errard de Bar-le-Duc shows in *La fortification réduite en Art et démontrée* (1594, 1604), Fig. 4 (lib. 1, Cap. X) among other things a regular approach with trenches zig-zag in trace, supported by batteries, at each angular point of which 3 gabions have been placed.

³¹⁾ Marolois' method of approach (*The Art of Fortification*, 1st edition, without text, of 1614, Fig. 144) has been reproduced here from the illustration in *Winkler Prins' Encyclopedia*, 6th edition, under the word "Beleg". For the designations of his works of attack see note 20; unlike Stevin, he does not give an illustration of the sapping foot by foot (or full sap); however, he does describe the execution, by not more than 2 men, mostly "Foremen", who throw the earth on both sides of the trench.

³²⁾ On de Montluc see: Lazard, *Vauban*, p. 9.

³³⁾ Jähns, *Gesch. d. Kriegswissensch.*, pp. 805 and 814; also, Wauwermans on the plagiarism by Hans van Schille in the *Bulletijn van de Maatschappij der Antwerpsche bibliophilen*, I, 1882.

³⁴⁾ See illustration 6 after the drawing of the architect Pierre le Poivre in *Publications de la Société historique et archéologique dans le Limbourg*, parts LXXXVIII-LXXXIX (1952-1953) p. 93 and Wijn, p. 281.

continued for a long time³⁵). Although Valter and his brother-in-arms and contemporary Captain-engineer I. P. Delprat, who published a voluminous book on the same subject (Delft, 1825), devote most of their studies to Vauban and his followers and only Delprat by way of transition states what the authors Hondius³⁶), Freitag³⁷) and Dögen³⁸) offered, it must be regretted that they almost completely overlooked the important works of Stevin, military adviser to Prince Maurice. They presumably had only a very superficial knowledge of these works³⁹).

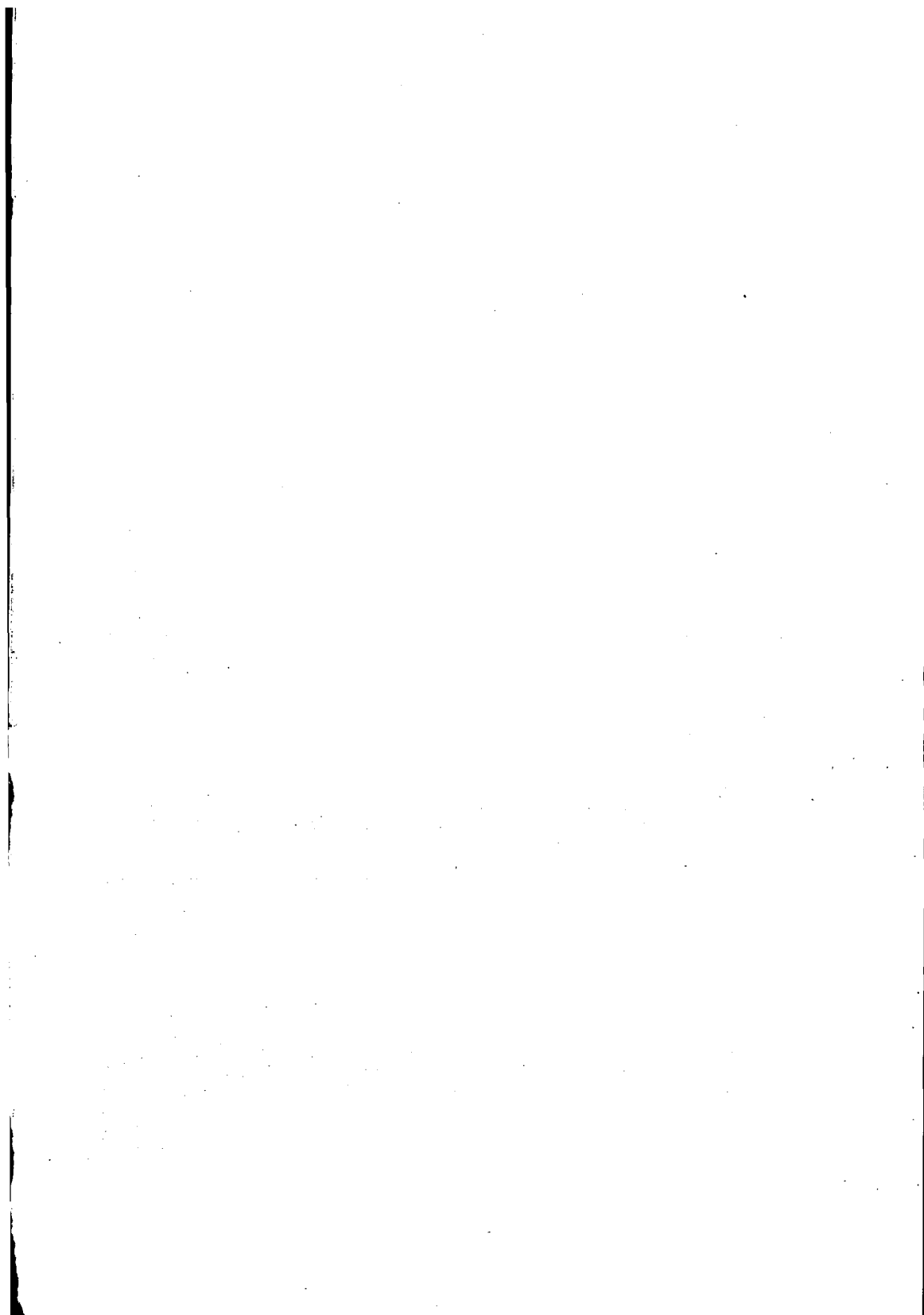
³⁵) See note 26; the present author served in 1910 and 1911 on the Commission appointed by the Commander of the Battalion of Pioneers to revise the *Handboek van den Sapper* (*Manual of the Sapper*) of 1895.

³⁶) With his *Korte beschrijvinge ende afbeeldinge van de generale regelen der Fortificatie*, etc. (The Hague, 1624) Henricus Hondius was the first author on the art of war after Marolois and Stevin; in the 4th and last part he describes "the Army earth-walls, the lines, sappings and approachings to the fortresses to conquer them, etc."

³⁷) Adam Freitag, Pole by birth and still honoured in his country as a great mathematician and builder of fortresses, wrote at a very young age in Leyden in 1630 his — for that time excellent — book: *Architectura militaris oder Fortification*, the 3rd—and last—part of which deals with the attack and defence (fol. 123-194); in it, he mentions the "Sappe oder Untergrabung", the procedure of which appears to be that of Stevin's "sapping", because also he has 2 men digging behind one another. In addition, he gives 4 examples (fol. 174, 175) with clear illustrations of works of attack, applied in 1629 in front of Bois-le-Duc and among which also those from Heinsius' book occur (see note 23).

³⁸) Matthias Dögen's *Krises Baukunst* (Amsterdam, 1648), the last part of which, entitled: *Streitbau-Kunst oder Sturm- und Wärbau* (fol. 391-475), also describes the attack on a fortress is, like Hondius and Freitag, frequently quoted by Delprat. It contains clear illustrations, but owing to its long-windedness it is even more difficult to read than Marolois' work.

³⁹) Valter commits a great inaccuracy, writing on p. 19 that Stevin's *Castrametatio* also deals with the building of fortresses by means of pivoted sluice-locks; apparently, this mistake has not been noticed by Lieutenant-General Krayenhoff, who offered a prize for the competition concerned. Delprat states on p. 29 of his Reply to the same competition of 1825 that Stevin had described the defence of the fortresses by means of sluices in his *New Manner of Fortification* issued in 1616 (sic), but nothing else.



VANT BELEGHEREN DER STEDEN EN STERCKTEN

VANT BELEGHEREN CORT BEGRIJP

Int belegheren der steden of sterckten vallen drie voornamelicke verscheijdenheden, te weten Hinderwering, Omringeling en Naerdering, daer af van elck int besonder geseijt sal worden.

Noch valter te anmercken de macht en staet der twee crijgende parthijen; want d'een soo cranck sijnde, dat hij niet te velde en can commen, en alle dingen gheschapen staende, dat hij sijn landen t'eenmael moet verliesen, in sulcken gevalle ist oirboir, om d'een Stat corts na d'ander te winnen, en te eer heel meester van sijn Viandt te worden, datmen de omleggende hinderingen haer doet opgeven, sonder gheschut daer voor te brengen. 't Welck te wege gebrocht wort, mette cranckste plaetsen eerst an te tasten, en al diet gheschut doen planten, met ghevelt in te nemen, of haer opgevende, die niet aen te nemen, dan om daer mee na sijn wille te doen; welcke sulcx sijnde, datse an al d'ander een schrick geeft, men comt gemeenlijck tottet begeerde, te weten met minder oncosten, met min verlies van volck en alles op corter tijt; maer de macht der twee crijgende parthijen becans evegroot wesende, inder vougen dat elck van hemlien hier wint en daer verliest, in sulcken gevalle en can die voet (gelijck d'ervaring in alle langduerige crijch leert) niet gevolcht worden, want soodanige wreetheyt, als men op 's vyants volck ghebruyckt, dergelijcke moetmen opt' sijne verwachten, 't welck dickwijls geschiet met verlies van goede Soldaten en Amptlien, sonder d'een des anders meester te connen worden.

VANDE HINDERWERING

Commende het Heyr, om een Stadt te belegeren, soo ist oirboir eerst te weeren het hinder van omliggende Huysen of Stercktkens, die ant leger belet mochten doen, soo wel op beesten en menschen, die wat te verre daer afwijcken, als op de toevoering van leeftocht en alle gaende en keerende lieden, die telckens met sterck gheleij van crijchsvolck soudon moeten bewaert sijn. Doch dienter voor het innemen van sulcke plaetsen acht ghenomen opde omstandigen, te weten ofse niet te verre en liggen; ofse niet seer luttel hindernis en soudon doen; ofse niet te sterck en sijn, en te veel tijts soudon behouven en te groote swaricheyt hebben om in te nemen. Voort als de Stadt lichtelijck besloten kan worden, oft niet beter

OF BESIEGING TOWNS AND FORTRESSES

OF BESIEGING ARGUMENT

In the besieging of towns or fortresses there are three main different actions to be distinguished, to wit Reconnoitring, Investment and Approach, each of which will be discussed in particular.

Besides, we must consider the strength and the condition of the two belligerents, for if one is so weak that he cannot come into the field, and all conditions are such that he cannot but lose his lands, in such cases it is expedient to conquer one town shortly after the other, and completely to master one's enemy so quickly that one forces him to give up the surrounding hindrances without bringing ordnance before them. Which is effected by first attacking the weakest spots, and to take by force all who make to plant the ordnance or, when they surrender, not to accept it, to do with them thereafter as one pleases; the use of this is that it frightens all the others and one usually achieves what is desired, to wit with less cost, with minor losses of men and everything else in a shorter time; but if the two parties at war are about equally strong, in that each of them wins here and loses there, in such cases this method (as experience in all prolonged wars teaches) cannot be followed, for such cruelty as is inflicted on the soldiers of the enemy must be expected for one's own, which often involves loss of good soldiers and officers, without one becoming master of the other.

OF RECONNOITRING

When the army comes to besiege a town, it is expedient first to take houses and little fortresses in the neighbourhood, which might hinder the army; similarly, animals and men who stray a little too far; this also relates to the supply of victuals and all coming and going people, who would each time want strong convoy of infantry. Still, before taking such places one should consider the circumstances, to wit whether they are not too far off; whether they would cause very little hindrance only; whether they are not too strong and require too much time and trouble to conquer. Furthermore, if the town can be easily invested, whether it would not be better to do the same particularly before more infantry,

en waer, 't selve voor al te doen, eerder meer volck, leeftocht met andere nootlijckheyt in ghaeck, en of, de Stadt ghewonnen sijnde, die andere plaetsen, hun schijnbaerlijck niet en souden overgheven, met diergelijcke.

Aengaende Steden daer sulcke hinderlijcke plaetsen niet en sijn, ist kennelick dat mense niet en behoeft te weeren; inder vougen dat dit vermaen alleenelick dient voor plaetsen daer nodich valt.

VAN DE OMRINGELING

't Gebeurt int belegeren van sommige Steden, datmen den viandt beletten wil daer in heijmelick te brengen Crijchsvolck, leeftocht, Crijchstuijch, of die openbaerlick met geweld te ontsetten, waer tegen de omringeling oirboir is. Angaende belegeringen daermen sulcx gantschelick niet en vreest, ist openbaer, datmen gheen moeite, cost, noch tijtverlies der omringeling en behouft. Maer om voor plaetsen daerse nodich is, de ghemeene regel te beschrijven, ick neem daer toe tot voorbeeld een Stadt, liggende op een pladt even landt, sonder eenich voordeel van marassen, rivieren, rotsen, of andere dingen, die van selfs besluyting maken, en in oneijndelicke verscheijdenheden connen vallen, waer aff daer na besonderlick gheseyt sal worden. Hiertegen neem ick te sijn een Heijr van twintich duysent mannen, welcke in drie hoopen gedeelt sijnde, ick legh die in drie legers om de Stadt, even wijt van malcander, en daer aff ontrent thien duysent voeten, dats een half uijer gaens of 4000 ghemeene stappen, twelck genomen wort voor een bequame langde, want hoewel het groffschudt voorder can reijcken, soo vallen nochtans de cogels soo ongewis, te cort of te lanck, datmen ghemeenelick daerom niet en laet soo na te legeren, en te besluyten het ongeval te verwachten: 't Is wel soo dat verder soude seeckerder sijn, maer t'veoirsaecht meerder omringheling, en is oock ongherieviger om dat men vant leger totte naerdering dagelick een langer wech, over en weerover moet loopen: Maer legers te na de Stadt te leggen, heeft benevens de schade vant gheschut des viants oock swaricheijt van de overvliegende cogels der naerdering van over d'ander sijde der stadt, twelck mette cleene steden meerder perikel heeft: Tusschen elcke twee der voorschreven drie Legers legh ick twee vierbolwerckige schansen, daermen in leggen mach 300 of 400 Crijchslieden, van grootheijt en form gelijck hier na eigentlicker verclaert sal worden, oock soo wijt vande stadt, als elck der voorschreven drie Legers, en soo verre van malcander, dat de langden van d'een tot d'ander en vande selve totte Legers al even sijn. Daer na legh ick opde langde, tusschen elcke twee schantsen, en oock tusschen de schantsen en de legers van ontrent 500 tot 500 voet een Clapmuts (sulcke naem mitsgaders oock papemuts hebben die weerkens in der Heeren Staten leger gecregen omdat se viercant sijn gelijck een Priesters bonette) oock al even wijt van malcander en van grootheijt om daer in, alsser de viandt met geweld ontrent is, een rije dats tien Crijchslien met haer rijeleyer wacht te houden wiens form, mate, staketting, met haer omstandighen volgen sal: Deze clapmutsen dienen, opdat de wachten, als verre van hulpe des legers sijnde, inder nacht vande viandt, deur anslach niet vermoort en worden, gelijckt soude connen ghebeuren als sij langs de borstweeren stonden; ten anderen den viandt, willende heijmelick deur de omringheling inbreecken, tegenstand te doen ter tijt toe uijt de legers hulpe gecomen is: Dese clapmutsen gemaect sijnde, men treckt grachtkens van d'een tot d'ander met haer borstweeren, te weten de grachtkens boven breed 6 voet, inden bodem 2 voet, diep ses voet, en mette eerde

victuals and other necessities arrive there, and whether, the town being taken, those other places would not probably surrender, and so on.

Concerning towns where such obstacles are not found, one obviously need not take them, so that this warning only serves for places where it is necessary.

OF INVESTMENT

In besieging some towns it happens that one wants to prevent the enemy from secretly bringing soldiers, victuals, military utensils into them, or to relieve them openly by force, against which investment is expedient. Concerning sieges where this is not feared at all, it is obvious that the trouble, cost and loss of time which the investment involves, are not necessary. But to describe the general rule for places where it is necessary, I take as example a town lying on flat, even land, without any advantage of marshes, rivers, rocks or other things which themselves form a barrier, and which may be of infinite variety, which will be discussed in particular. Against this I assume that there is an army of twenty thousand men, divided in three parts; I place them in three camps round the town, at equal distance from one another and about ten thousand feet from it, which is half an hour's walk or 4000 ordinary steps, which is taken to be a suitable distance, for although the range of the ordnance is greater, the bullets fall so uncertainly, at too short or too long a distance, that one usually for this reason does not refrain from camping so near and decides to await the misfortune. It is true that further away would be safer, but it requires more investment and is also more inconvenient, because one must daily cover, there and back, a longer way from the camp to the approach: But placing camps too close to the town has, besides the drawback of the enemy's ordnance, also the disadvantage of bullets flying across from the army approaching the town on the other side, which with smaller towns gives more trouble. Between each two of the above-mentioned three camps I place two four-bastioned redoubts, wherein one can lay 300 or 400 soldiers, the size and shape of which will be explained afterwards more in particular; also, so far from the town as each of the above-mentioned three camps, and so far apart that the distance from one to the other and from the same to the camps is equal. Thereupon I lay at a distance of about 500 to 500 feet between each two redoubts, and also between the redoubts and the camps a bonnet (the name of priest's cap, which it has also acquired in the army of the Honourable States, derives from the fact that it is square) also equally far from one another and of such a size to place therein, if the enemy is round about with force, a file of ten soldiers with their file-leader on guard, and whose shape, dimensions, palisade will follow with their conditions: These bonnets serve in order that the guards, when being far from the assistance by the army, shall not be murdered during the night by a surprise attack of the enemy, as could happen if they were standing along the parapets; secondly, to offer resistance to the enemy who wants secretly to break through the investment, until from the camps comes rescue. These bonnets having been made, one digs ditches from the one to the other with their parapets, to wit the ditches at the top 6 feet wide, at the bottom 2 feet, 6 feet

daer uijt commende de borstweeren, onder anleggens 6 voet, boven dick 2 voet, hooch ses voet, met een banck hooch 1 voet, breed 3 voet, waer mee de Stadt omringelt is tegen den Viandt die van buijten mach commen. Maer als men oock vreest den uijtval des viandts binnen sijnde, die mette buytenste t'samen op een tijt de belegeraars mochten antasten, d'een van achter d'ander van vooren, soo maeck(t) men noch een ander gracht met sijn borstweer, van form als de boveschreven na de Stadt sijde, tusschen welcke en d'ander uijterste grachtkens gelaten wort 300 voeten.

Noch verstaetmen dat elck der drie legers dagelicx de wacht verandert vande twee vierbolwerckige schantsen en vande dertien of veertien Papemutsen die hem naast sijn. Maer om door teijckening noch beter te verclaren tgeene tot hier toe

★ ★ ★ ★ ★

deep, and with the earth dug up from them one makes the parapets, at the base 6 feet, at the top 2 feet thick, 6 feet high, with a step 1 foot high, 3 feet broad, by which the town is invested against the enemy who may come from outside. But if one also fears the sally of the enemy inside, who with the one on the outside might together attack the besiegers at the same time, one at the back and the other in front, then one makes still another ditch with its parapet, of the same shape as the one described above, towards the town, between which and the other outer ditches a distance of 300 feet is left.

It is also to be understood that each of the three camps daily changes the guard of the two four-bastioned redoubts and of the thirteen or fourteen nearest bonnets. But to explain by a figure even better what has been said before: let

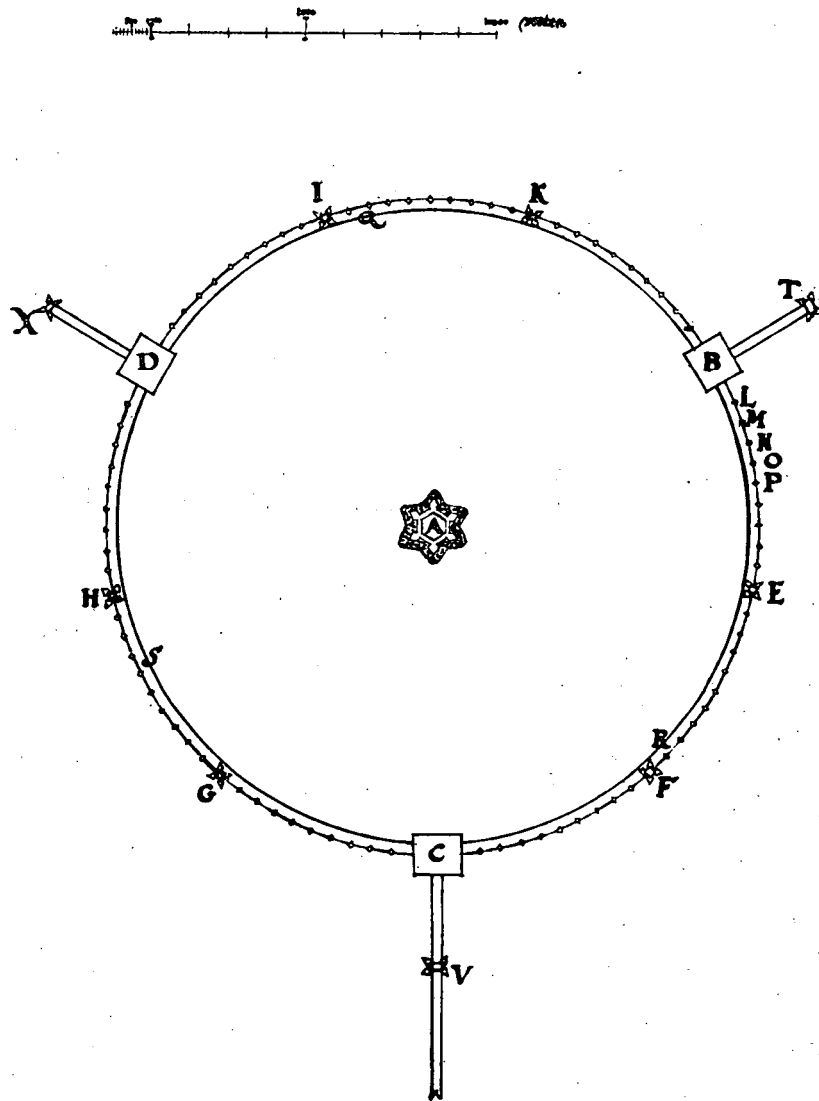


Fig. 1. Investment (Circum- and Contravallation); general plan.

geseijt is: laet A de Stadt beteyckenen, B, C, D, de drie legers ewewijt van malcander, en vande Stadt ontrent 10.000 voeten. De vierbolwerckige schansen die tusschen de drie legers liggen, sijn als E, F, G, H, I, K, en de papemutsen tusschen beijden sijn als L, M, N, O, P, met d'ander diergelijcke. Voort bediet Q, R, S, de boveschreven binnegracht.

Noch is tot beschermenis deser omringheling, als gemeene regel dit te anmercken, te weten datmen uijt het middel van elck der drie legers treckt twee rechte grachtkens, lanck twee of drie duysent voeten en wijt van malcander 300 voet, van diepte, breedte en borstweren gelijk de voorgaende, en ten eijnde vandien een vierbolwerckige schans, als beteyckent wort met T, V, X, die de voorschreven twee grachten en borstweeren van buijten en binnen strijcken connen.

Doch is dese schans met soo diepe bree grachten, en soo hooge dicke wallen, dat mense sonder naerdering niet over lopen en can, en daarmen groffgeschudt op gebruijcken mach. Dit gebou dient om daer me des viants groffgeschut verre vant leger te houden en daer af niet bedwongen te worden, het leger op te breecken, en verleggen, want totte 3000 voeten van B tot T, noch vergaert de verheijt van T tot sijn geschut, het maeckt al een goede langde: Waer bij noch te bedencken staet, dat des viants leger, plaets genomen hebbende voor een deser drie legers, soo canmen terstont sijn uijsteecksel soo veel verlangen en voorder graven, als de gelegentheijt toelaet: Oock machmen dan uijt d'ander twee legers in dit soo veel volcx brengen, datter in d'ander alleenelick genouch blijft, om tegen anslagen verseeckert te sijn.

Merckt noch dat de viant, uijt oirsaeck des buijtewerckx voor B, niet wel antasten en can de schans K noch E, als wesende te seer inden rugge gesien, en datmen bovendien meer ander sulcke buijtewercken maken mach.

Angaende ijmant mocht dencken dat deze uijsteecksels stercke wacht souden behouven om die te bewaren, of anders dat de viant inder nacht over de cleene langhe borstweerkens lichtelick mocht inbreken, innemende de plaets tusschen t'leger als B en de schans: Daer op wort geseijt datter geen of weijnich wachts behouft, want schoon genomen datmen met Ruijterije noch voetvolck des legers, hem sulcx inder nacht niet en had connen beletten, soo en soude hij den dach angedommen sijnde, daer in niet connen blijven, om het groffgeschudt dat van wetersijden daer op strijckt, en boven dien het gantsche leger daer hij af can overvallen worden. Tis oock kennelick datmen den viant met sulcke buijtenwercken bejegenen mach niet alleen voor de drie legers, maer tot allen plaetsen der omringeling daert nodich valt.

Om nu noch deur meerder formen breder te verclaren gelijk vooren beloofd is, de gedaente der schantsen als E, F, G, H, I, K, en der clapmutsen, oock der schansen als T, V, X, altemaal int cleen geteyckent, soo sal ick mette schansen als E, F beginnen.

De pertinente maet van dese schansen heb ick niet gevonden doch dit isser af dat de schansen E, F, G, H, I, K, sijn viersijdige, diens vier gordinen elck evelanck sijn, en groot om in te logeren soo veel volck als geseijt is, maer de drie schansen T, V, X, hebben de twee gordinen lanck 300 voeten, dats soo lanck als de uijsteecksels breed sijn, dander twee gordinen alleenlick soo lanck dat de schansen groot genouch sijn om daer in soo veel volck te logeren als men oirboir verstaet.

Noch, meen ick, dat in dese schansen moeten wesen hutten voor de soldaten,

A represent the town, B, C, D, the three camps equally far from one another, and from the town about 10,000 feet. The four-bastioned redoubts lying between the three camps are designated as E, F, G, H, I, K, and the bonnets in-between as L, M, N, O, P, and so on. Besides, Q, R, S indicates the inner ditch described above.

To protect this investment it should further be stated as a general rule that from the centre of each of the three camps one digs two straight ditches, two or three thousand feet long and 300 feet apart, their depth, width and parapets the same as described above, and at the end a four-bastioned redoubt, as indicated by T, V, X, which can strike the above-mentioned two ditches and parapets on the outside and inside.

However, this redoubt has such deep, wide ditches, and such high, thick walls, that one cannot cross it without approach and has to use ordnance on it. This work serves to keep the enemy's ordnance far from the camp, thus to prevent being compelled to raise the camp and remove it, for if up to the 3000 feet from B to T, there be added the distance from T to its ordnance, it is already a reasonable length: In which connection it is also to be considered that when the enemy's army has occupied a position in front of one of these three camps, one can at once extend one's projection BT and dig further as circumstances permit: Also, one can then from the other two camps bring so many men in it as to leave enough in the others to be secured against surprises.

It should further be observed that the enemy, by reason of the outwork before B, cannot very well attack the forts K or E, as being too much seen in his back, and that besides more such outworks can be made.

If somebody should think that these projections require a strong guard to protect them, or else that the enemy could easily break in during the night across the narrow long parapets, occupying the space between the camp at B and the fort: To this it is said that few if any guards are necessary, for assuming that neither cavalry nor infantry of the camp could have prevented him from doing so during the night, he could not remain in it after daybreak, because of the ordnance striking it from both sides, while besides the entire army from the camp may attack him. It is also clear that the enemy can be engaged by means of such outworks, not only in front of the three camps, but at any spot of the investment where it should be necessary.

In order now better to explain by more figures, as promised before, the shape of the redoubts E, F, G, H, I, K, and of the bonnets, also of the forts T, V, X, all drawn on a small scale, I shall begin with the redoubts E, F.

The exact dimensions of these redoubts I have not found, but it is certain that the redoubts E, F, G, H, I, K, are quadrilateral, the four curtains each being of equal length, and of such size as to encamp in them as many infantry as stated above, but the three forts T, V, X, have two curtains 300 feet long, which is as long as the projections are wide, the other two curtains being only so long that the redoubts are large enough to encamp so many soldiers in them as are deemed necessary.

Still, I think that in these redoubts there must be huts for the soldiers and

en soetelaers om niet mits de onghemackelicheyt der wachten de dagelicksche op en af trecking van die schansen te moeten doen, maer sonder ongemack daer eenige dagen op de wachten te connen blijven leggen soo den veltoverste sulcx gerivigher verstont, veranderde alleenlick dagelicx de Soldaten der Clapmutsen uijt die schansen. Ja ofschoon die schanswachten dagelicx verandert wierden, soo en souden die voor gheen beswaernis des Crijchsvolcx connen ghereeckent worden.

Tot hier toe is vande heele omringeling geseijt, maer als de Stadt lage ande zee, t'konde sijn datter te lande maer den helft of een minder gedeelte te sluijten en viel, alwaer door de voorgaende ghemeene regel vande heele omringeling, bekend is, de meijning vant geene men in een gedeelte te doen heeft.

*Hier moeten volgen omringelingen van sijn Extie.
Daer naer omringelingen der ouden.*

NAERDER VERCLARINGE VANDE GEDAENTE DER CLAPMUTSEN EN HARE GRACHTEN

Aengesien de form der heele omringeling op dit papier te groot en ongerivich soude vallen, als men de grachten der Clapmutsen met haer omstandigen daer in wilde teijckenen, soo sijn die inde voorgaende form met ijnckel linikens aengewesen; maer om nu de meijning daer af deur grooter form te verclaren, soo

* * * * *

sutlers in order that, in connection with the inconvenience to the guards, it should not be necessary daily to go up and down to these redoubts, but that they could remain there on guard without inconvenience for some days if the general should deem this more expedient, only the soldiers of the bonnets being daily relieved from those redoubts. Yea, although these fort guards should be daily changed, this could not be considered a drawback for the soldiers.

Up to now we have spoken of the entire investment, but if the town were situated on the seaside, it could be that on land half or even less had to be invested, in which case from the preceding general rule of the entire investment is known what is to be done in part.

*Here must follow investments of His Excellency.
Then investments of the Ancients.*

FURTHER EXPLANATION OF THE SHAPE OF THE BONNETS AND ITS DITCHES

As the figure of the entire investment would turn out to be too large and inconvenient on this paper if the ditches of the bonnets with their details were to be drawn on it, those of the preceding figure have been indicated in it only by lines, but to explain the significance thereof by a larger figure, let A B C D

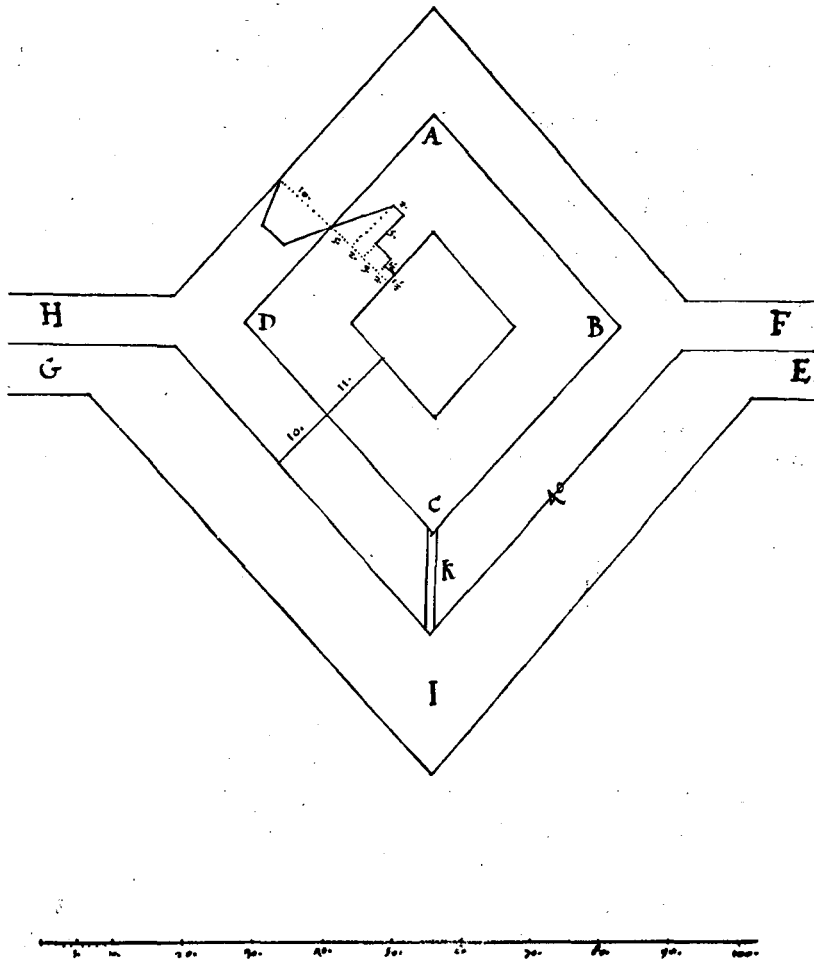


Fig. 2. Bonnet (little fort or redoubt in the line of investment).

laet ABCD een clapmuts beteyckenen, soo geleijt dat de wal AB strijckt het borstweer E op sijn buijtekant, dats langs de gracht F. S'gelijcx strijckt de wal AD over d'ander sijde het borstweer G op sijn buijtekant, dats langs de gracht H: maer de wal CB strijckt het borstweer E op de binnesijde, en CD het borstweer G oock op de binnesijde. Noch is te weten dat van G over I tot E geen borstweer en is als d'ander, uijt oirsaeck dattet selve tot achterdeel der Clapmuts soude strecken, want den viant bij nachte op eenigen anslach daer achter bedeckt soude komen staen; maer is ter hoochte des borstweers met een breede afdaecking daermen voor die der schans op ontdeckt staet, maer vrinden sijnder achter bedeckt tegen den viant van buijten. Voort beteyckent K een houte optreckende brugske. Maer want ijmant nu dencken mocht, dat dit afdakende borstweer of een ander daer onnodich schijnt, uijt oorsake dattet comt op de binnesijde der omringelinge, en dat de clapmuts selfs aldaer in plaats van borstweer is, soo dient hierop tot antwoordt, dat als daer geen borstweer en waer, soo soudemen het leger lichtelick uijt en in connen loopen, deur diender niet meer hoochde en soude sijn, dan vande gront des grachts tottet majjlandt. Ten anderen soo souder tusschen de twee einden der borstweeren ende Clapmuts een openheijt blijven, daermen voor bloot soude sijn tegen de viant die van buijten stonde.

Maer sulcke afdaeckende borstweeren langs de grachten om de clapmuts gaende, soo is daer vanden gront des grachts totten bovekant vanden sulcken hoochde, als tot ander plaetsen daer borstweeren sijn, en die voorss openheden sijn gestopt.

In gelijck hier deese afdaecking comt op de binnesijde der Clapmuts, alsoo salmen verstaen datmen om dergelijcke reden oock sulcke afdaecking maeckt op de binnesijden der vierbolwerckige schansen.

Wanneer een Clapmuts moet comen niet op een rechte borstweer alsvooren, maer op den houck daer twee voortgetrocken borstweren vergaren, dan comt de form gelijck angewesen wort met L.

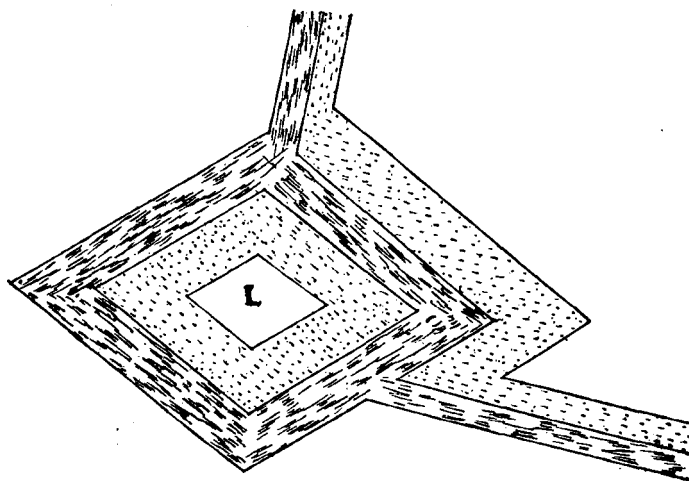


Fig. 3. Bonnet at the corner of two trenches or lines.

denote a bonnet, so situated that the wall AB strikes the parapet E on its outside, i.e. along the ditch F. Similarly, the wall AD on the opposite side strikes the parapet G on its outside, i.e. along the ditch H: but the wall CB strikes the parapet E on the inside, and CD the parapet G, also on the inside. It should also be known that from G via I to E there is no parapet like the other, because this would be detrimental to the bonnet, for the enemy would during some night attack be covered behind it; but at the level of the parapet there is a broad glacis where for those of the redoubt one stands exposed, while friends behind it are protected against the enemy from outside. Furthermore K represents a small wooden draw-bridge. But if somebody should now think that this glacis or another seems unnecessary there, seeing that it comes on the inside of the investment, and that the bonnet itself in that place functions as a parapet, the answer is that if there were no parapet in that place, it would be easy to walk into and out of the line of investment, because there would not be any height left other than from the bottom of the ditch to the ground level. Secondly, between the two ends of the parapets and the bonnet there would remain an open space, before which one would be exposed to the enemy on the outside.

But as such shelving parapets run along the ditches round the bonnet, the height from the bottom of the ditch to the top is the same as to other places where there are parapets, and the foremost open spaces have been closed.

As this glacis comes on the inside of the bonnet, it is to be understood that for the same reason such a glacis should also be made on the inside of the four-bastioned redoubts.

If a bonnet is to be constructed not on a straight parapet as described above, but at the corner where two extended parapets meet, the figure indicated as L is to be considered.

VANDE NAERDERING CORT BEGRIJP

De naerdering wort in drie deelen gescheijden, t'eerste vant naerderen tot op de grachtcant (contrescarpe), het tweede over de gracht, het derde over den wal.

Dese worden bij
veelen genoemd
als volcht: Ende want elck deel sijn besonderlicke manier vandoen heeft, soo sal ick elck
besonderlick beschrijven: Maer angesien daer in seecker woorden commen diemen
elders weijnich gebruijckt en onbekent sijn als

- | | |
|-----------------------|--|
| 1. <i>Trencheen</i> | 1. Loopgraven, |
| 2. <i>Cordegarden</i> | 2. Loopschansen, |
| 3. <i>Baterijen</i> | 3. Grofschutweeren, |
| 4. <i>Galerijen</i> | 4. Looven, |
| | met noch drie woorden van graving, als |
| 5. <i>Uijtsetten</i> | 5. Blootgraven, |
| 6. <i>Zapperen</i> | 6. Bedecktgraven, en |
| 7. <i>Mineren</i> | 7. Ondergraven, |

soo sal ick die eerst bepalen.

Daer na sullen 8 voorstellen volgen. Int eerste voorstel verclaring der gemeene regel vande manier de(r) naerdering tot op de grachtcant. Int 2^e voorstel ettelicke omstandigen der bedecktgraving. Int 3^e voorstel manier der naerderingh deur de gracht. Int 4^e voorstel de naerdering deur de wal. Int 5^e voorstel sal gegeven worden grontteijckening van een Stadt om te trachten nade bequaemste teijckeningh der loopgraven dieder vallen can, om na de manier vandien de naerdering totte grachtcant te doen. Int 6^e voorstel middelen dieder sijn om de naerderingh wel te bevorderen. Int 7^e voorstel sal een ander besonder ghemeene regel op Naerderen tot op de grachtcant beschreven worden. Int 8^e voorstel sal van een manier van waterloopgraven geseijt worden voor St. Andries besloten.

OF THE APPROACH ARGUMENT

The approach is divided into three parts, the first of the approach on to the counterscarp, the second across the ditch, the third over the wall. And since each part has its special features, I will describe each separately: But as certain words will occur in it which are elsewhere little used and unknown, such as

1. Trenches,
2. Redoubts or Cordegardes,
3. Batteries,
4. Galleries,

with three other words of digging, such as

5. Setting out, Tracing or Flying sap,
6. Sapping or Full sap, and
7. Mining,

I shall define them first.

Then will follow 8 propositions. In the first proposition an explanation of the general rule of the manner of approach on to the counterscarp. In the 2nd proposition various conditions of sapping. In the 3rd proposition the manner of approach through the ditch. In the 4th proposition the approach through the wall. In the 5th proposition will be given a ground plan of a town to try after the best drawing of the trenches that can be made, to make in that way the approach to the counterscarp. In the 6th proposition means that are available to promote the approach. The 7th proposition will describe another special general rule for Approaching on to the counterscarp. In the 8th proposition a manner of water-trenches will be discussed as determined before fort St. Andrew.

I. BEPALINGH.

Loopgraven zijn drooge grachtens, waer af de eerde na de Stadtsijde opgeworpen wesende, verstrekt voor borstweer om daer achter bedecktelick te loopen of gaen, en an te brengen alle behoefte totte naerdering nodich.

Laet tot breeder verclaringh van desen A een Stadt beteyckenen, waer af B, C, D, E, sijn vier bolwerckxpunten en na den bolwerckpunt C comt een loopgracht als beteyckent wort mettet verbruijnde van F tot G de eerde daer uijt gecomen en na de Stadtsijde geworpen, is beteyckent mette tippeling van H tot I; dit soo wesende tis openbaer hoemen in dese loopgracht FG bedecktelick commen can, van F totte Statsgrachtscant an G, sonder uijt de Stadt gesien te wesen, want de loopgracht FG deur tgedacht voortgetrocken sijnde, loopt den bolwerckpunt B mis, en tegen d'ander bolwercken als D, E, ismen bedeckt achter het borstweer HI.

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1st DEFINITION

Trenches are dry ditches, the earth from which is thrown up on the town side, serving as a parapet to walk or go under cover behind it and to supply all things necessary for the approach.

Let for a better explanation A represent a town, of which B, C, D, E, are four points of bastions; and towards bastion-point C comes a ditch, as indicated by a hatched strip from F to G, the earth coming from it and thrown to the town side being indicated by the dotted strip from H to I; this being so it is obvious how one can come under cover into this trench FG, from F to the counterscarp of the town at G without being seen from the town, for the trench FG being thought produced, runs away from the point of bastion B, and against the other bastions D, E, one is protected behind parapet HI.

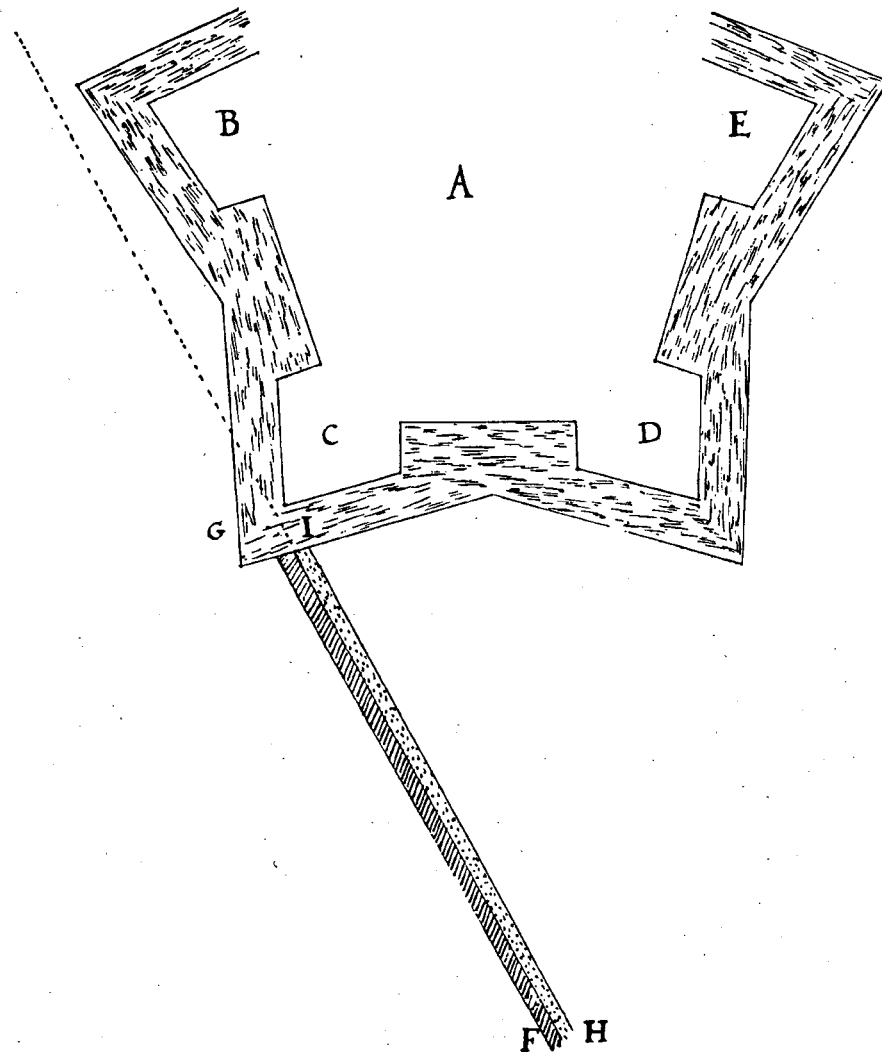


Fig. 4. Town with approach; general principle.

Dese loopgraven worden diep gemaect onder het majlandt ontrent 3 voet (alst waterige of steenige gront niet en verhindert) hooch 7 of 8 voet boven den gront des grachts, of daert nodich is, soo veel hooger datmen bevrijt mach sijn voor alle toorens en hooge gestichten der Stadt daermen af soude mogen ontdeckt en beschoten worden. De breedte is van ontrent 18 voet om daer deur niet alleenlick menschen bedecktelick te gaen maer oock te varen met wagens grofschudt, cogels, cruijt, schanscorven, rijs en alle ander nootlickeijt der naerderingh.

II. BEPALING.

Loopschansen sijn seecker wijze van schansen, diemen int naerderen maeckt, om deur de Crijchsliden daer op liggende, de Gravers te verseeckeren tegen het uijtvalen der belegerde. Om deser loopschansen gedaente wat breeder te verclaren, soo is te weten, datse tweederleij sijn, deerste licht opgewrocht, diemen al naerderende telckens nieu maeckt, verlatende d'eerste en leggende de wacht altijt inde laatste, d'ander de alderlaetste te weten diemen op de grachtcant legt om met musquettiers daer op schudtgeveert te houden tegen de belegerde die over haer wallen schieten, en de naerdering over de gracht verhinderen, waer deur sij oock stercker en beter gewrocht worden als d'ander met dicke schootvrije borstweeren om des viants grofgeschut te connen verdragen; maer om tgeene gheseyt is door een form noch beter te verclaren, soo laet dese vierhouckige form beteyck-

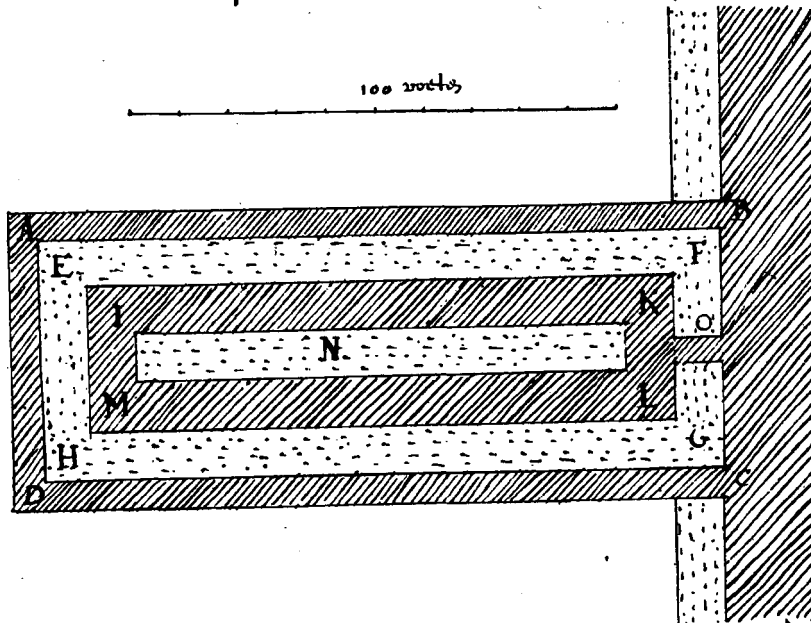
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These trenches are made about 3 feet deep under the ground level (if watery or stony soil does not prevent this), 7 or 8 feet above the bottom of the ditch, or where necessary so much higher that one may be invisible from all towers and tall buildings of the town whence one might be discovered and shelled. The width is about 18 feet, in order that not only men may go under cover, but also carts with ordnance, bullets, powder, gabions, fascines and all other things necessary for the approach.

2nd DEFINITION

Redoubts are a certain kind of forts made for the approach, the soldiers lying on them, thus protecting the diggers against sallies of the besieged. To explain the shape of these redoubts somewhat more in detail, it should be known that they are two-fold: the first of a light construction, being replaced each time during the approach, the first being left and the guard invariably placed in the last one, the other the last of all, namely the one which one erects on the counterscarp to shoot or skirmish from there with musketeers against the besieged who fire over their walls and prevent the approach across the ditch, for which purpose they are made stronger and better than the others with thick bullet-proof parapets in order to withstand the enemy's ordnance; but to explain what has been said better by a figure, let this quadrangular figure represent a redoubt of the first

lijkt is door een form noch beter te verclaren, soe laet



Deze vierkante form betrefden een loopstroom

Fig. 5. Redoubt or Cordegarde (Infantry-post in approach).

nen een loopschans van d'eerste sorte, waer in de verbruijnde plaetsen grachten bedien, d'ander getippelde borstweren, te weten ABCD een gracht breed 6 voet (uijtgenomen de sijde BC hebbende de breedte der loopgraven daerse een deel af is) en diep vier voet, EFGH een borstweer anleggens 10 voet, hooch 6 voet met sijn banck na behooren; daerbinnen noch een gracht als IKLM, breed 10 voet, diep 4 voet, en binnen deselve een borstweer als N; voort beteyckent O den inganck der loopschans, uijtcommende inde loopgraven BC, des borstweers langde als van E tot H valt hier van 50 voet, d'ander sijde EF, maecktmen drie of viermael soo lanck, twelck hier genomen is op driemaal doende 150 voet. De reden waerom men dese lanckwerpige wijze bequamer acht dan viercant met even sijden, is dese: Ten eerste dat twee schansen evenveel wercx of borstweers hebbende, soo can op dese lange sijde EF meer volcx nevens malcander staen om na de Stadtsijde te schieten, dant doet opde sijde eens viercants, — Ten anderen soo gaetmen inde corte grachtkens als van M tot I en van L tot K bedeckter, dan wanneert lange grachten sijn, als in een viercant, — Ten derden het borstweer N is aldus eer gemaect, om datmen de eerde van beide sijden opwerpt, twelck anders vier borstweeren vallen met een ledich viercant int middel. D'oirsaeck waerom binnen het borstweer EFGH, noch gegraven wort de gracht IKLM, is deur dienmen alsoo terstont met luttel moeyte bedeckt is, eensdeels om de insincking, ten anderen om des borstweers verhooging aan beiden sijden.

III. BEPALING.

Grofschudtweer is een plaats bereijdt, om daer uijt met grofgeschut te schieten.

Als men gheen uijtvalen der belegerden en vreest, soo en maeckmen het grofschudtweer met geen besloten schans, maer alleenlick den borstweer opt majjlandt; hooch vier voet, met schanscorven daer op om de grofschutters te bedecken, en tusschen de selve deur te schieten: Maer moetende tegen uijtval verseeckert sijn, men maeckt een vierhouckige schans, hebbende van voor tot achter 50 voeten, te weten het borstweer na de Stadtsijde 15 voeten, het achterste borstweer anleggens 6 voeten, en de overschietende 29 voeten tusschen beiden, dienen voor het geschut en sijn deijsing; inde breedte geeftmen de schans soo veel maal 14 voeten, alsmender sticken op brengen wil; rontsom comt een gracht diep 6 voeten, en soo breed alster eerden behouft totte voorss borstweeren: Het boveschreven borstweer na de Stadtsijde is hooch 4 voet boven het Majjlandt, waer op men schanscorven stelt, daermen tusschen deur schiet.

kind, where the hatched spots indicate ditches, the other dotted spots parapets, namely A B C D a ditch 6 feet wide (except the side BC, which has the width of the trenches, of which it forms part) and 4 feet deep, E F G H a parapet broad on base 10 feet, 6 feet high with its step as required; within it another ditch as IKLM, 10 feet broad, 4 feet deep, and within it a parapet as N; furthermore O is the entrance to the redoubt, leading to the trenches BC, the length of the parapet from E to H is here 50 feet, the other side EF being made three or four times as long, in this case three times, which is 150 feet. The reason why this oblong shape is regarded better than an equilateral square one is this: In the first place, two forts having the same length of work or parapet, can accommodate on this long side EF more soldiers standing beside each other to shell the town side than on one of the sides of a square. Secondly, in the short ditches, as from M to I and from L to K, one is better covered than in long ditches, as in a square. Thirdly, parapet N is thus sooner made, because the earth is thrown up from both sides; otherwise one gets four parapets with an empty square in the centre. The reason why within the parapet EFGH also the ditch IKLM is dug is because one is thus immediately covered with little difficulty, on the one hand because of the excavation, on the other because of the raised parapet on both sides.

3rd DEFINITION

A *battery* is a place made to fire therefrom with ordnance.

If one does not fear sallies of the besieged, one does not make the batteries with a closed fort, but only with the parapet on the ground level, four feet high, with gabions on it to protect the gunners and to fire between them: But if one must be protected against sallies, one makes a quadrangular fort, measuring from front to back 50 feet, to wit the parapet to the town side 15 feet, the last parapet 6 feet on base, and the remaining 29 feet between the two serving for the ordnance and its recoil; broadwise one gives the fort as many times 14 feet as one wants to bring pieces on it; round about it comes a ditch 6 feet deep, and so wide as earth is required for the aforesaid parapets: The above parapet on the town side is 4 feet high above ground level, on which one places gabions, between which one fires.

Laet tot breder verclaring dese form een grofschutweer beteyckenen, waer in gelyck vooren de verbruijnde plaetsen grachten bedien, d'ander getippelde borstweeren, te weten ABCD de gracht, E het dick borstweer na de Stadtsijde, wiens gracht AB daer voor commende breeder is als d'ander, F is t'majlandt daer t'geschut op staet inde borstweeren omvanghen, G den ingang des grofschutweers, uijtcommende inde loopgracht BC, bequaem om het geschut en alle nootdrift al bedect daer in te brengen. Maer want bij sulcke grofschutweer gemeenlick geleyt wort een loopschans na de wijze der 2^e bepaling, om d'een d'ander te bewaren, soo vervoucht men die bequamelick nevens malcander, deur diense een selve breete hebben van 50 voeten. Om t'selve met een form noch beter te verclaren, laet A een grofschutweer sijn alsvooren, waer nevens vervoucht is de loopschans B, hebbende t'samen den gracht C gemeen.

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Let for better explanation this figure represent a battery, where as before the hatched spots indicate ditches, the other dotted ones, parapets, to wit A B C D the ditch, E the thick parapet to the town side, whose ditch AB in front is wider than the other, F is the ground level on which the ordnance is placed surrounded by the parapets, G the entrance to the battery, leading to the trench BC, suitable to bring in under cover the ordnance and all necessities. But since near such a battery is usually laid a redoubt in accordance with the 2nd Definition, one to protect the other, the best plan is to make one next to the other, because they have the same width of 50 feet. To explain the same even better by means of a figure, let A be a battery as meant above, next to which has been erected the redoubt B, having the ditch C in common.

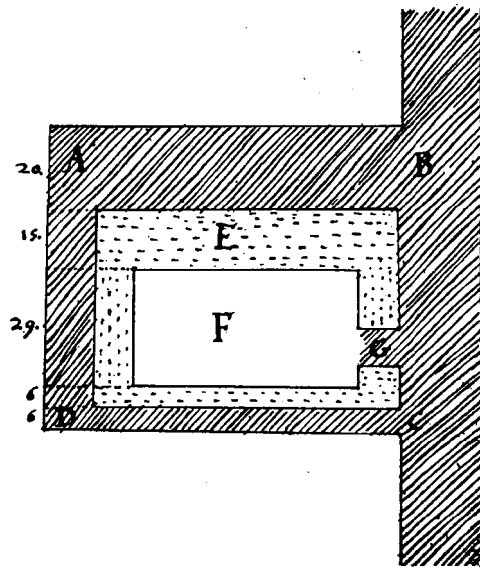


Fig. 6. Battery.

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is de Loopstond B. Zekende t'samen den gracht C
gemeen.

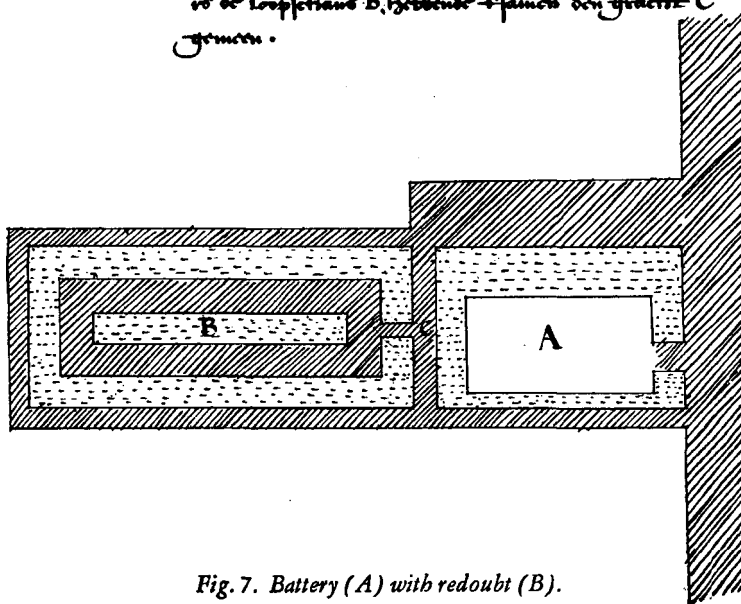


Fig. 7. Battery (A) with redoubt (B).

IV. BEPALING.

Looven zijn ganghen gemaect met jocken nevens malcander gestelt, en bedekt met planken rijs en eerde om vrij deur de gracht ande Stadswallen te gaen, onbeschadicht van tgeschut der belegerden.

V. BEPALING.

Blootgraven is wanneermen al gravende staet boven opt landt bloot voor de viandt.

VI. BEPALING.

Bedecktgraven is wanneer een graver soo diep in deerde staet, en al voortgravende geduerlick soo veel eerde als borstweer voor hem opworpt, dat hij voor de Viandt altijd bedeckt blijft.

VII. BEPALING.

Ondergraven is wanneer den Graver onder d'eerde gravende, boven met eerde bedeckt is.

I. VOORSTEL:

*Te verklaren de gemeene regel vande manier der naerdering
tot op de grachtcant.*

Wanttet somswijlen deur t'cleen getal der belegerden of deur haer onervarentheijt, versuijm of ander oirsaken gebeuren can, datmen den eersten nacht met blootgraving* tot opde grachtcant comt, sonder bedecktgraving*, en datmen die tot ander plaetsen om der belegerden heftich schieten en uijtvalen, gebruijcken moet, soo sal ick daer aff twee voorbeelden beschrijven.

*uijtsetting
oppeering*

4th DEFINITION

Galleries are passages made with frames placed side by side, and covered with boards, fascines and earth, in order to go freely through the ditch towards the town walls, without harm from the ordnance of the besieged.

5th DEFINITION

Setting out or tracing is when while digging one stands on the land exposed to the enemy.

6th DEFINITION

Sapping (full sap) is when a sapper stands so deep in the earth, and while digging throws up continuously so much earth as parapet, that he remains hidden to the enemy.

7th DEFINITION

Mining is when the digger or miner, while at work under the earth, is covered by earth.

1st PROPOSITION:

*To explain the common rule of the manner of approaching
to the counterscarp*

As, owing to the small number of the besieged, or through their inexperience, neglect or other causes it may sometimes happen that during the first night one reaches the counterscarp by setting out, without full sapping, and that one must use this on other places because of the vehement shelling and sallies of the besieged, I shall describe two examples of it.

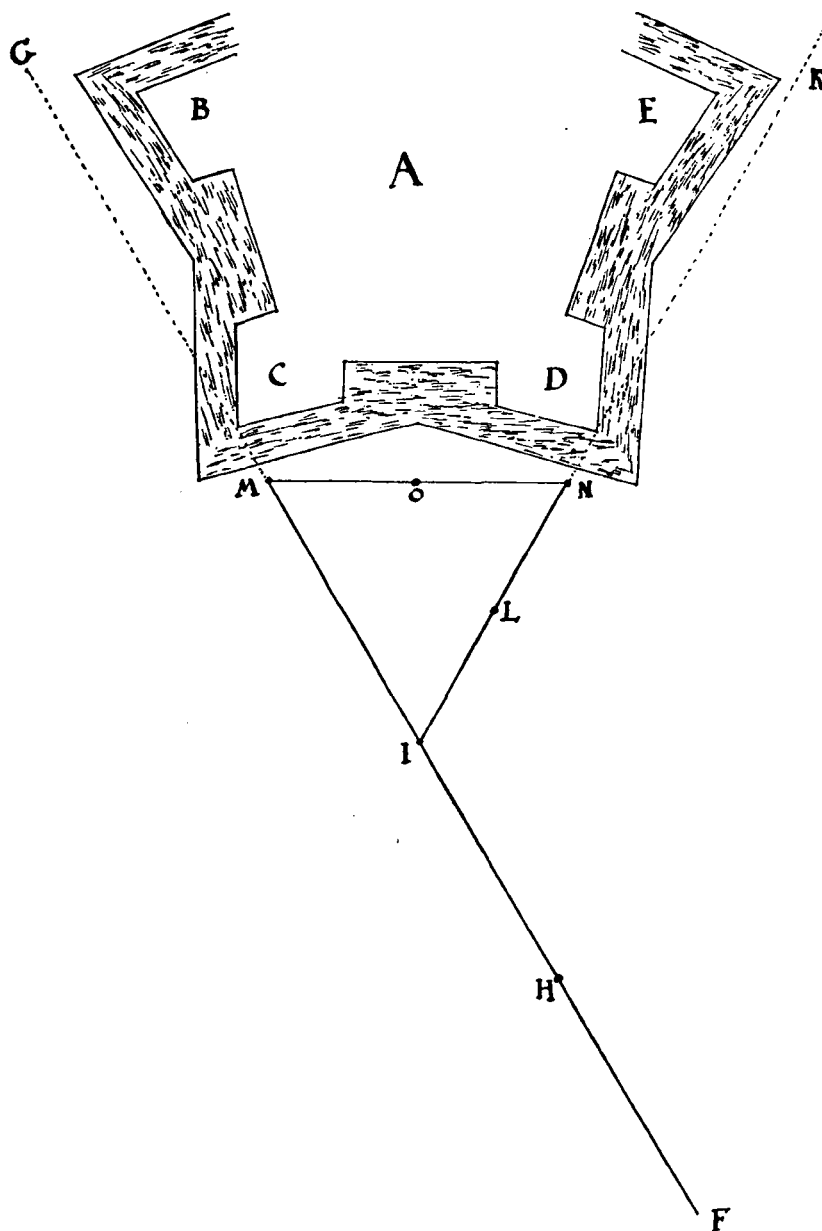


Fig. 8. Fort with approaches, made by setting out.

1e Voorbeeld van de naerdering in welke men den eersten nacht met blootgraving sonder bedecktgraving tot opde grachtcant comt.

Laet A een Stadt beteyckenen, gelegen, neem ick, op een plat lant sonder voordeel van hoochten, leechten, hagen, bosschen of diepe wegen, maer daermen de naerdering dadelick moet graven, diens vier bolwercxpunten sijn B, C, D, E. Dese Stadt heeftmen voorgenomen an te tasten tusschen de twee punten C, D, tot welcken eijnde men de loopgraven wil beginnen 5000 voeten vande Stadtswallen, als bij F, twelck genomen wort voor een middelmatige langde: Doch soomen metter daet bevonde dat de belegerde den Incomst te heftich beschoten int op en aftrecken vande wacht, en van ander groote hoopen volcx, tis kennelick datmen sulcke loopgraf tot sijn willen mach verlangen. Dit soo sijnde ick ga bij dage ontrent de voors plaets F ter eender en ander sijde, tot dat ick den bolwercxpunt C sie bedecken den punt B, gelijk angewesen wort mette lini FG, en stel an F een baeck, en noch een inde rechte lini FG, als ter plaets van H. Ick driebaeck daer na op HF, en stel de baeck I tot sulcken plaets, dat ick den punt D sie bedecken den punt E, gelijk angewesen wort mette lini IK, en stel inde selve lini IK de baeck L. Dese vier baken F, H, I, L, meugen als geseijt is, inden dach gestelt worden, met kleen perikel van geschoten te worden, als buijten musquet sijnde, maer de volgende twee als MN, op de grachtcant, die steltmen bij nachte als volcht: Wantmen den eersten nacht als men de naerdering beginnen wil, geen loopschansen en heeft, om mettet volck daer op leggende sich te verseecken tegen de uijtvalen der belegerde, men stelt soo stercken wacht te voet en te peerde, datmen sich daertegen verseeckert hout; na dat sulcke wacht gestelt

* * * * *

1st Example of the approach by which one reaches the counterscarp during the first night by setting out without full sapping.

Let A represent a town, situated, I assume, on flat land without the advantage of heights, valleys, hedges, woods or deep roads, but the approach to which must be dug at once, the four points of the bastions being B, C, D, E. One has planned to attack this town between the two points C, D, for which purpose one wants to start the trenches 5000 feet from the town walls, at F, which is taken as an average length: But if it is actually found that the enemy shells the opening of the trenches too heavily during the mounting and relieving of the guard, and other large crowds of infantry, it is natural that such a trench can be made longer according to one's desire. This being so, I go by daytime round about the aforesaid place F on the one and on the other side, until I see bastion point C cover point B, as indicated by the line FG, and place a beacon at F, and another one in the straight line FG, at the location of H. I then point 1) at HF, and set beacon I in such a spot that I can see point D cover point E, as is indicated by line IK, and place beacon L in the same line IK. These four beacons F, H, I, L, may, as has been said, be placed by day, with small risk of being shelled, as being beyond the range of the musket, but the next two, M, N, on the counterscarp, are placed during the night as follows: Since during the first night in which one wants to start the approach, one has no redoubts to protect oneself by the soldiers lying on them against the sallies of the besieged, one places such a strong guard, infantry and cavalry, that one is protected against them; after such a guard has been placed, and one can

¹⁾ See Part 2, note 3 on p. 355.

is, en datmen ande grachtcant verseeckert genoeg commen mach, men steeckt eerst totte drie plaetsen F, I, L, drie baken of stocken met lanteernen daer op, en commende ande grachtcant tot sulcken plaets, daermen de twee lanteerns I, F, over een siet commen, als an M, daer steltmen een baeck met een lanteern verduijstert na de Stadt toe, en alleen licht gevende over d'ander sijde. Sulcken lanteern steltmen oock an N, te weten opde grachtcant daermen de twee lanteerns L, I, over een siet commen, en noch een in de lini M N, als an O. Dese baken alsoo staende, en de gravers al stillekens an commende, soo steken de Werck-beleijers (Conducteurs) van ontrent vijf tot vijf voet of twee gemeene stappen, een spa in d'eerde inde linien die over al deur twee baken angewesen worden, en an elcke spa steltmen al voortgaende een graver, welcke gravende ter diepte van ontrent drie voeten en in de langde vijf voeten, men heeft graven daermen achter de opgeworpen eerden in bedeckt can gaen, gelijk dat anwijzen de decklinien FM, IN, NM, maer want die soo int duijster metter haest al sou gemaect sijn, soo wordense, den dach angecommen wesende, sonder perikel verbreet op 18 voet, en de borstweeren verhooght na behooren. Om welcker gestalt noch eijgentlicker te verclaren, soo sal ick an wedersijden der decklinien de verbruijnde grachten en getippelde borstweeren teijckenen gelijk dese 2^e form anwijst.

Aengaende Imant mocht twijffelen of dit niet te grooten werck en soude sijn om op een nacht te connen gedaen worden, soo is te weten, dat, al warender schoon 7000 voeten wercx, die souden, op 5 voeten een man gestelt, met 1400 gravers connen gedaen worden, en dat op min als een uijr tijts.

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reach the counterscarp with sufficient protection, one erects first in the three places F, I, L, three beacons or poles with lanterns on them, and arriving at the counterscarp to such a place from where one sees cover one another the two lanterns I, F, for instance at M, there one places a beacon with a lantern, darkened on the town side and giving light only on the other side. Such a lantern is also placed at N, namely on the counterscarp from where one sees the two lanterns L, I, cover one another and still in the line MN, for instance at O. These beacons thus standing, and the sappers quietly approaching, the conductors, at a mutual distance of about 5 feet or two normal steps, put a spade in the earth in the lines indicated everywhere by two beacons, and at each spade one places, while going on, a sapper, who digs about 3 feet deep and 5 feet long, thus forming trenches in which one can go under cover behind the earth thrown up, as indicated by the cover lines FM, IN, NM, for though they have been made in a hurry in the darkness, they are without danger broadened after daybreak to 18 feet, the parapets being raised as required. To explain the shape even better, I shall on either side of the cover lines draw the hatched ditches and dotted parapets as indicated by this 2nd figure.

If somebody should doubt whether this would not be too great a work to be completed in one night, it should be known that even if there were more than 7000 feet to work, this could, with the men spaced at 5 feet, be done with 1400 sappers and that in less than an hour's time.

• Batterien

• Face

• Bresche

De loopgraven aldus tot op de Stadtsgrachtant gedaen sijnde, daer resten noch langs de'selve grachtant te leggen de Grofschutweeren*, om de wallen te beschieten, welcke ick voorbeeltsche wijze nemen tot seven elck van 6 sticken te weten een voor elcke puntsijde* der twee bolwercken, een voor t'middel der gordine, en noch twee elck schietende op een strijckweer. Maer om dit met een form noch beter te verclaren, laet ABCD en EFGH twee bolwercken betijckenen, voor welcke geleyt sijn de seven grofschutweeren als I, K, L, M, N, O, P, te weten de vier I, L, N, P, voor de vier puntsijden AB, BC, FG, GH; het grofschutweer I dient om den bolwercxpunt B ter eender sijde te beschieten, en L ter ander, welcke twee t'samen daeran haest groote walbrake* connen maecken, en desgelijcx is oock te verstaen mette twee grofschutweeren N, P, op den punt G, het grofschutweer M comt voor t'middel der gordine DE. De Stickken van K schieten opt strijckweer EF, en van O opt strijckweer CD; de plaetsen tusschen de grofschutweeren L, M en tusschen M, N betijckenen borstweeren, dick en hooch als d'ander, om musquettiers daer in te leggen. Het borstweer des loopgrafs datter te vooren gegraven wiert langs de Stadtsgracht, twelck QR is, commende achter de grofschutweeren, wort verhooght 6 of 7 voeten hoger dan de borstweeren der grofschutweeren, ten eijnde dat de musquettiers daer op leggende, mogen schieten over de grofschutters sonder die te hinderen; dit voorss borstweer QR is opde kruijn dick gelijck d'ander 15 voeten, om t' grofschut der Stadt te mogen verdragen.

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The trenches thus having been made to the counterscarp of the town, there still remain to be laid along the same counterscarp the batteries to shell the walls, which by way of example I take to be seven, each of 6 pieces, namely one for each face of the two bastions, one for the middle of the great curtain, and another two, each shelling a flank. But to explain this even better with a figure, let A B C D and E F G H be two bastions, in front of which have been laid the seven batteries I, K, L, M, N, O, P, namely the four I, L, N, P for the four faces AB, BC, FG, GH; battery I serves to shell bastion point B on one side and L on the other, which two together may make large breaches; similarly are to be understood the batteries N, P at point G, battery M being placed before the middle of curtain DE. The pieces of K shell the flank EF, and those of O the flank CD; the places between the batteries L, M and between M, N are parapets, equally thick and high as the other, wherein musketeers are placed. The parapet of the trench dug beforehand along the counterscarp, being QR, coming behind the batteries, is raised to 6 or 7 feet above the parapets of the batteries, in order that the musketeers, lying on them, can fire over the heads of the gunners operating the ordnance without hindering them; this aforesaid parapet QR is on the top as thick as the other, 15 feet, thus to withstand the ordnance from the town.

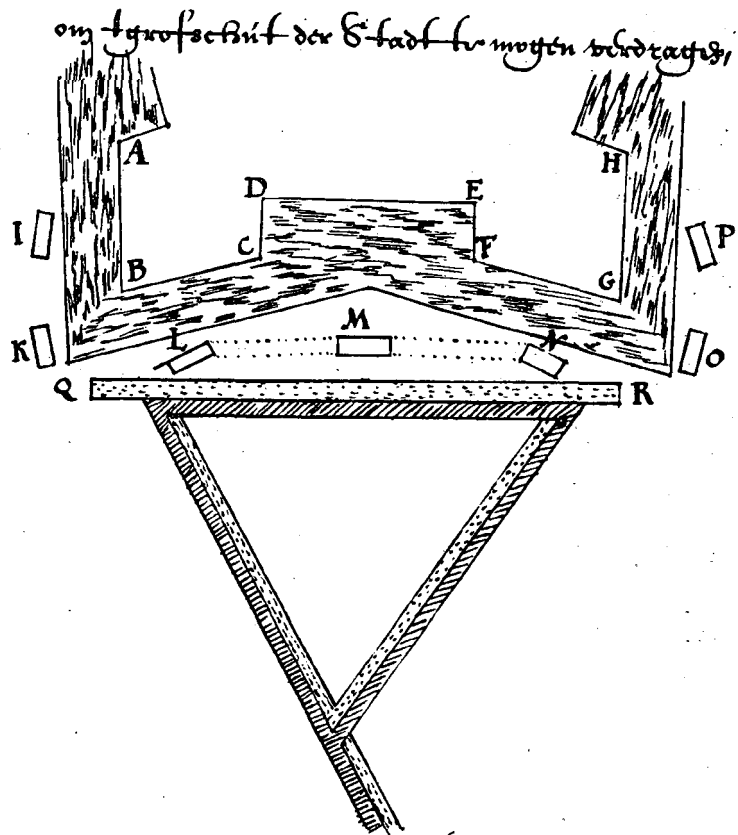


Fig. 10. Fort with approaches, completed and with batteries.

2e Voorbeeld vande naerderingh in welcke men niet alleen deur blootgraving den eersten nacht an de grachtcant comt, maer daermen oock moet bedeckt graven en verscheijden loopschansen en Grofschudtweren maken.

De saecke nu genomen dattet heftich schieten, de uijtvalen en cloeckheijt der belegerden niet toe en laet de naerdering tot opde grachtcant den eersten nacht te doen alleenlick deur blootgraving als uit eerste voorbeeld, maer datmen sich met bedecktgraving, loopschansen en grofschutweeren behelpen moet, soo sal ick daer nu af seggen.

De gravers na uijtgestelde wacht den eersten nacht soo verre gecommen sijnde, als den tijt en omstandigen willen toe laten, men maeckt ten eijnde des loopgrafs een loopschans en grofschudtweer nade manier verclaert inde 3 bepaling; daermen volck en grofschut in brengt, om te bewaren datter gegraven is en de ontsaende graving te bevrijden met minder uijtgestelde wacht dan den eersten nacht: Daer na voorder gegraven sijnde twee, drie ofte vier hondert voeten, of soo veel meer of min als de tegenwoordige omstandigen schijnen te vereijsschen, soo maeckt men weerom ten eijnde des wercx ander loopschansen en grofschutweer, brengende het Crijchsvolck en grofschut inde selve en d'ander verlatende, tenwaer sij noch dienst conde doen: Dergelijke loopschansen en grofschutweeren verlechtmen drie, vier, of meer mael, om also van naerder, met seeckerder schieting, tgrofschut der belegerde te breecken, haer schanscorven en grofschutweeren onbruijckbaer te maecken, en de naerdering meer te bevrijden; doende dese verlegging soo dickwils, tot datmen aende grachtcant comt; alswaermen eijntlick de laetste grofschutweeren en borstweeren der musquettiers legt, gelijk int eijnde des eersten voorbeelts geseijt is.

Merckt noch dat inde bovestaande voorbeelden de sake genomen wiert al of de Stadt gheen buijtenwercken en hadde, maer die hebbende, tis kennelick dat de decklijnen der loopgraven dan souden moeten getrocken worden na de uijterste punten der selver buijtenwercken, gelijkse hier vooren getrocken wierden na de uijterste punten der bolwercken.

2nd Example of the approach in which one reaches the counterscarp during the first night not only by setting out, but for which one must also sap and make various redoubts and batteries.

Assuming now that the vehement shelling, the sallies and bravery of the besieged do not permit making the approach to the counterscarp during the first night only by setting out, as explained in the 1st example, but that one must make shift with full sapping, redoubts and batteries, I shall now speak thereof.

The guard being mounted and the sappers having progressed during the first night as time and circumstances permit, one makes at the end of the trench a redoubt and a battery as explained in the 3rd definition; in this one brings infantry and ordnance to retain what has been sapped and to safeguard the trench made with fewer guards than during the first night. Then, after sapping another two, three or four hundred feet, or so much more or less as circumstances seem to require, one makes again at the end of the work other redoubts and batteries, bringing the infantry and ordnance into it and leaving the other, unless they could still be useful. Such redoubts and batteries are removed three, four or more times, thus from nearby, with more effective shelling, to silence the ordnance of the besieged, to make their gabions and batteries useless and better to safeguard the approach; this is repeated until one reaches the counterscarp, where finally the last batteries and parapets for the musketeers are erected, as stated at the end of the first example.

Also note that in the above examples it has been assumed that the town has no outworks; but if it has, it is evident the cover lines of the trenches must be drawn in that case towards the outermost points of these outworks, as drawn before to the outermost points of the bastions.

Om t'selve bij voorbeeld beter te verklaren, laet A een stadt zijn voor wiens twee bolwercken geleijt sijnde de twee buijtenwercken D, E, tis kennelick, datmen dan de loopgraven moet trecken na de selve twee punten, als ange wesen wort mette decklijnen FG en HI. Maer de buijtenwercken gewonnen sijnde, soo valt te anmercken, dat de wallen en grachten der selve, selden tot goede loopgraven dienen connen, om daerme voort totte Stadtsgracht te naederen, overmits dat haer puntwallen en sijdwallen uijtte Stadt strijckelick getrocken zijn of behooren te wesen, en dattet met verblindingen, dweersen* en diergelijcke moet geholpen zijn, onbequaem om met wagens en peerden daer deur te varen; daerom die verlatende, het schijnt dat beter waer heel rechte nieuwe te graven, als van I over K totte grachtcant an L, en van K totte grachtcant an M. Angaende de manier der bedecktgraving, in dese naerdering nodich vallende, daer soude men hier vermaen af meugen doen, maer gemerckt daer af veel te seggen valt, ick salder het volgende voorstel af beschrijven.

* *Traversen*

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To explain the same better by an example, let A be a town before whose two bastions (B, C) the two outworks D, E have been built: obviously, the trenches must then be dug to the points indicated by the cover lines FG and HI. But, once the outworks have been conquered, it is to be noted that the walls and ditches of the same can seldom serve as good trenches through which to approach to the moat, because its faces and flanks have been drawn so that they can be striked from the town, or ought to be so, and because they must be covered with blinds, traverses, etc., thus rendering them unfit to go through with carts and horses; therefore, leaving them, it seems it were better to dig completely new ones, as from I via K to the counterscarp at L, and from K to the counterscarp at M. Concerning the manner of full sapping necessary for this approach, one could give advice here but because much is to be said about it, I shall describe it in the following proposition.

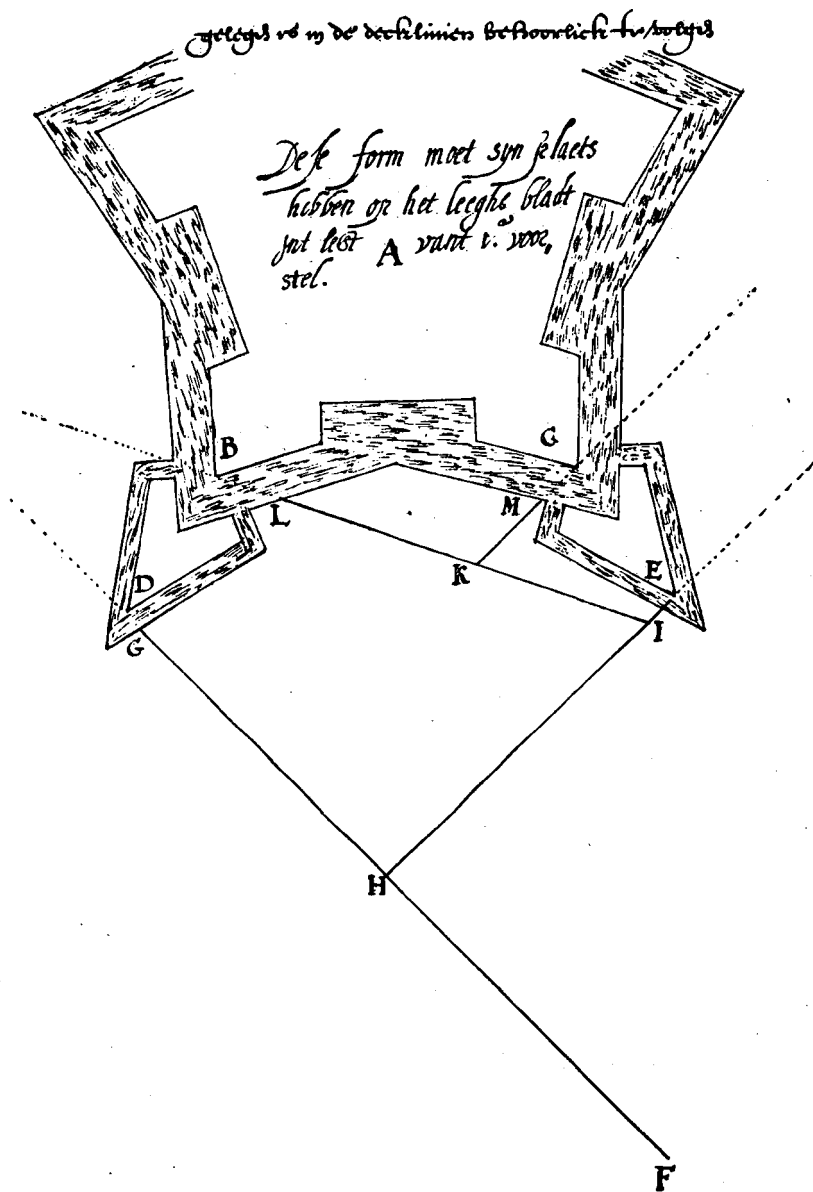


Fig. 11. System of approaches on fort with outworks.

II. VOORSTEL:

Te verklaren ettelijcke omstandighen der bedecktgraving.

De bedecktgraving die gebruikt wort als men de viant te na is om bloot te graven, geschiet gemeenlick aldus:

Een graver gaet alleen voor, soo diep in d'eerde wesende dat hij genouch meent bedeckt te sijn, dats ontrent vier voeten, en worpende de eerde over de behoorlicke sijde na de Stadt als borstweer, maect sijn loopgraf alleenelick soo breed, dat hij vrijelick aerbeijden can, twelck valt ontrent drie voeten. Na desen eersten volgen meer ander, welke onder den schuts van tgeene den eersten gedaen heeft, oock al bedeckt wercken, makende de enge loopgraven en onvolkommen borstweren op haer behoorlicke breedte en hoochde, om met wagens, peerden en grofschut daer in vrijelick te gaen en keeren, na den eijch der loopgraven verclaert inde 1e bepaling. Maer om vant geene hier int gemeen geseijt is, bij voorbeeld eijgentlicker te sprecken, soo laet A, B twee bolwercxpunten beteyckenen, tuschen welke gegraven moet sijn de loopgracht van C tot D langs de Stadtgracht-cant, twelck men gemeenlick met bedecktgravingh moet doen. Genomen nu dat CD sij de decklini waer in de loopgracht op haer volle breedte volmaect is van C tot E, maer van E tot F alleenlick soo breed als den eersten graver gedolven heeft dats 3 voeten breed, doch soo isser van F naer D toe noch een eijnde borstweers 6 voeten verder dan de gracht, als neem ick FG dat ick voorwalleken noem, twelck den eersten graver alsoo geduerlick voor hem opworpt voorder dan de gracht, om geduerlick daer achter int arbeijden bedeckt te wesen.

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2nd PROPOSITION:

To explain various conditions of full sapping

Full sapping, as applied when the enemy is too nearby for the flying sap, is as a rule effected as follows:

A sapper goes ahead alone, being so deep in the earth as he thinks fit for being covered, which is about four feet, and throwing the earth over the required side to the town to make a parapet, he makes his trench only so wide as is necessary for him to work freely, which is about three feet. After this first sapper come others, who under the protection of what the first has done, also work under cover, bringing the narrow trenches and incomplete parapets to their required width and height, to go and return therein freely with carts, horses and ordnance in accordance with the requirement for trenches explained in the 1st definition. But to speak more properly by an example of what has been said here in general, let A, B represent two points of bastions, between which must have been dug the trench from C to D along the counterscarp of the town, which one must generally do by full sapping. Assuming now that CD is the cover line in which the trench is at its full width and completed from C to E, but from E to F only so wide as the first sapper has dug, which is three feet, there is from F in the direction of D another piece of parapet six feet further from the moat; I take FG, which I call head of the sap, which the first sapper thus continuously throws up before him, further than the moat, to be constantly covered behind it during his work.

binge moet doen. Enomen in dat CD sij de det

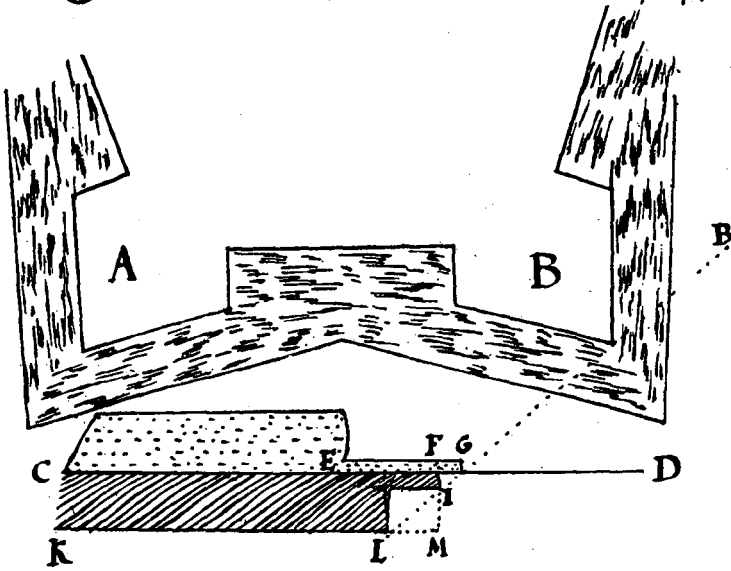


Fig. 12. Sapping (Called full sap with mask).

Vervolch

Tis kennelick dat hoe den eersten graver nader D comt, hoe hem het voorwalleken van 6 voeten, meer bedecken soude, en vervolgens corter mocht gemaect sijn; maer soo hij verder van D waer, dattet hem dan min bedecken soude, twelck soo luttel conde wesen, dat hij hem behelpen mocht met eenige dicke schootvrije plancken, of viercante mandekens met eerde voor hem te stellen, en die alst noot is voort te schuijven. Anders machmen sich behelpen met soo diep te graven datmen sonder borstweer bedeckt is; ten derden machmen knielende graven etc.

De reden blijkt oock waerom de gravers die de loopgraven verbreyden niet te na de eerste meugen commen, want hoewel hij bedeckt is, soo soudensij connen ontdeckt sijn; om twelck te verclaren, laet des volmaeckten loopgrafs buijtenkant KL voortgetrocken worden tot M, nevens den eersten graver an I, en BG sij voortgetrocken tot datse KM deursnijt als an L, dit soo sijnde, tis openbaer dat al wat inden driehouck LIM is, bloot staet voor t'punt B. Maer angesien inde bedektgraving alleenelick eenen aldus voorgaet, soo en heeftse om bekende redenen, niet sulcken rasschen voortganck, als de blootgraving.

De middelen diemen gebruijckt, om de selve soo seer te doen spoeden als men can, is datmen den versten dickwils verandert, en soo haest hij te moede is, een ander in sijn plaets stelt, sulcx dat den eersten dieder int werck is, altijt dapperlick werckt, en wort bevonden alsoo, in bequame eerde, alle uijer 10 of 12 voeten gevoordert te connen worden, in harde steenige gront moetet langer anlopen, als voor Gulick en condemen tot ettelicke plaetsen naulicx een voet ter uijer graven. Noch heeft de bedektgraving daer in voordeel boven de blootgraving, datmen soo wel bij dage als bij nachte arbeijden can, ja bij dage mette meeste seeckerheijt en voortganck, uijt oirsaeck dat de Gravers dan doorde uijtvalen der belegerde soo heijmelick niet overvallen en connen werden, als bij nachte en datmen dan beter siet, wat men doet.

Alsser eenige loopgracht te maken is, die men deur bedektgraving soude moeten wercken, en dat mense nochtans metter haest sonder perijkel wil blootgraven, dat can geschien als men opde loopschansen, Grofschutweeren en loopgrachten, dieder gemaect sijn, soo veel musquettiers can leggen datse met geduerich schieten een half uijer lanck de belegerde het schieten verbieden, want op dien tijt van een half uijer, can een graver in goe eerden, met blootgraven sich bedecken. Tot meerder verseeckertheijt van sulcke wijze, staen de gravers, als het schieten begint, ant eijnde des loopgrachts, gereet met bosstacken diese nevens malcander over eijnde stellen drie voeten vande decklini, als blinding, om daer achter te wercken en de eerde te werpen tusschen de selve blinding en de decklijn. Wanneer de bestedingh op sulcke voorwaerde geschiet, te weten dat de gravers alsoo met musquettiers een half uijer lanck sullen bevrijt sijn, en dat den last vant schieten oock wel nagevolcht wort, en elck op sijn tijt wel past, men can deur sulcke blootgraving haestelick doen, dat anders met bedektgraven veel langer soude anlopen.

Tgebeurt oock tot bevordering vant bedektgraven, datmen in de nacht van 20, tot 20 voet, of soo veel men oirboir verstaet, maeckt een put daer in een man deur t'behulp vande opgeworpen eerde bedeckt can staen, en den dach angecommen sijnde, loopt in elcke put een man, welcke d'een na d'ander toegravende en datter tien putten sijn geweest, men can dan op een uijer soo veel graven als anders een alleen op thien uijeren.

Opdat de Bedektgravers lichtelick uijt de gracht geraken, om een uijtval te

Continued

Obviously, the more the first sapper approaches D, the more the head of the sap of six feet would cover him, which then could be made shorter; but if he were further back from D, it would cover him less, which might be so little that he would shift by placing before him some thick bullet-proof boards, or square baskets filled with earth and which if necessary could be pushed forward. Otherwise one might shift by digging so deep that one is covered without parapet; thirdly, one might sap in a kneeling position, etc.

The reason is also clear why the sappers who widen the trench must not come too close to the first, for although he is covered, they might be discovered; to explain which, let the outside KL of the completed trench be extended to M, beside the first sapper at I, and BG extended until it intersects KM at L; this so being, it is clear that all that is in the triangle LIM, is exposed to point B. But since in the full sapping only one goes first like this, it does not, for known reasons, make such rapid progress as the flying sap.

The means which one uses to speed up the work as much as possible, is that one often relieves the farthest; as soon as he is too tired, he is replaced by somebody else, such that the first of those at work invariably works energetically, so that it is found that in suitable earth, one can progress 10 to 12 feet per hour; in hard rocky soil it will take longer, as before Juliers, where one could in various places scarcely sap one foot per hour. Another advantage of full sapping over flying sapping is that one can work during the day as well as at night, yea, during the day with more certainty and progress, because the sappers then cannot so secretly be surprised by the sallies of the besieged as during the night and because one then sees better what one is doing.

If a trench is to be made which would have to be dug by full sapping, while one wants to make it hurriedly without danger by flying sap, this may be done by placing on the redoubts, batteries and trenches which have been made, so many musketeers that by continuous firing they render it impossible for the besieged to shell for half an hour, for within that time a digger can in suitable earth cover himself by flying sap. To ensure more safety for this manner of working, the diggers, when firing starts, stand at the end of the trench, ready with branches, which they erect side by side, three feet from the cover line, as a blind, to work behind it, throwing the earth between this blind and the cover line. If the contract work takes place under such conditions, to wit that the diggers shall be protected by musketeers for half an hour, and that the charge of firing is also followed, and each pays careful attention to his time, one can by such flying sapping do quickly what otherwise would take much longer by full sapping.

To promote full sapping it also happens that during the night holes are dug, 20 feet, or as long as is regarded expedient, apart, in which a man may stand covered by means of the earth thrown up, and day having come, in each hole one man runs who saps to the other; if thus there have been 10 holes, people can in an hour sap as much as otherwise a single man in ten hours.

In order that the sappers may easily leave the trench to escape from a sally,

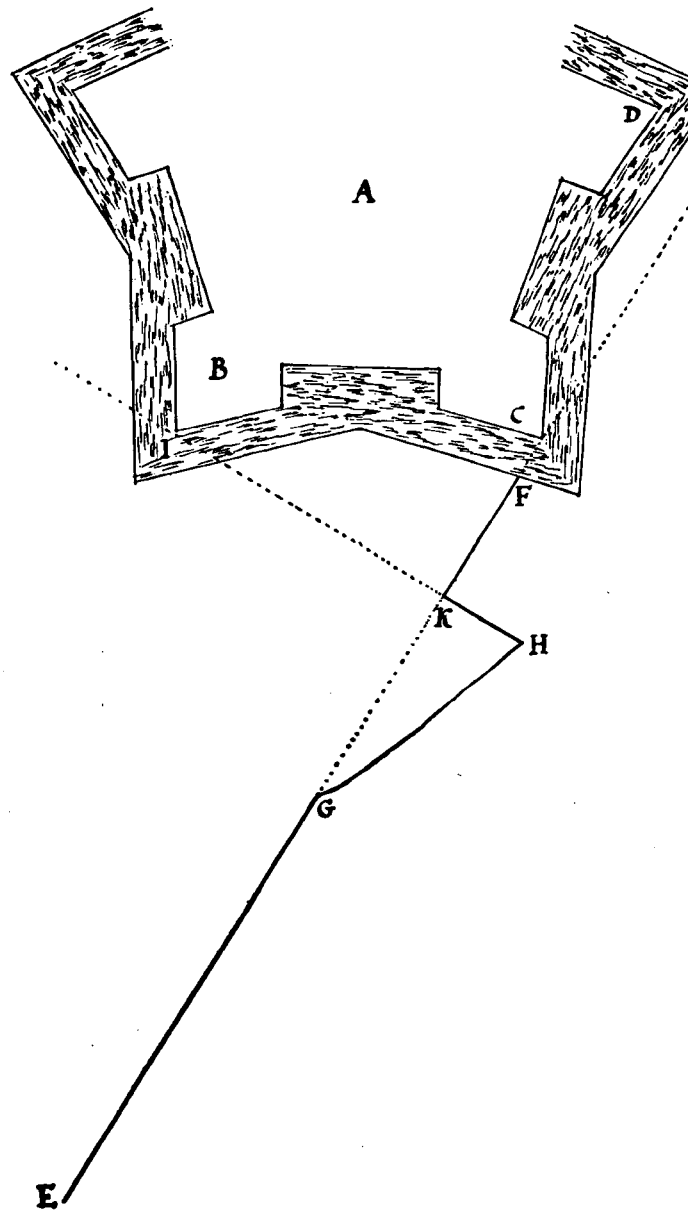


Fig. 13 Repair of erroneous work in an approach.

ontlopen, soo steken sij de spa in d'een cant des grachts, tot half wegen der hoochde om die als trap te gebruijcken; anders connen sij tot dien eindje van te vooren twee of drie trappen inden cant des Loopgrachts graven.

Als den eersten graver knielende arbeijt, hij can met vier voeten diepte des loopgrachts bedeckt sijn, oock ter plaetse daer geen opgeworpen eerde en is. Maer want hij dan mette spa de eerde des uijttersten cants niet van boven neerwaert en can afstecken, sonder hem bloot te geven, soo gebruijckt hij in sulcken gevalle een houweel waerme hij bedeckt blijvende van boven neerwaerts slaet na de manier gelijck die reetschap vereijst, en worpt daer na de afgehouden eerde met een spa opwaerts.

Noch staet te gedencken dat ant recht volgen der decklini, veel gelegen is, want soo den eersten bedecktgraver te seer na de Stadtsijde loopt, al stonde hij int graven soo diep in d'eerde, dat hij geduerlick bedeckt waer te wijle hij werckt, soo en sullen nochtans sij die achter hem graven niet bedeckt sijn, waer uijt dickwils volcht datter veel geschoten worden eer sulcx gebetert is, en al gebetert sijnde met dweersen en verblindighen, of sulcx alst wesen mocht, soo ist gemeenlick noch manck sorghelick werck. Maer bij aldien den eersten bedecktgraver te seer vande Stadt wijckt, soo comt hij oock in ongevallen. Laet tot verclaring van desen A een Stadt sijn dies drie bolwercxpunten B, C, D, en de Decklini dieder besloten was te loopen sij EF te weten van E na den bolwercxpunt C tot ande grachtcant F, maer den eersten bedecktgraver deur misverstant of onachtsaemheijt en heeft niet gevolcht neem ick de selve decklini EF, dan sij gecomen van E over G tot H na de buijtsijde der Stadt; dit soo sijnde ick segh,

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they put the spade in one side of the trench halfway up the slope to use it as a step; otherwise they can for this purpose first make two or three steps in the side of the trench.

If the first sapper works in a kneeling position, he can be covered by a trench four feet deep, also there where no earth has been thrown up. But as he cannot then cut the earth of the furthest side with the spade from the top downwards without exposing himself, he uses in such cases a pick-axe with which, while remaining covered, he cuts down after the manner required by this tool, and then throws up the earth thus loosened with a spade.

It is also to be borne in mind that it is very important that the cover line should be followed straight, for if the first sapper goes too much to the side of the town, even if during sapping he should stand so deep in the earth that he was continually covered while at work, those sapping behind him will not be covered, from which it often follows that many men are shot before this has been remedied, and after it has been remedied with traverses and blinds or something else, it is nevertheless in general wrong work that gives worry. But if the first sapper goes too far away from the town, he also comes to grief. Let, to explain this, A be a town with three bastion points B, C, D and the cover line which had been decided upon to run along EF, to wit from bastion point E to bastion point C as far as the counterscarp F, but if the first sapper through misunderstanding or negligence, has not followed, I take the same cover line EF, and from E via G to H comes to the outside of the town; this being so, I say that

dat hoewel men van E over G tot H toe bedekt gact, nochtans om van daer op F te commen en can dat met rechte loopgracht niet gevouchelick geschien; soo nu de vrage waer, hoemen bij gemeene regel, in dit en dergelijcke ongevallen doen soude, mijn gevoelen is, datmen van H soude loopen na den punt B, gelijk angewesen wort mette lini HI tot datmen comt inde decklini EF, of anders geseijt tot datmen den punt C siet bedecken den punt D, als an K tot F, sulcx datmen dan sall hebben de cromme loopgraven E(G)HKF in wiens plaets, alsmen eerst wel gewrocht hadde, beter waer, om de voorgaende redenen, de rechte loopgracht EF waer uijtmen mercken mach het groot voordeel datter gelegen is in de decklinien behoorlijk te volgen.

Tot hier toe is geseijt van loopgrachten, ter plaets daer eerde is om in te graven, maer daer de naerdering moet geschien deur waterige, marassige landen, als waermen geen loopgrachten graven en can, maer daermen boven twater maeckt wegghen en borstweeren van rijs tacken en bomen als mense genouch krijgen can, daer sal ick nu wat afseggen. Voor al is te weten dat deur de langduerige belegeringe van Ostende sulcken manier van borstweeren int gebruik gerocht is, welke oock beschreven heeft int Hoofdstick van sijn waer af den sin dusdanich is.

Vorder en is hier niet afgevonden.

III. VOORSTEL: *Vande naerdering door de Gracht.*

Hier vooren verclaert hebbende hoe op de Stadtsgrachtcant geleijt sijn de grofschudtweeren, en daer tusschen de borstweeren der musquettiers, mitsgaders het lanck hooger borstweer daer achter, oock voor musquettiers, soo rester nu vande naerdering door de Gracht te seggen:

- * *Galerijen* Om twelck te beginnen men maeckt vande uijterste loopgracht af tot ande Stadtsgrachts watercant 6 of 8 of soo veel enden van looven*, als men overcomsten deur de Gracht wil hebben, want angesienmen der soo haest acht, als maer een en maeckt, soo hout sijn Vorstelicke genade voor een regel oirboir te wesen, veel overcomsten of loven te maecken, want op een alleen can de viandt deur de wal tegen graven om die inden mont te beschieten en te breken eerse over geraeckt,
- * *Minering* of schoon over gecommen sijnde om dan tegen de belegeraers ondergraving* te wercken; maer op soo veel verscheijden ancomsten t'seffens en can hij dat niet over al bestellen, en doet hem de moet verliesen; nu want dese endekens loven
- * *Sappering* opt landt staen, soo connense met bedektgraving* lichtelick gemaect worden, maer van daer voort niet dan water sijnde, soo moet de gracht gevult worden, om gront te hebben daer de looven (diens maecksel ick terstont beschrijven sal) op rusten, waer toe een groote menichte van rijs al gereet sijnde, men begint mettet voors grofschut te schieten en breecken alle grofschutschietgaten, schanscorven, grofschutweeren en borstweeren der belegerden dieder mochten overgebleven sijn, waer benevens al de musquettiers oock geduerlick schieten over de canten der borstweeren daer de belegerde musquettiers mochten achter leggen, en can hier mede te wege gebrocht worden datter niet een der belegerden is, die dorft over het borstweer kijken, sulcx datmen de gracht bij claren dage haest can vullen al ofter geen vianden in en waren; twelck alst soo met sulcke seeckerheijt toegaet, t'gebeurt datmen bloot daer over loopt, inde wallen begint te graven, en dat de

although one proceeds covered from E via G to H, to come thence to F is not properly possible by a straight trench; now if the question were how by a general rule one should act in this and similar mishaps, my feeling is that one should go from H to point B, as is indicated by line HI, until one reaches the cover line EF, or in other words, until one sees point C cover point D, as from K to F, in such a manner that one shall then have the curved trenches E(G)HKF, instead of which, if one had first worked correctly, it were better, for the aforementioned reasons, to have the straight trench EF, from which one can see the great advantage of accurately following the cover lines.

Up to now has been spoken of trenches where there is earth to dig in, but if the approach has to be made through watery, marshy lands, where one cannot dig trenches, but where one makes above the water roads and parapets of fascines and trees if they are available in sufficient quantities, I shall now say something about it. It should also particularly be known that through the prolonged siege of Ostend such a kind of parapets has come into use, which has also described..... in the Chapter of his of which the meaning is the same.

No more has been found.

3rd PROPOSITION:

Of the approach through the moat

Having explained before how on the counterscarp of the town have been erected the batteries, and in between the parapets of the musketeers, together with the long, higher parapet behind, also for musketeers, the following remains to be said of the approach through the moat:

To begin with one makes from the outermost trench to the side of the moat 6 or 8 or as many ends of galleries as one wants crossings through the moat, for as in this way one makes as soon eight as one, so his Royal Grace esteems it as a rule to be expedient to make many crossings or galleries, for against only one the enemy can dig through the wall, to shoot in its mouth and to destroy it before it reaches the other side, or if it has reached it then to work against the mining of the besiegers; but on so many different points he cannot order this everywhere and it makes him lose courage; now if these ends of the galleries stand on land, they could be readily made by full sapping, but since in front there is nothing but water, the moat must be filled up to obtain ground on which to found the galleries (the construction of which I shall describe presently), for which a large quantity of fascines has been put ready; one starts by shelling with the aforesaid ordnance, destroying all ordnance embrasures, gabions, batteries and parapets of the besieged which may have been left, beside which all the musketeers also fire continuously across the tops of the parapets behind which the besieged musketeers might lie, and the result of this may be that there is not one of the besieged who dares to look over the parapet, so that one can almost fill up the moat in broad daylight as if there were no enemies in it; this may be done with such certainty that it happens that one walks across it exposed, begins to dig into

Stadt haer overgeeft, sonder looven gemaect te worden; de vulling des grachts van Gulick die breed was ontrent 70 voeten, diep . . . voeten hier wat meer, daer min, wiert aldus gedaen op 3 uijeren tijts daer toe waren 8 mannen die geduerlick rijs in wierpen en . . . man die anbrochten. Doch dat soo niet luckende, maer datter om bedectelick en vrijelick over en weerover te loopen, looven moeten sijn, soo is dit de wijze: Men maeckt jocken of galgen van hout dick . . . of . . . duijm, hooch . . . voeten, breed . . . voeten, die in voorraet al gereet sijn, om van ontrent twee tot twee voeten een Jock te stellen, twelck aldus toegaet: genomen, als vooren geseijt is, gestelt te wesen ande watercant het laetste Jock vant eijnde loofs dat opt lant staet op beijde sijden en boven op met eerden beset; om nu van daer voort te wercken, men worpt int water soo veel rijs, tot dattet hooch genouch is, en soo breed om opde sijden te verhoogen soo veel als het beschutsel der looven behoeft.

Daer sijn noch ander middelen om deur grachten te commen, als met vlotten over water; oock canmen sommige grachten drooch maecken (stoppende eenige wateren die inde gracht loopen) mettet water daer uijt te malen en drooch sijnde daer deur te graven.

Dit is t'geene ick vant naderen deur de gracht uijt mijn Vader Za. schriften heb, belangende vant naderen deur de wal daer heb ick alleenlick dese volgende anteykeningen af gevonden.

IV. VOORSTEL:

Vande naerdering door de wall.

De wal can gewonnen worden met ondergraven*, met springen, met stürmen gheen binnewercken sijnde, dan de Stadt, met grofschut sonder storm, met verdrach.

Int doen springen der wallen deur ondergraving staet te bedencken de onseckerheijt vant uijtbrecken, inwaert of uijtwaert; uijtwaert breeckende, sij beschadicht u eijgen looven, volck, grofschut en sijn weeren. Te weijnich buscruijt doet onseckere brake, te veel stelt in perikel u eijgen looven, volck, grofschut en magazijnen dieder ontrent sijn. Het ondergraven is goet om dat de belegerde geduerlick in vreesen sijn van op te springen.

V. VOORSTEL:

Wesende gegeven de grontteijckening van een Stadt; te trachten na de bequaemste teijckening der loopgraven dieder vallen can, om na de manier vandien de nadering totte grachicant te doen.

Want ons voornemen is, te beschrijven de gemeene regel vande bequaemste teijckening der loopgraven dieder van een voorgestelde Stadt vallen can, soo is te weten datmen die beter can treffen deur een rechte grontteijckeningh, dan uijt dadelicke besichting der Stadt sonder besichting der grontteijckening; daerom salmen sulcke grontteijckening van een belegerlicke Stadt, tot dien eijnde maken te krijgen alst geschien can, mits welverstaende datse ligge (gelijck wij de saecke hier voorbeeltse wijze nemen) op een plat even landt, sonder voordeel van dijcken, grachten, diepe wegen, hagen, hoochten daermen bedectelick achter gaen can, en dieder van selfs sijn sonder datmen loopgraven behouft te maken.

the walls and the town surrenders without galleries being made; the moat of Juliers, which was about 70 feet wide, feet deep, here a bit more, there a bit less, was thus filled up within three hours; for this purpose there were 8 men who constantly threw fascines into the moat and men who carried it. But if this is not successful, so that to go under cover and freely up and down there must be galleries, then this is the way:

One makes frames of wood, or inches thick, feet high, feet broad, which have been put ready for use, to be placed at a distance of about two feet, which is done as follows: take, as stated before, that is erected the last frame on the water front of the galleries standing on land, covered at both sides and on top with earth; now to proceed thence, one throws so many fascines into the water that it is high enough and so broad as to raise the sides so much as the protection of the galleries requires.

There are still other means of crossing moats, as with rafts across the water; also, some moats can be drained (by blocking some waters running into the moat), by pumping the water from them and being dry, to dig through them.

This is what I have on the approach through the moat from my deceased Father's writings; concerning the approach through the wall I have only found the following notes.

4th PROPOSITION:

Of the approach through the wall

The wall can be conquered by mining, by blowing up, by storming if there are no retrenchments, then the town, with ordnance without storming, by negotiation.

When blowing up the walls by mining one should be aware of the uncertainty as to which way the mine springs, to the inside or to the outside; when it springs to the outside, it damages your own galleries, soldiers, ordnance and batteries. Insufficient gunpowder makes the breach uncertain, too much of it endangers your own galleries, soldiers, ordnance and store-houses in the vicinity. Mining is expedient because the besieged is in constant fear of being blown up.

5th PROPOSITION:

The ground plan of a town being given, to try, after the best drawing of the trenches that can be made in that way, to approach to the counterscarp

Since it is our intention to describe the common rule of the best drawing of the trenches that can be made for a town under consideration, it should be known that it can be made better by a correct ground plan than by direct observation of the town without studying the ground plan; therefore one shall try to obtain for this purpose, if it can be achieved, such a ground plan of a town to be besieged, provided, it be understood, that it lies (as we assume here by way of example) on flat, level land, without the advantage of dikes, moats, deep roads, hedges, elevations, behind which one can go under cover, and which are provided by nature without trenches having to be dug.

Sulcke grontteijckening neem ick te wesen de bijgevouchde form, van een Stadt met 13 bolwercken als A, B, C, D, E, F, G, H, I, K, L, M, N, welcker twee A, B commen op des stats scherpste hoecken, de twee C, D liggen tusschen drie gordinen, altermael in een rechte lini, de ses E, F, G, H, I, K liggen tusschen seven gordinen die een uijtwendige bocht maken, maer de drie L, M, N tusschen vier gordinen, maeckende een inwendigen bocht, gelijckt veel gebeurt met steden die an rivieren liggen, om dat, bij gemeene regel, an die sijde de diepte der riviere is. Dit soo sijnde ick segh A, B twee bolwercken te wesen tusschen welcke men de Stadt mettet meeste voordeel mach antasten, om de naerdering daer op te doen, en de loopgraven bequamelicxt te teijckenen, en dat na de manier beschreven int eerste voorstel als angewesen wort mette loopgraven OP, QR en PR. En

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Such a ground plan I take to be the annexed form, of a town with 13 bastions A, B, C, D, E, F, G, H, I, K, L, M, N, two of which, A, B, are at the sharpest corners of the town; two, C, D, lie between three curtains, all in a straight line, the six E, F, G, H, I, K, lie between seven curtains which make an outward bend, but the three L, M, N between four curtains, making an inward bend, as often occurs in towns lying on rivers, because the river is as a rule deepest on that side. This so being, I say that bastions A, B are two bastions between which the town can be attacked with the greatest advantage, to make the approach on this point and to draw the trenches most efficiently, and that according to the manner described in the first proposition these are indicated as the trenches OP, QR and PR. And to

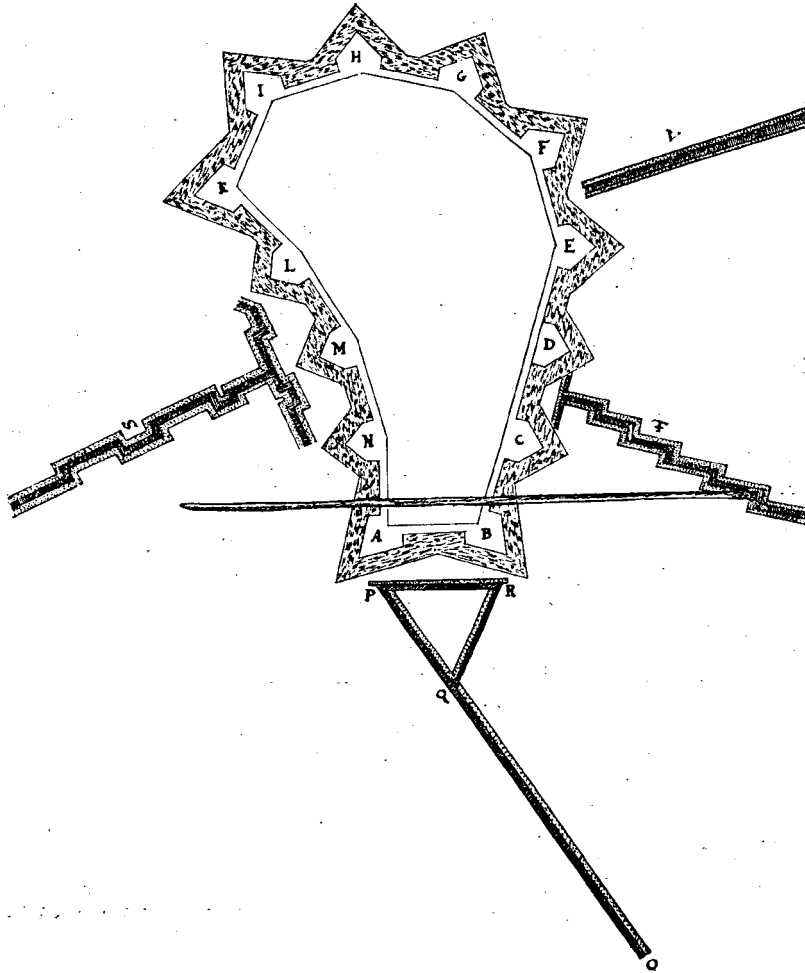


Fig. 14. Irregular fortress with approaches and three kinds of sapping.

om reden te verclaren waerom dit des bequaemsten oirt is, om de Stadt mettet meeste voordeel an te tasten, en dese de beste manier der loopgraven sijn, die mij nu op dese geveve form te voorcommen; mitsgaders vant voordeel tusschen dese wijze, ende de cromme loopgraven na de gemeene manier. Soo is te weten, daer veel bolwercken op een rechte lini sijn, of op een inwendigen bocht, gelijckt veel groote steden gebeurt, en sooder in dese form teijckening af te sien is, daer valt de naerderingh beswaerlick, en als men schoon over de gracht gerocht is, en de saecke tot stormen bereijdt heeft, soo en can men sonder groot achterdeel niet stormen, om dat men van de belegerde op de sijden en inde rugge beschoten wort. En daerom tast men de steden liefst an op de scherpste uijsteeckende punten, tenware dat most gelaten sijn om marasch, rivieren, of ander beleten.

Nu de reden waerom dit de bequaemste loopgraven sijn, die mij op dese teijckening te voorcommen, mitsgaders t'voordeel hier in boven de gemeene manier. Soo segh ick, daer cromme loopgraven sijn, en can den Veltoverst geen vast gemeen besluit hebben vande geheele oirden der loopgraven; sij sijn oock middelen om de annemers bedriechelick te connen behandelen, groot gelt bedingen van wercken die dickwils buijten perikel sijn, jae den selve werck meer als eens doen betalen; men cander het grofschut en wagens niet bequamelick deur brengen, maer men moet dat bij nachte, inde duijsterheijt, met stilte anbrengen, om te min geschoten te worden; men cander op eenen nacht niet veel werck me spoijen, om de gestadige veranderingen dieder vallen mette decklijnen; maer met lange rechte loopgraven als dese can den Veltoverst een gemeen besluit hebben vande geheele oirden; de annemers en connen oock hier in niet bedriechelick handelen; tgrofschut en wagens voert men daer in bij lichten dage, sonder perikel, met al veel beter voortganck; voerliën en ander die bevreesd sijn, en hemliën t'soecken maecken, sijn anders gewillich; lange rechte loopgraven connen int werck sulcke voortganck hebben (gelijck te verstaen is uijtset voorgaende eerste voorstel) dat men den eersten nacht daer me tot op de grachtcant can commen, voornamelick als men begint (gelijck wel gebeurt) sonder dat den viant schiet.

Maer soomen om der belegerden macht, de Stadt meer dan op een plaets wilde antasten, met naerdering, soo valt voor eerst te anmercken dat men geen naerdering behoort tegen over malcander te doen, om de overvliegende cogels wille daer de naerderaars malcander me beschadigen, ten ware dat om de groote langde der Stadt sulcx buijten perijckel stonde. Dit verstaen sijnde en dat men om de bovess. beletsels van maras, rivieren of anders gedrongen waer de Stadt an te tasten ter plaetse daer veel bolwercken op een rechte lini of een inwendigen bocht lagen, alwaermen om bekende redenen soo bequamelick sulcke groote rechte linien niet maken en can, soo sal ick eenige formen teijckenen uijt welcke en andere men ter plaetse daert noot is de bequaemste nemen can, als S, T en V.

VI. VOORSTEL:

Vande middelen dieder sijn om de naerdering wel te bevorderen.

Het helpt luttel dat ijmant weet watter tot een naerdering behoort, als hij niet en heeft menschen diet verstaen en doen connen. Om sulcke te krijgen en van nieuws bequaem te maecken, daerse niet en sijn, en wel te onderhouden daermense heeft, soo valter te anmercken dat men daer toe moet hebben, cloecke leijtsmannen,

explain the reason why this is the most expedient place to attack the town with the greatest advantage, and why these are the best types of trenches, which now occur on this given plan, hence the advantage between this manner and the curved trenches according to the common rule, it should be known, that because many bastions lie in a straight line, or in an inward bend, as is often seen in large towns, and as can be seen in this plan, there the approach is difficult and when one has already crossed the moat, and prepared everything for storming, one cannot storm without great disadvantage, because one is shelled by the besieged from the sides and in the back. And therefore one prefers to attack the town on the sharpest projecting points, unless this cannot be done because of marshes, rivers or other hindrance.

Now the reason why these trenches occurring on this drawing are the best ones and therefore have advantage over the common rule, I say that where there are curved trenches, the General cannot have a precise, general opinion of the entire layout of the trenches; they are also means for fraudulent practices by contractors, stipulating much money for works which often do not involve any risk, yea claiming payment more than once for the same work; one cannot readily transport ordnance and carts through them, but this must be done at night in the darkness and in silence to avoid being shelled; one cannot in one night complete much work with it, because of the continuous changes in the cover lines; but with long straight trenches such as these the General can have a general opinion of the entire arrangement; the contractors cannot either perform sharp practices here; the ordnance and carts are carried into them in broad daylight, without any hazard, with much better progress; drivers and others who are scared and go off, are now willing; long straight trenches can speed up the work so much (as can be understood from the above 1st proposition) that it may bring the soldiers in the first night on to the counterscarp, particularly if one begins (as does happen) without the enemy shelling.

But if, because of the power of the besieged, one wants to attack the town in more than one spot, by approach, it should first of all be observed that one must not make the approach from opposite sides, because by the bullets flying across, the approaching armies will damage each other, unless because of the great length of the town this risk is precluded. This being understood and while because of the above-mentioned hindrances of marsh, rivers, or otherwise one is compelled to attack the town at the location where there are many bastions in a straight line or in an inward bend, where for known reasons one cannot so easily make such large straight lines, I will draw some figures from which, and others, one can where need be take the best, such as S, T and V.

6th PROPOSITION:

Of the means available to promote the approach

It is of little avail if a man knows what an approach involves, if he has not got the men who understand it and can accomplish it. To get them and to make skilled from unskilled ones, there where they are not available, and to keep them where one has got them, it can be stated that for this purpose one must have

want die meer uijtrecchten met versaefde wercklien, als versaefde leijsmannen met cloecke wercklien; om totte selve wel te geraecken in genouchsame menichte, sulcx datmen alsser eenige geschoten sijn niet verlegen en blijft, maer terstont ander in haer plaets mach hebben, den Overst salt vernemen bij al de gheene daer hijt schijnbaerlick best af can weten, twelck voornamelick behooren te wesen Opsienders der wercken*; daerom waert goet voor al te trachten na getrouwe en cloecke opsienders die de doot weijnich vreesen, en de selve doen acht nemen wie int graven vrijmoedichst en onverschroomt wercken en uijt de gheene, die soo deur anderen als deur hem angedient worden, salmen verkiesen de cloeckste en bequaemste om die tot Leijsmannen* der naerdering te gebruijcken, hemlien doende onderrechten en verstaen tgeene totte anleijdinge nodich is, als soo wel bij nachte als bij dage, op baken rechte of andere begeerde decklijnen te graven, Loopschansen, Grofschutweeren, en diergelijcke te maken. En soodanige leijsmannen moetmen alleenlick soo groote besolding geven, of vereeringen doen, datmen metter daet bevindt genouch bequame daer na te trachten, die in onversaeftheijt malcander soecken te boven te gaan.

* *Contrerolleurs
van de fortificatie*

* *Conducteurs*

VII. VOORSTEL:

Inhoudende een besondere gemeene regel opt Naerden.

Om bij gemeene regel vant naerden te spreekken, soo stellen wij ons voor een belegerde sterckte, waer af t'landt daermen op naerdert pladt is, niet waterich noch cluspich, noch oock voordeel hebbende vande [dekking] van hagen, grachten, diepe wegen of diergelijcke, alswaermen t'sijnen voordeele nemende datmender vindt, soo en valt daer af geen gemeene regel. Het gaet mettet beschrijven der naerdering toe, gelijckt mettet beschrijven der Stercktebouwing, want gelijckmen sich daer met goede reden ten eersten voorstelt formen dienende op een pladt eerdich landt, sonder voordeel of achterdeel, om daer me de ghemeene regel te verclaren en deur kennis van dien tot alle ontmoetende plaetsen na t'meeste voordeel te meugen trachten. Alsoo ist oock oirbaar int beschrijven der naerdering, datmen sich ten eersten voorstelt een form dienende op een pladt eerdich landt, sonder voordeel of achterdeel. Want soomen comt ter plaets daer sulck heel even landt is, men mach de regel volcomelick volghen; maer het landt anders gestelt sijnde, men mach uijt de gemeene regel sijn meeste voordeel trecken.

Om dan tot de saecke te commen, men sal den eersten nacht datmen begeert te naerden, soo stercken wacht houden, en soo veel verlooren schiltwachten stellen, datmen hem tegen alle uijtvalen dien eersten nacht verseeckert hout, ist niet genouch mettet halve Leger, men macher meer toe nemen, wantmen daer na tot groote verlichtingh vant Crijchsvolck kleene wacht behouven sal, uijt oirsaeck dat de manier der nabeschreven loopgraven soodanich sal sijn, datmen daer in beschanst sal wesen.

brave foreman, because they accomplish more with cowardly workmen than cowardly foremen with daring workmen; to acquire a sufficient number of them, such that if some have been killed, one is not short of them, but can at once replace them, the General will learn from all those who apparently know best, who should mainly be the superintendents of the fortifications; therefore, the main purpose is to try after loyal and daring superintendents who have little fear of death and to make them observe those who work in digging most boldly and fearlessly, and from among those who are thus recommended by others and by himself one shall choose the most daring and skilled ones, to use them as foremen for the approach, to teach them and make them understand what is necessary for this purpose, both during the day and at night, to dig by means of beacons straight or other desired cover lines, to make redoubts, batteries and such like. And such foremen should be given such high pay or be honoured so much that one in fact finds enough of fit men striving for it, who as regards undauntedness try to outdo one another.

7th PROPOSITION:

Containing a special common rule for approaching

To speak by a common rule of the approach, we assume a besieged fortress, the land round about, on which one makes the approach, being flat, neither watery nor swampy, nor having the advantage of the protection of hedges, ditches, deep roads or such like, where one takes to one's advantage what one finds there, for this there is no common rule. The description of the approach is like that of the Art of Fortification, for just as for good reasons one there in the first place proposes figures on a flat, earthy land, without advantages or disadvantages, to explain therewith the common rule and through knowledge thereof to gain most advantage for all places one meets, thus, in describing the approach, it is also permissible that one in the first place imagines a figure on flat, earthy land, without advantages or disadvantages. For if one comes to a spot where there is such very flat land, one can perfectly follow the rule, but if the condition of the land is different, one can from the common rule obtain most advantage.

Then to come to the matter, one shall in the first night during which one wants to approach, keep such a strong guard and post so many extra sentries as to be safeguarded during this first night against all sallies; if it is not sufficient to take half the army-camp, one may take more for this purpose, because afterwards, to the great relief of the soldiers, one will need a small guard, since the manner of the trenches described hereinafter shall be such that one is entrenched in them.

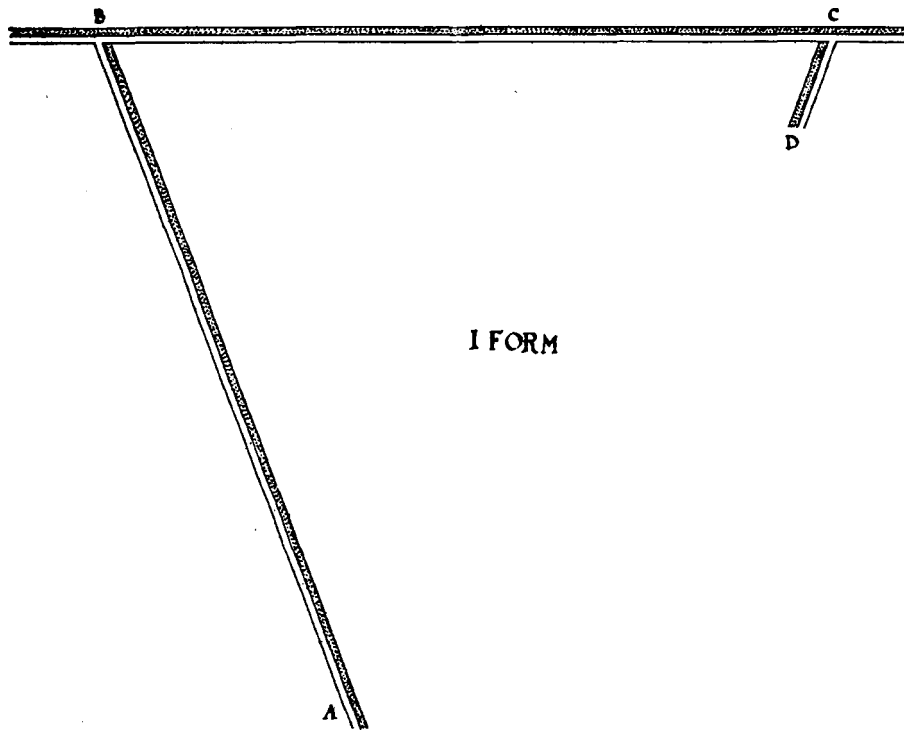


Fig. 15. Systematic manner of approaching and taking the counterscarp (1).

I FORM

Sulcke wacht den eersten nacht gestelt sijnde, mensal beginnen te graven de drie loopgraven als in d'eerste form AB, BC, CD, vijf voeten breed, welverstaende dat BC langs de Stadtgracht comt, ten naesten datmender alsoo denckt te graven. Achter AB ismen bevrijt voor t'een uijterste vande Stadt, en achter CD voor t'ander uijterste. De getippelde plaetsen bedien borstweeren, d'ongetippelde, wegen.

Dit loopgracht BC langs de Stadtgracht is oirboir ten aldereersten te graven; eensdeels wanttet ghemeenelick twee of drie dagen na de comste anloopt eermen begint te naerderen, soo sijn de belegerde van dat begin en ant naeste loopgraf (twelck volgende t'gestelde doch moet gedaen sijn) onseeckerder dan opde volgende nachten, wantse dan weten datmen mettet graven sal voortvaren. Ten anderen merckense waermen vorder graven wil. Ten derden als men anders doet, men stelt hem elckemael datmen naerder comt in nieu perikel der musquetschoten, daermen aldus al de rest der graving sonder perikel doet, mits datmen volcht de manier die hier na geseijt zal worden.

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DIAGRAM I

Such a guard having been mounted during the first night, one shall begin to dig the three trenches as in the first form AB, BC, CD, five feet wide, it being understood that BC runs along the moat of the town, closest to the place where one thus intends to dig. Behind AB one is protected against one end of the town and behind CD against the other end. The dotted spots represent parapets, the non-dotted one's roads.

It is expedient that the trench BC along the moat should be dug first of all; on the one hand because usually two or three days elapse after arrival before one starts the approach, so that the besieged from this beginning and at the nearest trench (which following the above must be done) are more uncertain than during the next few nights, because they then know that one will continue digging. On the other hand, they see where one wants to go on digging. Thirdly, if one proceeds in a different way, each time one comes closer one is endangered anew by the musket shots, whereas one does all the rest of the digging without risks, provided one follows the method to be described below.

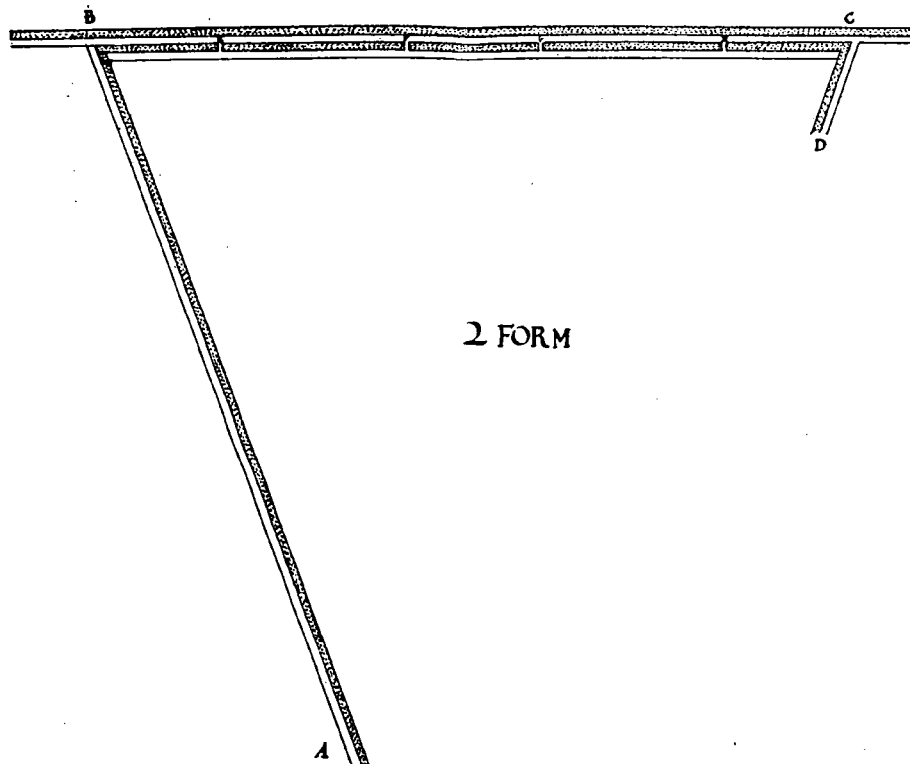


Fig. 16. Systematic manner of approaching and taking the counterscarp (II).

II FORM

Alsmen aldus voor hem heeft het borstweer BC, en het loopgraf vijf voeten breed gelijk in d'eerste form, men sal op de cant van d'ander sijde dats achter sich, opworpen een borstweer van vijf voeten hooch, als inde tweede form, latende daer in vier openheden, gelijk geteijckent sijn met E, F, G, H, tusschen welcke openheden de eerde wech genomen sal worden soo diep als d'ander loopgraven sijn, en d'eerde daer uijt commende, salmen worpen opt borstweer voor dat gat, om in t'selve gadt te bedeckter te sijn. En sal dan dat loopgraaf breed sijn 10 voet.

Dit gedaen wesende, men sal deur die openheden commen achter dat opgeworpen borstweer, en graven daer soo diep als d'ander loopgraven, worpende d'een helft van d'eerde op dat voorss. borstweer, en d'ander helft achter sich.

Tis oock te gedencken datmen int maecken van t'selve borstweer, een voetbanck bewaer vant maijlandt self. Oock datmen op de achterste sijde d'eerde int eerste soo verre achterwaert worpe, te weten 5 voeten, datmen daer na eerde genouch hebbe om 't borstweer van vijf voeten hooch, achter sich op sijn hoochde te brengen.

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DIAGRAM II

If one thus has in front parapet BC, and the trench five feet wide as in the first figure, one shall on the other side, which is at one's back, raise a parapet five feet high, as in figure II, leaving in it four openings, as drawn with E, F, G, H, between which openings the earth is to be removed so deep as from the other trenches, and the earth coming from it shall be thrown on to the parapet before this hole, thus to be better covered in the same hole. And this trench shall then be 10 feet wide.

This being done, one shall through these openings come behind this raised parapet, and dig there so deep as in the other trenches, throwing one half of the earth on the foremost parapet and the other half behind oneself.

It is also to be borne in mind that in making the same parapet, one should spare a step from the ground level itself. Also, that at the back the earth is first thrown so far to the back, namely 5 feet, that subsequently one has enough earth left to bring the parapet of five feet high behind oneself to the required height.

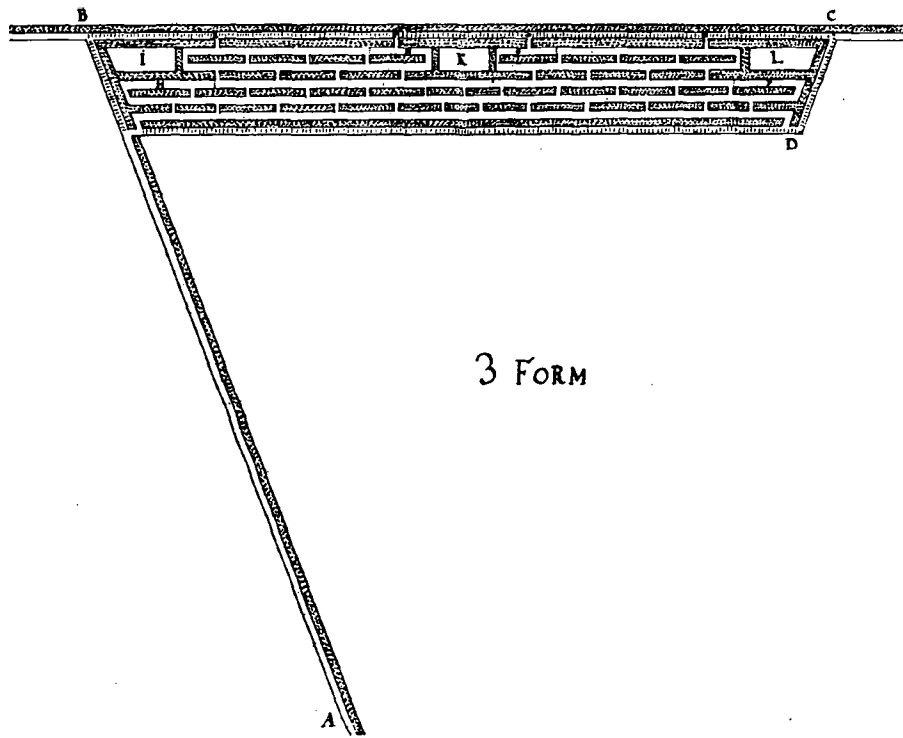


Fig. 17. Systematic manner of approaching and taking the counterscarp (III).

III FORM

Nu gelijk hier dit tweede borstweer gemaect is sonder perikel van musquet-schoten, alsoo salmen daer achter maecken een derde, vierde, en soo veel als men nodich verstaet, twelck wij voorbeeltsche wijze genomen hebben tot ses, als inde 3 form: waer in noch veroirdent sijn drie baterijen geteijckent I, K, L, diemen genouch siet, oock al sonder perikel te meugen gemaect worden. De eerde daer toe salmen halen uijt de houcken bij B en C, want daerom is dat borstweer daer 100 voeten overschietende gemaect.

Wij hebben de dicke der borstweeren onder, oock de breedte der loopgraven, genomen op 10 voeten: sulcx dat achter elck borstweer een loopgraf comt sonder maijlandt tusschen bejden.

De vier percken M, N, O, P, sijn vier cordegarden, diemen sonder timmeren aldus maken mach: men sal leggen veurensche balcxkens, vant een borstweer tottet ander, met deijlen daer op, en men sal met cleijne moeijte een warme cordegarde hebben, wesende an drie sijden gestopt met eerde.

Dese moeijte en cost van cordegarden is soo kleen, datmen al de geene die inde loopgraven leggen, lichtelick soude connen doen logieren onder sulcke decksels, tegen regen en onweer.

De reden waerom datter inde uijterste borstweeren niet soo veel open deurgangen en sijn als inde binneste, is om tegen de uijtvallen beter verseeckert te wesen.

Men sal den heelen dach deur meugen wercken, en t'savons gedaen hebben, want alle twee, of drie uijeren canmen een loopgraaf maecken, mits datmen drie mannen op de roe stelt.

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DIAGRAM III

Now that here this second parapet has been made without danger from musket shots, one shall thus make behind it a third, fourth, and so many as one considers necessary, which we have taken by way of example to be six, as in figure III: in which are still arranged three batteries, drawn I, K, L, of which one sees sufficiently that they can also be made without danger. The earth shall for this purpose be dug from the corners at B and C, for which reason the parapet there has been made 100 feet longer.

We have taken the thickness of the parapets at the base, as well as the width of the trenches, 10 feet, such that behind each parapet comes a trench without ground level between the two.

The four enclosures M, N, O, P, are four cordegardes, which without carpentry can be made as follows: one shall lay deal beams from one parapet to the other, with boards on them, and one will with little effort have a warm cordegarde, covered on three sides with earth.

The effort and cost which cordegardes involve are so small that all those lying in the trenches could easily be lodged under such covers against rain and thunderstorm.

The reason why the outermost parapets do not have so many open passages as the inner ones is in order to be better protected against the sallies.

One can go on working all day long and be ready in the evening, for one can make a trench every two or three hours, provided one places three men per rod.

De rechte loopgraven als dese, sijn van min werck dan de cromme, diemen ghemeenlick maect; sijn oock bequamer om int werck rasch me voort te varen, want stellende twerckvolck op rechte rijen neven malcander, t'beleijt en behouft soo veel bedenckens niet. Men can oock deur rechte loopgraven met wagens en peerden grofgeschut en diergelijcke bedeckter en bequamer commen als deur d'ander.

De kleene rechte schreefkens die int middel der vier uijterste loopgraven staen, beteyckenen palen, waer me de heele begraving besloten is als een schans, verseeckt tegen uijtvalen, mits welverstaende dat d'eerde op alle vier die sijden steijl afgestecken sij.

Men behouft oock niet te wachten van palen te slaen, tot dat al de loopgraven gedaen sijn, maer men canse vande drie eerste graven die in d'eerste form geteyckent sijn, soo haest slaen alsmense gegraven heeft, want al hoort de viant het cloppen, hij en can het werckvolck niet schieten geen hinder doen.

Angaende het vierde loopgraff, dat cannen met palen besluyten als het derde loopgraf gedaen is.

VIII. VOORSTEL:

Inhoudende seecker manier van Waterloopgraven.

Dit was besloten gedaen te worden en de gereetschap wiert gemaect voor Sint Andries Schans, maer gaven hun s anderdaechs op.

ABC is de Contrescharpe D sijn drie ponten alsoo oock sijn E en F over beide sijden met borstweeren van plancken met netten tusschen beijden daer in gestampt.

Van G tot H sijn ponten langs het landt met dergelijcke borstweer na de schans toe.

Al de ponten liggen 6 voeten vande cant des lants ABC tot desen eijnde:

Soo de viant een uijtval gedaen hadde opde gheene die de Contrescherpe in hadden de onse souden over de ponten DEF geloopt hebben achter haer borstweeren, op de ponten van G tot H en daer beschermpt sijn en vier geven sulcx dat de viant op de Contrescherpe niet en soude hebben cunnen blijven. Men soude dit mogen noemen waterloopgraven.

The straight trenches like these involve less work than the curved ones, which are commonly made; it is also easier thus to proceed quickly with the work, for when the workmen are placed in straight rows side by side, it is easier to supervise them. Also, through straight trenches one can with carts and horses, ordnance and the like march on under more cover and more easily than through the curves ones.

The small straight dashes in the centre of the four outermost trenches represent palisades, by which the entire work is enclosed as a fort, protected against sallies, it being understood that the earth on all four sides is cut off steeply downwards.

Also, it is not necessary to postpone placing the palisades until all the trenches are finished, but one can drive the poles into the ground as soon as the first three trenches drawn in figure I have been dug, because even if the enemy hears the hammering, he cannot hinder the workmen by shooting.

As regards the fourth trench, one can shut it off with a palisade after the third trench has been completed.

8th PROPOSITION:

Describing a certain manner of making water trenches

This had been decided upon and the materials were made before fort St. Andrew, but it was given up the next day.

ABC is the counterscarp; D, as well as E and F, are three pontoons with parapets made of boards on either side with nets pushed in between.

From G to H are pontoons along the land with a similar parapet towards the fort.

All the pontoons lie 6 feet from the bank ABC of the land for the following purpose:

If the enemy had made a sally towards those who occupied the counterscarp, our infantry would have walked via the pontoons D, E, F behind their parapets on the pontoons from G to H and would be protected there and have fired, so that the enemy could not have remained on the counterscarp. One might call these water trenches.

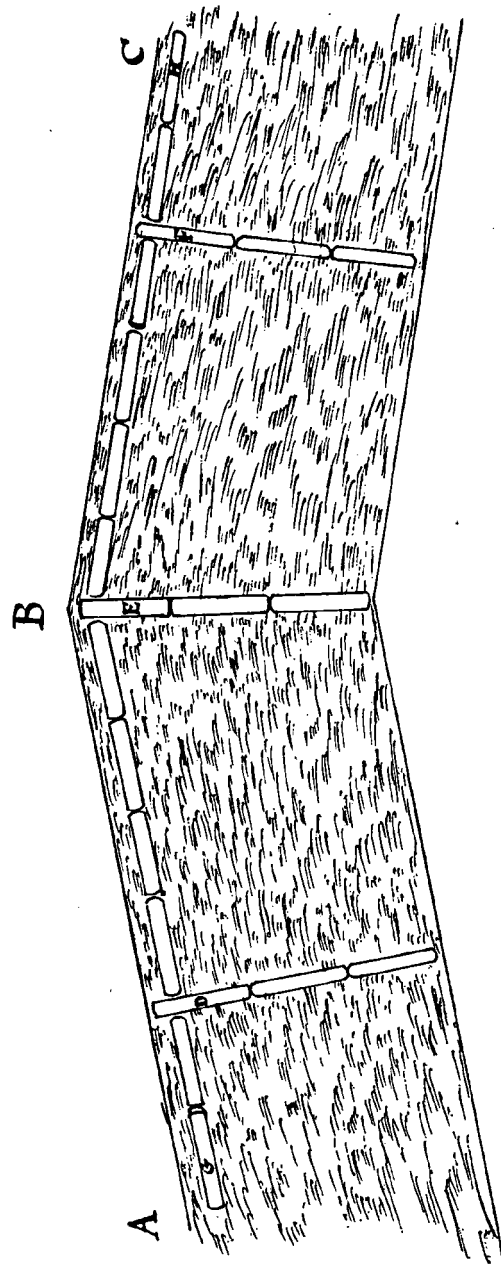


Fig. 18. Water trenches in the outer ditch of a counterscarp.

VAN DE PYCKSCHANSEN

OF PIKE REDOUBTS

INTRODUCTION*

The preceding parts described Stevin's military works concerning the art of building fortresses and camps and the besieging of fortresses. Naturally, there was little room to discuss the fighting proper with light and heavy weapons, as part of the tactics. Since, as stated elsewhere, Stevin was accomplished as an author in this respect also¹⁾, we would detract from these accomplishments, if in this last part we did not give in full one of his little-known posthumous writings, dealing with the tactics of infantry, and elucidate upon it.

In this way we hope once more to prove that Stevin was not only a master of the art of war of his time, but also contributed to the reforms of this science, which are generally ascribed to Prince Maurice and the Counts William Louis and John of Nassau, be it in his own characteristic way of argumentation and development of the matter. These reforms mainly concern the formations and movements of the infantry of the time, namely the *pikemen* and the *musketeers* and particularly an improved formation against cavalry in the open field. To achieve the object in view he also devotes an important part to the serious training of the men in the array devised by him, which by reason of its shape he gave the typical name of *Pike Redoubt*, but which meant nothing but a battle-array of square or rectangular shape.

As can be seen, this array meant a change in the existing positions, not so much of the deep mass formations, which were soon abandoned in Maurice's time, but rather of the arrays introduced instead thereof, according to which the bodies or troops of pikemen and musketeers were arrayed side by side, i.e. more or less "in line" already²⁾.

Like most of his manuscripts Stevin's treatise on the pike redoubts is no longer available in its original form, but in this case we still have two sources at our disposal which allow us to derive the contents almost completely, viz. Beeckman's extract of what was found by him on June 15th, 1624 under "Pyckschansinghe" in Stevin's posthumous papers³⁾ and folios 71-86 of the manuscript 128A-9I in the Royal Library at The Hague, which latter pages have been published herewith.

Of the former extract only part has been printed by C. de Waard in his

*) At our request this introduction has been corrected by colonel Dr. J. W. Wijn (see also note 24), the author of *Het Krijgswezen in den tijd van Prins Maurits* (Utrecht 1934).

¹⁾ *Gen. Introduction*, pp. 4 ff.

²⁾ For these battle arrays see particularly Wijn, pp. 475 ff. in connection with p. 432, as well as the sources cited by him; also the Royal Library manuscripts and in this connection the *Materiae politicae*, pp. 203 ff. and *Beeckman's Diary* (de Waard, II p. 424); in addition, Hahlweg, *Die Heeresreform der Oranier und die Antike*, pp. 125 ff.

³⁾ *Gen. Intr.* pp. 8, 9.

Journal tenu par Isaac Beeckman de 1604 à 1634 (Tome II, Appendices, p. 426), namely the Argument and a statement of the lay-out in "definitions" and "chapters". It also occurs under the heading: 6th Subdivision of the Pike Redoubts, on pp. 142-3 of the "Titles and Arguments of the Art of War" at the end of the *Materiae Politicae*, edited by Stevin's son Hendrik. However, concerning the pike redoubts this book contains nothing but a reference on the use of the spade-pick axe by the soldiers (p. 246 of the 8th subdivision, of the Theory of War) to "the use of the pike redoubts", which, however, is lacking from the book. Beeckman gives much more than the above, but his notes, although elucidated by 3 figures, are yet not more than a concise extract of what we know from the manuscript in the Royal Library. A correct and — as far as possible — complete publication of Stevin's invention in the field of battle arrays⁴⁾ must therefore be based on the latter source, rather than on Beeckman's report, which, although not without merit, is too short⁵⁾. As mentioned before, the manuscript from the Royal Library must have been made by the care of Hendrik Stevin⁶⁾ round about 1635; it is about 5 times as long as Beeckman's extract and instead of 3 it contains 15 figures, namely 2 in the 1st definition, 9 (including 6 small ones) in chapter 1 and 4 in chapter 3. After the Argument, in which Stevin criticizes the customary array of "a troop of pikemen with musketeers on either side", at least when used against the cavalry, he explains in 3 definitions the concepts: pike redoubt, corner troops and flanks or sides, after which, just as with Beeckman and in the *Materiae Politicae*, follow the 4 chapters, entitled:

1. Of the array of the pike redoubts.
2. Of the marching and wheeling of the pike redoubts.
3. Of the irregular pike redoubts.
4. The manner of exercise in learning the use of the pike redoubts.

A 5th chapter: "Of entrenching the pike redoubts" is mentioned by Beeckman, but not described. Also the *Materiae Politicae* (p. 143) mention a 5th chapter, but with a different title, viz.: "Of the array of the pike redoubts, whose musketeers are drawn up within the inner plane of the pikemen otherwise than according to the preceding manner" ⁷⁾.

The 3 definitions, together with the 1st paragraph of chapter 1, explain the basic principle of the pike redoubt, the "arrangement" of this kind of battle array (see *figure 1* for the general shape). The essentially square complex of troops, in fact sections or quart-companies of pikemen and musketeers, consists of 4 "flanks" each of one company, *i.e.* consisting of 4 troops and at each corner a

⁴⁾ Stevin may have been influenced to some extent by the examples of octagonal battle-arrays, as found in Johann Jacobi von Wallhausen, *L'art militaire pour l'Infanterie* (1615); similar battle-arrays also occur as "Battaillon against Cavalry" in manuscript 1A-750 in the library of the Ministry of War, but, as stated on p. 14 of the *Gen. Intr.*, this M.S. may have been composed by Stevin himself.

⁵⁾ See *Gen. Intr.* p. 12, from which it appears that de Waard has not published everything from Beeckman's notes on the pike redoubts, but that the copies of these notes are still available.

⁶⁾ For the presumable date of ca. 1635 see *Gen. Intr.* p. 11, under 3.

⁷⁾ To this presumably relates the figure occurring in fol. 219 V^o of Beeckman's extract, which indicates the disposition of 4 troops of musketeers, each of 50 men, surrounded by 4 troops of pikemen, together 396 men strong.

"corner troop", invariably formed by pikemen. By this ground plan Stevin ensures that the positions on either side of the "redoubt" will not be deeper than 5 ranks, which in his time was the maximum ⁸⁾. It is further based on companies of 100 men with 10 file-leaders, whom he considers to be equally divided in pikemen and musketeers: of each of these there are 2 troops, but the file-leaders are divided over 2 of the 4 troops, which therefore are alternately 25 or 30 men strong, all troops having a width of 5 files. The spaces in between and the distances between the men in the files and the ranks are usually 3 feet, so that each troop of 25 men is 15 feet wide and deep ⁹⁾. The outside of the square four-company redoubt thus worked out at 75, the inside at 45 feet. In addition to describing the position of the troop in the pike redoubt battle array, chapter 1 also indicates how the musketeers "walk in and out" of the redoubt, *i.e.* make sallies, and how meanwhile their places are protected by the pikemen, who as it were, form a fixed base to which the musketeers return.

The 2nd paragraph of chapter 1 deals with the "bevelling" of the corners, as was also often done with those of the walls of an earthen redoubt. This was done to remove dead or unprotected spaces, which might be formed otherwise; in Stevin's time this was preferably done by pikes rather than by the still very slowly firing musketeers. In a square battle-array the corners are obviously the weakest spots. The spaces of 15 feet between two troops of pikemen could all the better be defended and kept open by them because, as Stevin observes in the 1st definition (and Beeckman adopts elsewhere) the pikes are 15 feet long. In the 3rd definition he incidentally indicates what "het geweer", *i.e.* the armament of the soldiers should be, namely a "forked pike" for the pikemen with a "pistol" ¹⁰⁾ in their belt, the musketeers a musket, and both also a rapier and a "spade-pick axe" (the portable tool advocated by Stevin). (See for example Dijksterhuis, p. 245.) What the forked pikes should be like ¹¹⁾ and how they had to be charged to effect the best defence, is shown and explained in the 3rd paragraph of chapter 1, namely on pp. 493-494 by the figure of 3 pikes extended parallel to each other. In spite of Stevin's firm belief where he describes that, provided the pikes are held in the prescribed position, the sharp prongs will prevent "the further advance" of the enemy's horses, we believe that he somewhat overestimates the repelling power of the pikes as well as of the musket fire, particularly because, being satisfied with a depth of 5 ranks, he presupposes a very high morale of the pikemen. The morale could of course be raised by good discipline; that Stevin did not overlook this point, appears from chapter 4 of the manuscript, in which he extensively discusses the necessity

⁸⁾ That the depth was at first larger, appears for example from Wijn, p. 475.

⁹⁾ Although the strength of the companies varied considerably in practice, Stevin apparently adhered to 100 soldiers plus 10 "file-leaders"; see for example *Mat. pol.* fol. 195, 4th definition: "Ten files, one half pikemen, the other musketeers, make a company". Also here therefore a depth of 10 ranks.

¹⁰⁾ That, in addition to the pike and the rapier, the pikemen also had to carry a hand fire-arm, is not plausible, unless a "hantroer" should mean a pistol. We have nowhere found a confirmation of the latter; cf. for example Wijn, *Krijgswezen*, pp. 134-140, the order of Febr. 4th 1599 quoted there, p. 137, and the figures from the work of Jac. de Gheyn (see note 11) in *Staatse Leger* part II.

¹¹⁾ For pictures of pikes see for example the well known drill book of Jacobus de Gheyn, printed in 1608 as *Wapenhandelinge van roers, musquetten ende spiessen*, but which had been composed already round about 1597. (Wijn, *Krijgskundige aantekeningen van Johan de Middelste van Nassau*, part VIII; Hahlweg, *Die Heeresreform der Oranier* p. 36).

of practising the soldiers in handling the pike redoubts, even in a sham fight, namely with "Cavalry as enemies, in order thereby better to experience and learn how things happen in practice"! On the following page (fol. 86) he once more pleads in favour of the two-pronged pikes, by which in contrast to the one-pronged one, an attack by "curassiers and armoured horses" might be repelled, and he recommends making experiments with both arms¹²⁾.

The 4th paragraph of chapter 1 is also important; it describes and elucidates by 8 figures (the musketeers being omitted for greater clarity) how pike redoubts of 2, 4 and 6, and of 3, 5 and 7 companies, respectively, all with troops of 25 or 30 men and subsequently of 8, 20 and 100 companies, all with troops of 55 men, can be formed.

Beeckman formulates briefly the mathematical solution of these "constructions" in his unpublished extract for the first six as follows:

"if there are only two companies, there shall be only two troops on each flank, 4 companies 4 troops, 6 companies 6 troops and so on, but an odd number of companies make a rectangle, as with 3 companies one makes two sides of 4 troops and two sides of two troops, with 5 companies 2 sides of 6 troops and 2 of 4, with 7 companies 2 sides of 8 troops and 2 of 6" ¹³⁾.

Beeckman also adopted Stevin's figure of the 8-company redoubt with "troops of 55 pikemen, more than twice as long as they are wide" ¹⁴⁾; the redoubt of 20 companies is mentioned by him only, and of Stevin's monster example of a pike redoubt of 100 companies or a standard of 10 banners ¹⁵⁾ he also gives a two-fold solution, namely with or without an inner redoubt.

In the same chapter, 4th paragraph, one also finds examples if troops, less than two companies strong, are to be arranged in pike-redoubt battle-array; the solution is then to divide the company into 8 troops, formed according to the customary pattern of the 2-company redoubt; of this six drawings are given, for 160, 128, 96, 72, 32 and 64 men, respectively (fig. 11).

Chapter 2, concerning marching and wheeling with a pike redoubt, does not call for a further elucidation; it is here that Beeckman mentions the pike size of 15 feet, which "is equal to the front side of the 5 pikemen as well as of the 5 musketeers".

It now only remains to draw attention to chapter 3, on the "irregular" pike redoubts, which again illustrates Stevin's ingenuity in this matter of tactics, namely in adapting his battle array to the conditions in the field. By reference to 4 figures he describes successively: application of a three-sided pike redoubt as bridgehead; the disposition of 5 "troops" in the branch of a river; the enclosing of a river bend in the same way. Whereas these applications are obviously stationary and have rather the character of defence lines, the 4th example: defending a narrow strip of land between two water courses or other hindrances, shows the mobile nature of the battle array.

¹²⁾ On experiments with shields, with which the curassiers were equipped, see Wijn, pp. 153 ff.

¹³⁾ Beeckman speaks of "even" and "oneven"; Stevin (at least in the manuscript) of "parich" (paired) and "onparich" (unpaired).

¹⁴⁾ Here Stevin departs from his principle of the array with not more than 5 ranks (see also note 9).

¹⁵⁾ For this decimal organisation see also Stevin's *Castrametatio*, fol. 49, where instead of "banner" the word "pennon" is used (Part 2 of this Volume).

The battle array of the pike redoubts has not been applied to the extent which Stevin had expected. Even though this has been the fate of many of his military proposals¹⁶⁾, we can say of this reform that time was against it. For, the manuscript must have been composed during the Twelve Years' Truce. At least, on July 22nd 1618 Stevin wrote his well-known letter to King Gustavus Adolphus of Sweden, reproduced by Dijksterhuis and treated by him by reference to the study of Pelseneer¹⁷⁾; in it Stevin mentions a certain "concept" to be put into effect "si nos treves prindrent une fin et que la guerre se recommençoit". This project would according to the letter comprise no less than a "moyen par lequel on pourrait faire meilleure résistance avec les gens de pied contre la Cavallerie que selon ce qui est en usage", and almost certainly we must recognise in it the treatise *Of the Pike Redoubts*. Another communication in the same letter relates to an instrument which was to render it unnecessary to carry large quantities of digging equipment and by which probably the "spade-pick axe" was meant¹⁸⁾.

A typical feature is that the copies of the manuscripts on the two subjects occur in the Royal Library manuscript 128A-9I and that Hendrik Stevin offered the collection in question with a dedication to Prince Frederic Henry, to which he added a copy of the letter to the King, couched in the following words: "Meanwhile I hope that this part will give Your Highness at least so much pleasure that some of it will be found worthy to read, which I trust to be the case, the more so because I feel convinced that this part, like that of the *Castrametatio*, has been described to be put into effect, to show which to Your Highness I have added a copy of a certain letter written by my deceased Father to the King of Sweden".

Pelseneer's article emphasizes that various Swedish military historians have found occasion to take an interest in Stevin. In this connection Ludvig W. son Munthe¹⁹⁾ and Capt. G.B.C. son Barkman²⁰⁾ must particularly be mentioned; they do not appear, however, to agree with each other. Neither mentions the name of the pike redoubts, but Barkman who, it would seem to us, is not just in his criticism of Munthe, mentions the possibility that "Stevin meant the so-called hog feathers, a weapon used afterwards by the Swedish infantry for the above-mentioned purpose"²¹⁾. This conclusion, although not correct, is understandable in so far as that Gustavus Adolphus must actually be regarded as the inventor of what are called hog feathers, which weapon according to Jähns consisted of:

"ein 6½ Fusz langer Stock mit zwei Spitzen, deren jeder Musketier einen trug beim Angriff feindlicher Reiterei pflanzte der Mann die Schweinsfedern schräg vor sich in die Erde, so dasz dann das Fuszvolk ein Sechsfacher

¹⁶⁾ *Gen. Intr.* p. 16. As regards the proposal of the spade-pick axe, it should be observed that the picture of this portable tool also occurs in the Royal Library M.S. 128A-91.

¹⁷⁾ Dijksterhuis, p. 18, 354; Pelseneer, J. *Remarques sur une lettre inédite de Simon Stevin* (*Lychmos*, 1937, p. 373).

¹⁸⁾ Dijksterhuis, p. 355.

¹⁹⁾ Munthe, *Kongl. Fortifikationens Historia I*, (Stockholm, 1902) p. 220, note 1.

²⁰⁾ Barkman, *Gustaf II Adolfs Regementsorganisation vid det inbemska infanteriet*. Meddelanden från Generalstabens Krigshistoriska Avdelning (Stockholm, 1931), p. 73, note 3.

²¹⁾ Swedish text: "Stevin åsyftar s.k. *Svinfjädrar*, ett strids-medel som sedermera användes av det svenska infanteriet i ovan angivet syfte".

Gürtel fester Spiesze umgab Kleine Abteilungen vermögen sich mit solchen Schweinsfedern trefflich zu sichern, sei es im Viereck, sei es in Ravelin-formen" 22).

Gustavus Adolphus is said to have used these "Igelbalken", as he called them according to Jähns, and which were in some respects suggestive of Stevin's forked pikes, first against the Polish cavalry round about 1621, *i.e.* shortly after he had been informed about the design of Maurice's engineer. For lack of other records, in particular of the figures or drawings announced in Stevin's letter ²³), it is for the time being impossible to provide evidence that these data actually concerned the pike redoubts. Knowing as we do, however, that the Swedish King, who was himself a great reformer of military science, directed his efforts rather to improving fire arms, as a result of which the pike was fairly soon superseded by the musket, we need not be surprised that also in the States armies Stevin's pike redoubts, ingeniously invented though they were, have remained a paper design ²⁴).

The portable tools still everywhere in military use, however, can be safely regarded as having succeeded Stevin's spade-pick axe.

THE SPADE-PICK AXE.

(MS. 128 A-9I, p. 28, Royal Library, The Hague)

- ABCD.* A quadrangular sheet of iron, sharpened only at the side *AB*, having at the end *E* a pin with two square holes.
- F.* An iron hood with two feathers.
- G.* A wooden shaft, to be attached to the hood; the assembled tool has a length of about two feet.
- I.* A spade, composed of the iron sheet, hood and shaft.
- K.* An axe, composed as *I*, but the iron sheet fixed like an axe.
- L.* A pick-axe, composed as *I*, but the iron sheet fixed like a pick-axe.
- M.* A pin or feather, serving for attaching the iron sheet in the way, as shown by *I*, *K*, *L*.
- N.* The iron is fixed against the shaft by putting in the hole *O* the screw *P*. The tool is portable and is attached at the soldier's belt by means of the clasp or hook *Q*.
- R.* A pick-iron, that can be used instead of the iron sheet like *L*.

²²) Jähns, *Gesch. d. Kriegswiss.* p. 1284.

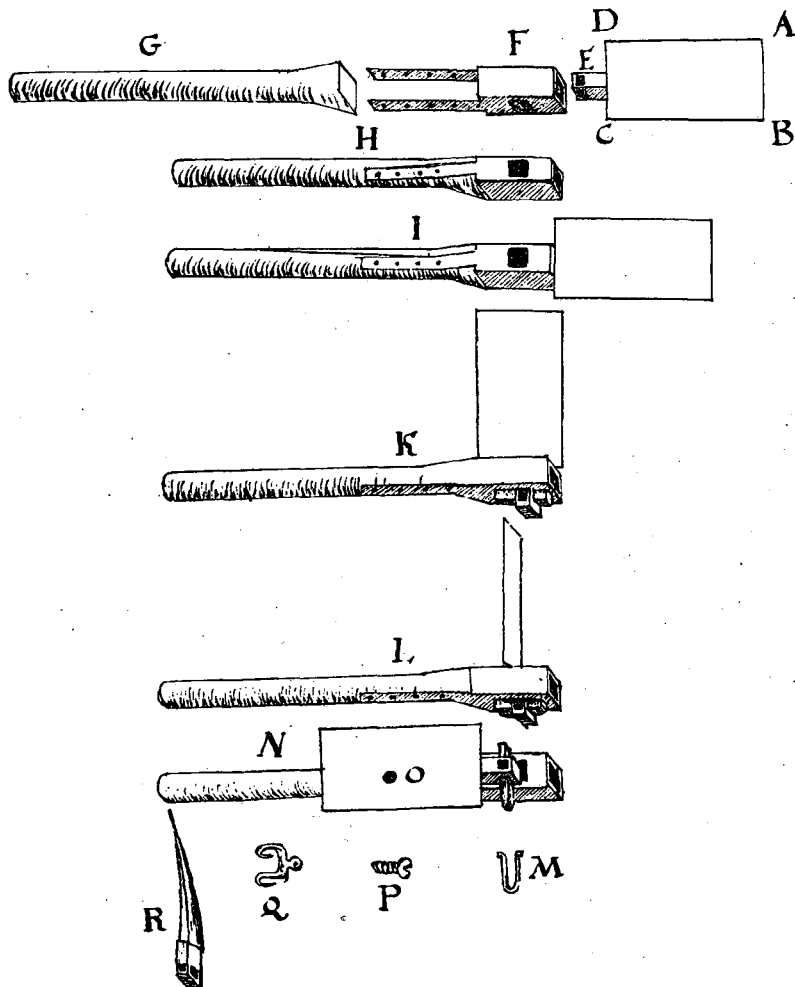
²³) On behalf of the editors of the periodical *Lychnos* (see note 17) Mr. Sten Lindroth, teacher at Uppsala, wrote the author on October 25th 1954: "The letter of Stevin reproduced in *Lychnos* of 1937 was found in our State Archives quite alone, without other papers or drawings by Stevin".

²⁴) The strength of the pikemen, previously 2/3 of a company, was reduced in the Thirty Years War (1618-1648) to half of the company or even less. Gustavus Adolphus even placed only 54 pikemen in a company of 144 men and determined the length of their pikes at 11 feet, while in 1631 he organised even some musketeer regiments without pikemen. (The former has been derived from Johann Gottfried Hoyer's *Geschichte der Kriegskunst*, Göttingen, 1797).

Dr. J. W. Wijn criticizes Stevin's pikes and "pike redoubts" as follows:

"The two-pronged pike probably made the upper end of the already unmanageable pike very heavy and had therefore to be shortened, so that the pikes of the back ranks no longer extended before the first rank. Also, the two-pronged pike was an unsightly arm and therefore probably unpopular with the troop.

The project of the pike redoubts is undoubtedly well-considered. One has possibly shrunk from the frequent drill required; perhaps also because of the insufficient depth. It does not appear as if exercises have been held with the pike redoubt".



*Spade-pick axe. Drawing with explanation.
(The Hague, Royal Library, MS 128 A - 9 I, p. 28)*

6 ONDERSCHEYT VAN DE PYCKSCHANSEN.

CORT BEGRIJP DESES SESTEN ONDERSCHEIJTS.

Het is geduerende desen Crijch op Convoien, gheleijen en ander tochten dickwils ghebeurt (gelijckt ghemeenelick doet in landen, die langduerige crijch hebben), dattet voetvolck, ontmoetende haers Viants Ruijters op vlacke heijen of velden, hemlien geen tegestant en hebben connen doen, maer gemeenelick daer afgeslagen worden (anders toegaende dan voormael bij de Griecken en Romeinen diens voornaemste macht in voetvolck bestont,) en dat bij gebreck van oirden, want een hoop Pijckiers sich stellende in viercante of vierhouckige slachoiden mette Musquetters op beijden sijden, na de gemeene wijze deses tijts, soo volcht daer uijt dat de Ruijterije op een der sijden ancommende, en de voorste Musquetters alleenlick eens geschoten hebbende, vallen daer in genouchsaem sonder tegestant, om dat se van haer Pijckiers niet en connen geholpen worden; sulcx dat de Musquetters terstond den rugge keeren haer eijgen Pijckiers opt lijf lopen en d'een met d'ander in onoiden op de vlucht geraecken. Maer soo men de Musquetters int middel stelt tusschen twee hoopen Pijckiers, soo sijn de sijden wel met Pijcken beset, maer de Ruijters mogen op de voorzijde en achtersijde der Musquetters in vallen, sonder van de Pijckiers geholpen te worden, oock sonder de Pijckiers met geduerighe schieting te mogen helpen.

Om hier tegen te voorsien, isser seker oirdening verdocht tot welcker beschrijving ick hier stellen sal drie bepalingen, inhoudende betijckening van Pijckschans, houckhoopen en sijden: Daer na sullen 4 hoofdsticken volgen, te weten

het 1e hoofdstick van de oirdening der Pijckschansen.

het 2e hoofdstick van't voorttreden en swenken der Pijckschansen.

het 3e van de onvolcommen pijckschansen.

het 4e de manier der oeffeningh int leeren van 't gebruijck, de Pijckschansen angaende.

I. BEPALING.

Pijckschans is een oirden van Pijckiers, soo gestelt, dat de punten der pijcken over al uijtwarts na de viant commende, hun Musquetters beschermt sijn en geduerich op haer Viant schieten mogen, oock de Pijckschans uijt en in lopen, sonder die in onoiden te brenghen.

OF PIKE REDOUBTS

ARGUMENT

It has often happened during this war on convoys, escorts and other campaigns (as usually occurs in countries waging prolonged wars) that the infantry, meeting their enemy cavalry on open heath or fields, could not offer them resistance, but were usually routed (unlike what formerly happened with the Greeks and Romans, whose main power consisted of infantry) owing to lack of good arrays, because when a troop of pikemen draw up in square or quadrangular battle arrays with the musketeers on either side, according to the customary manner of this time, it follows therefrom that when the cavalry attacks on one side, the foremost musketeers, having fired only once, are overrun there almost without opposition, because they cannot be assisted by their pikemen; such that the musketeers at once turn their backs, run into their own pikemen and one with the other flee in disorder. But if the musketeers are placed in the centre between two troops of pikemen, the flanks are admittedly occupied by pikes, but the cavalry can attack the musketeers in front and in the rear, without the latter being assisted by the pikemen, while they are not able either to help the pikemen by constant firing.

To remedy this, a certain array is invented for the description of which I shall here give three definitions, containing the significance of pike redoubt, corner troops and sides or flanks: Then will follow 4 chapters, namely

- chapter 1 of the array of the pike redoubts.
- chapter 2 of the marching and wheeling.
- chapter 3 of the irregular pike redoubts.
- chapter 4 the manner of exercise in learning the use of the pike redoubts.

1st DEFINITION

A pike redoubt is an array of pikemen, so placed that, while the points of the pikes are extending everywhere towards the enemy, musketeers are protected, can constantly fire at the enemy, and also leave and enter the pike redoubt without bringing it in disorder.

Laet tot naerder verclaring dese 1 form ABCDEFGHIKLMNOPQ een Pijckschans betijckenen, die ick tot voorbeelt neem te sijn van vier Vanen elcke van hondert Soldaten met haer thien rijeijers, op elcke sijde een Vaen, waer af de vier hoopen A B C D d'eerste sijde betijckent, E F G H de tweede, I K L M de derde, en N O P Q de vierde: Te weten d'eerste van twee hoopen Pijckers als A en C, te weten A van 25 mannen, met haer vijf Rijeijers, C van 25 mannen; en twee hoopen Musquettiers als B en D, te weten B van 25 mannen met haer vijf Rijeijers, D van 25 mannen en soo voorts met d'ander.

Benevens de voorgaende 1e form, stel ick noch de volgende tweede, alwaer de Musquettiers buijten de Pijckschans na de Ruijters haer Viant getrocken sijn, maer alleenlick soo verre als sij achten met versekertheit weedom in de Pijckschans te mogen commen, en daerentusschen al vertreckende gedeurllick oirdentlick schutgeveert houden, na de manier des 7e hoofdsticx van't 5 onderscheijt te wijle den Viant naerdert, in welke twee formen te sien is als volcht:

Ten eersten, hoe de punten der pijcken (gelijck inde bepaling staet) over al na de Viant commen.

Ten tweeden, hoe de Musquettiers inde 1e form over al tusschen Pijckers connen staen, daer af beschermt sijn en geduerlick op haer Viant schieten.

Ten derden, hoe de Musquettiers inde 2e form over al uijt de Pijckschans meugen loopen om tegen haer Viant oirdentlic schutgeveert te houden na de manier des 5 onderscheijts, 7 hoofdstick, en weder daer in commen als sij willen, sonder de Pijcken in onoiden te brengen, want daer sijn over al ruijme open-

★ ★ ★ ★ ★

Let for further explanation of figure 1 ABCDEFGHIKLMNOPQ represent a pike redoubt which by way of example I take to comprise four companies, each of one hundred soldiers with their ten file-leaders, on each side a company, of which the four troops A, B, C, D represent the first side, E, F, G, H the second, I, K, L, M the third and N, O, P, Q the fourth: To wit the first of two troops of pikemen A and C, namely A of 25 men with their five file-leaders, C of 25 men; and two troops of musketeers B and D, to wit B of 25 men with their five file-leaders, D of 25 men and so on with the other.

Next to the foregoing figure 1 place the following figure 2, where the musketeers have gone outside the pike redoubt to meet their enemy's cavalry, but only so far that they think to be able to return safely within the pike redoubt and in the mean time hold constantly orderly skirmishes, according to the manner of chapter 7 of the 5th subdivision, during the approach of the enemy, from which two figures can be seen:

First, how the points of the pikes (as described in the definition) are everywhere turned towards the enemy.

Secondly, how the musketeers in the first form can stand everywhere between pikemen, are protected by them and can constantly fire at their enemy.

Thirdly, how the musketeers in figure 2 can everywhere leave the pike redoubt to hold orderly skirmishes according to the manner of the 5th subdivision, chapter 7, and return into it whenever they like, without bringing disorder to the

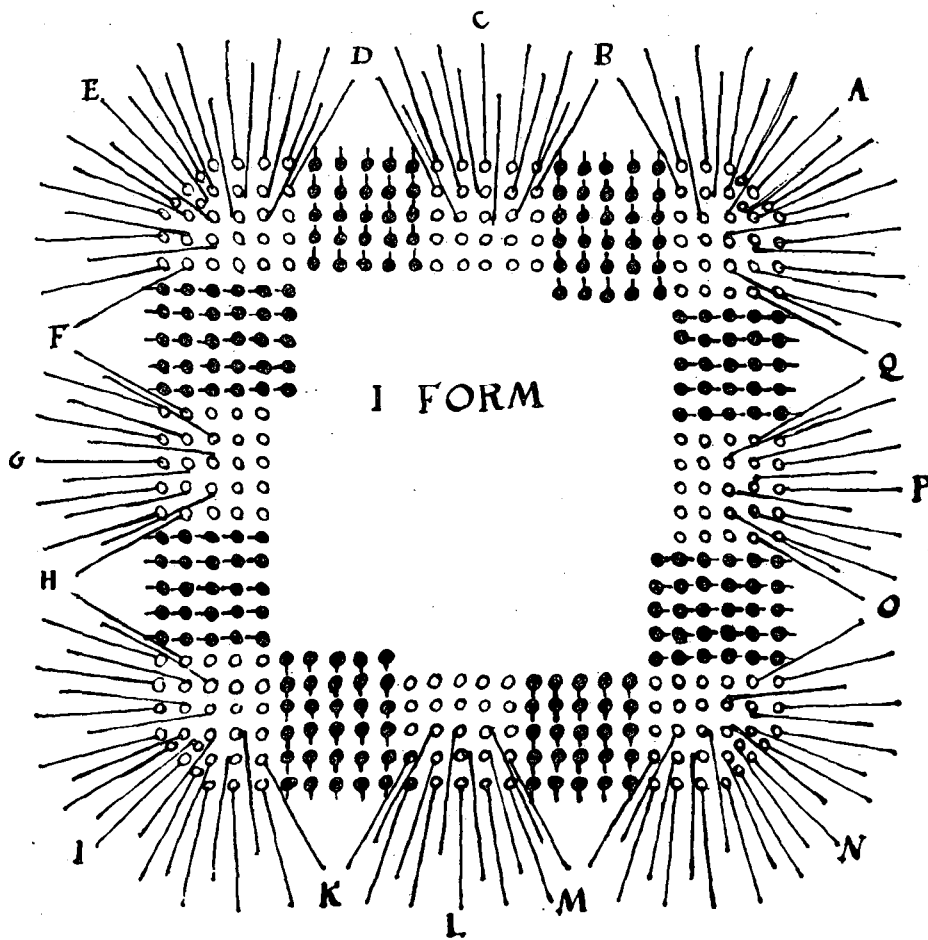


Fig. 1. Pike redoubt of 4 companies (General shape).

heden, die allen oogenblick mette Pijcken als poorten voor vrienden gheopent en voor Vianden gesloten worden.

Ten vierden, hoe wel de Musquettiers uijt de Pijckschans sijnde, gelijk inde 2 form, datter als dan tusschen de hoopen der Pijckeniers openheden blijven, soo siet men nochtans de selve soo wel of beter bewaert te wesen dan de voorhoofden, om dat de Viant, die daer in wil commen, soo van vooren als op beijde zijden beiegent wort met veel Pijcken, die de openheden wel connen beschermen deur dien se allenelick 15 voeten breedt sijn en de Pijcken van wedersijden 15 voeten lanck:

Ick heb hier tot voorbeeldt gestelt een pijckschans van vier vendels, waer me genouch verstaen schijnt de eigenschap van grooter en cleender pijckschansen, welcker oirdening en ander omstandigen hier na van elck int besonder breeder sal beschreven worden.

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pikes, for there are everywhere wide openings which at any moment can be opened by the pikes as gates to friends and closed to foes.

Fourthly, that although the musketeers have left the pike redoubt, as in figure 2, so that there remain openings between the troops of pikemen, one sees that it is equally well or better guarded than the frontages, because the enemy wanting to penetrate into it, is met in front and on both sides by many pikes, which can protect the openings because they are only 15 feet wide and the pikes on either side 15 feet long.

I have here by way of example taken a pike redoubt of four companies, which seems to suffice to understand the features of larger and smaller pike redoubts, the array and other conditions of each of which will be described hereinafter in particular.

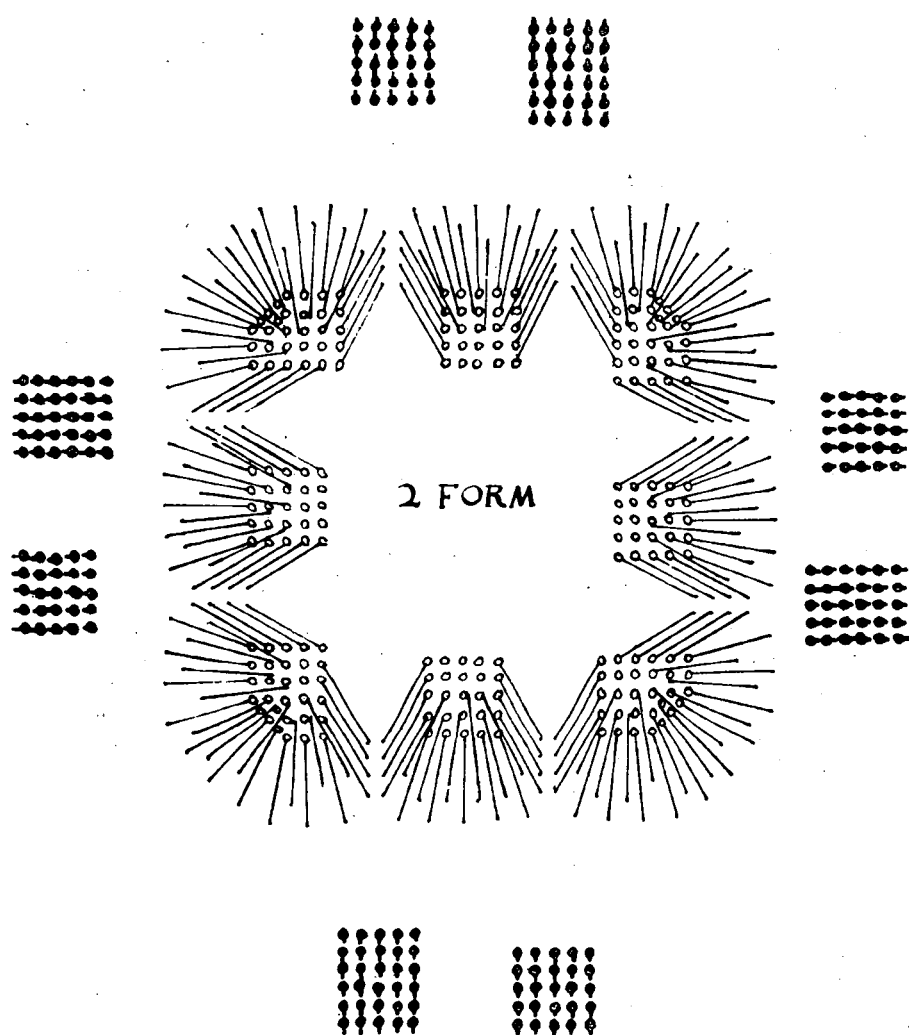


Fig. 2. Pike redoubt with the troops of musketeers sallying.

II. BEPALING.

De vier hoopen Pijckiers daer af op elcken houck der pijckschans een comt, heeten houckhoopen. Als inde eerste form der 1e bepaling de vier hoopen Pijckers A, E, I, N, op de vier houcken commende, worden houckhoopen genoemd.

III. BEPALING.

Sijde van een Pijckschans is den houckhoop mette volgende hoopen na de slinckerhant, doch sonder d'ander houckhoop die't begin van een ander sijde is.

Als inde 1e form der 1e bepaling de vier hoopen A, B, C, D, maken een sijde, te weten een houckhoop A mette volgende hoopen B C D na de slinckhant, doch sonder d'ander houckhoop E, die 't begin is der sijde E F G H en I 't begin der sijde I K L M en N 't begin der sijde N O P Q.

Noch staet te gedencken, dattet geweer deses Crijchsvolcx sal sijn als int 3 lit vant 1e hoofdstick deses 6 onderscheijts geseijt is, te weten de Pijckers met vorckpijcken, en een hantroer an haer rijem, voort soo wel Musquettiers als Pijckiers elck een spabijlhou, en haer rapier, hangende na de wijze der ouder Romeinen, niet schoens of de punt achter uijt stekende na het tegenwoordich gebruijck, dat in Pijckschansing zeer hinderlick soude sijn.

I. HOOFTSTICK.

Te verklaren de oirdening eens Pijckschans.

Inde veroirdening der pijckschansen vallen vier voornamelicke verscheijdenheden. Ten eersten van het stellen der Crijchslie in haer vier sijden: Daer na vande verplomping der vier houckhopen. Ten derden van het vellen der Pijcken, elck na een seeckeren oirt: Ten vierden, want de voorbeelden vant gene geseijt is, sijn sullen van een schants inhoudende effen vier Vendels, soo sal ten laetsten voorbeelt gegeven worden van meerder en minder Pijckschansen. Van welck vier verscheijdenheden vier leden sullen beschreven werden.

I. LIDT.

Van het stellen der Crijchslie in haer vier sijden.

Genomen datter tottet maecken van een Pijckschans voor handen sijn vier vendels, elck van hondert Crijchslie met haer tien Rijelejers, daer af d'een helft Pijckiers, d'ander helft musquettiers sijn: Dit soo wesende, men brenghet de vier vaendragers elck met haer vanen ter plaetse daer men de Pijckschans hebben wil, als neem ick den eersten ant punt A (fig. 3.), welcke daer gestelt wesende met sijn Vaen overeinde, men treet van sijn slinkerzijde af na B, soo veel stappen, als men weet, dat den buijtecant der pijckschans lanck sal sijn, 't welck in dit voorbeelt van wegen 25 Crijchslie, elck op drie voet, maeckt 75 voeten, dats 30 gemeene stappen, elcke van $2\frac{1}{2}$ voet, die commen neem ik an B, alwaer gestelt den tweeden Vaendrager met sijn Vaen overeinde, en den rugh gekeert na den eersten Vaendrager A, men stapt noch 30 stappen van B na C, commende de verdochte lini B C soo na rechthouckich op B A, als uijt het gesicht can geoordeelt worden, en daer gestelt den derden Vaendrager met sijn vaen overeinde,

2nd DEFINITION

The four troops of pikemen, one of which is placed at each corner of the pike redoubt, are called corner troops. As in figure 1 of the 1st definition the four troops of pikemen A, E, I, N placed at the four corners are called corner troops.

3rd DEFINITION

A side or flank of a pike redoubt is the corner troop with the following troops towards the left, but without the other corner troop which is the beginning of another flank.

As in figure 1 (1st definition), the four troops A, B, C, D make one flank, to wit corner troop A with the following troops B, C, D to the left, but without the other corner troop E, which forms the beginning of flank EFGH, and I the beginning of flank IKLM, and N the beginning of flank NOPQ.

It should also be borne in mind that the arms of these soldiers shall be as described in the 3rd paragraph of chapter 1 of this 6th subdivision, to wit the pikemen with forked pikes, and a pistol in their belt, and musketeers as well as pikemen each a spade-pick axe, and a rapier, worn after the fashion of the old Romans, not slanting or the point extending backwards according to present-day usage, which in pike redoubts would be very troublesome.

CHAPTER 1

To explain the array of a pike redoubt

In arranging a pike redoubt four main sections are to be distinguished. First, of the position of the soldiers on its four flanks: Then of the bevelling of the four corner troops. Thirdly, of the charging of the pikes, each in a certain direction: Fourthly, because the examples of what has been said will be of a redoubt comprising all four companies, lastly an example will be given of pike redoubts with more or fewer companies. Of these four sections four paragraphs will be described.

1st PARAGRAPH

Of placing the soldiers on the four sides

Assuming that to make a pike redoubt there are four companies available, each of one hundred soldiers with their ten file-leaders, of whom one half pikemen, the other half musketeers: This so being, one brings the four ensign bearers with their ensigns to the place where one wants the pike redoubt, for which purpose I take the first to point A in figure 3, who being positioned there with his ensign raised, one takes from his left towards B as many steps as one knows that the outside of the pike redoubt will be long, which in this example of 26 soldiers*), spaced at three feet, is 75 feet, which is 30 common steps, each of $2\frac{1}{2}$ feet; after arriving at B, where the second ensign bearer is placed with his ensign raised, and his back turned to the first ensign bearer A, one takes another 30 steps from B to C, the imagined line BC thus coming at right angles to BA, as can be judged visually, where is placed the third ensign bearer with his ensign raised, and his back turned to the second ensign bearer

*) A row, including 25 intervals needs 26 men, vid.lic. 25 soldiers with one file-leader.

den rugh gekeert na den tweeden Vaendrager an B, men stapt noch 30 stappen van C na D, commende de verdachte lini C D, soo na rechthouckich op C B, als bij 't ooch geschien can of anders naerder beproeft, sulcx dat D A oock 30 stappen doe, stellende an D den vierden Vaendrager, met sijn Vaen overeinde, den rugh gekeert na den derden Vaendrager an C, inder voughen, dat de vier vanen A B C D beteyckenen de vier toecommen punten der houcken vande Pijckschans. Daer na gedaen sijnde 't bevel *In schansoorden*, soo commen de Crijchslie elck bij haer Vaen, hun daer in slachoiden stellende met halve rijen, na de gemeene manier beschreven int 1e hoofdstick des 5 onderscheijts ('t welck als met een oogenblick soo daer geseijt is gedaen wort), keerende elck het aensicht na sulcken oirt gelijck sijn vaendrager en hem altermael op de rechterhant hebbende, den anderen Vaendrager op de slinckerhant; en commen aldus op elcke sijde vier hoopen: Als op d'eerste sijde de vier hoopen A E, F G, H I, K L, twee pijckiers, en twee Musquetters en tusschen twee hoopen Pijckiers overal een hoop Musquetters, gelijck de form naerder uijt wijst, alwaer mette linikens getrocken op de voorste Crijchslie, beteyckent wort den oirt daer hun aensichten henen sien. Merckt noch, dat die wilde, soude in plaets van met stappen te tellen alsvooen, meugen nemen met meerder seeckerheijt vier lonten, elcke van 75 voeten lanck, welcke gespannen staende in vierhouckige form, en op elcken houck een Vaendrager gestelt, en daer na gedaen alsvooen, men soude alsoo oock meugen de vier sijden veroirdenen.

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at B, one takes another 30 steps from C to D, the imagined line CD thus being at right angles to CB, as can be shown visually or else further checked, the side DA having to be also 30 steps long, placing at D the fourth ensign bearer with his ensign raised, and his back turned to the third ensign bearer at C, so that the four ensigns A, B, C, D represent the four points of the corners of the pike redoubt. Then the command *In redoubt array* having been given, the soldiers each come to their respective ensign, where they form battle-array in half files, according to the customary manner described in chapter 1 of the 5th subdivision (which is very quickly done as is mentioned there), each turning his face in the same direction as his ensign bearer and having him all on the right-hand side, the other ensign bearer on the left-hand side; and thus on each side come four troops: On the first side the four troops AE, FG, HI, KL, two of pikemen and two of musketeers, and between two troops of pikemen invariably a troop of musketeers, as can be further seen from the figure, where the short lines drawn from the foremost soldiers indicate the direction in which their faces are turned. Also note that if, instead of counting steps as before, one should want, for more certainty, to take four matches, each 75 feet long, stretched in a quadrangular shape, and at each corner placed an ensign bearer, after which one proceeded as before, one might also in this way arrange the four sides.

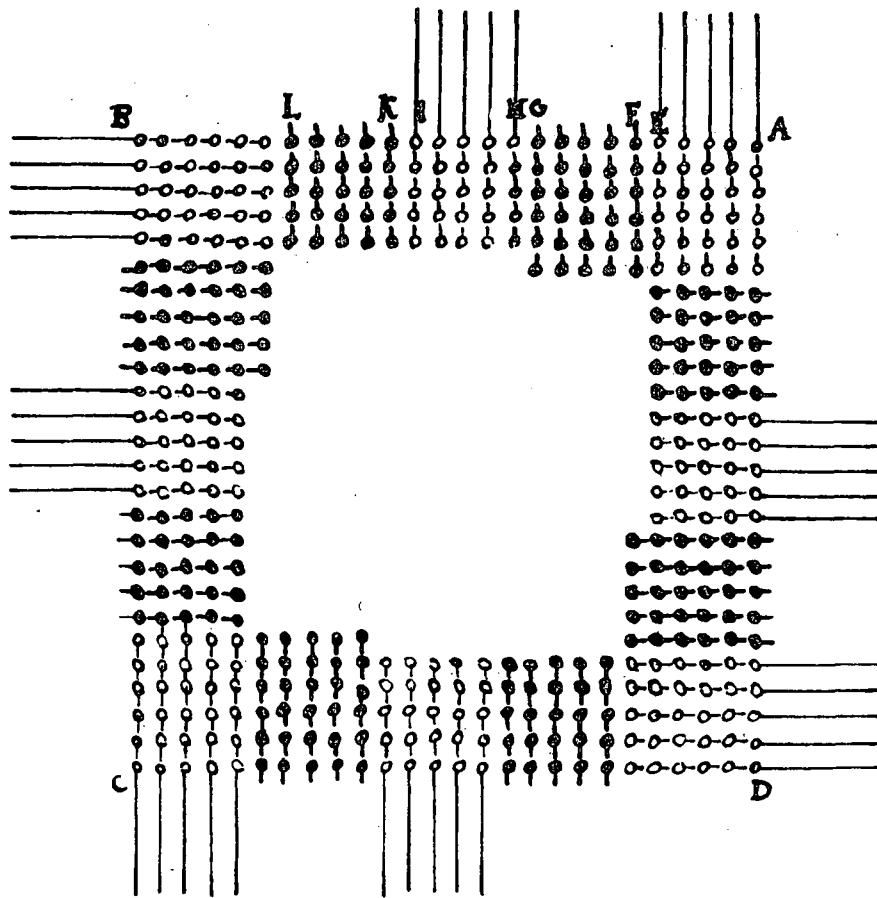


Fig. 3. Marking out a pike redoubt.

II. LIDT.

Vant verplompen der vier houckhoopen.

Wantter soo goeden bescherming der Pijckschans niet geschien en can met een man op den uijtersten houck alleen te stellen, als inde 1e form deses hoofsticx, maer dattet beter is in plaets van sulcken punt te hebben een lidt van Soldaten nevens malcander staende, daer me oock de punten der pijcken naerder bij malcander commen, soo ist oirboir dien houck te verplompen als volght:

Laet dese form A beteyckenen een der houckhopen, van de form des 1en lidts die verplompt moet sijn: Om twelck te doen, ick gebruijck daer toe alleenelick de vier Crijchslien, die op den houck staen geteyckent met 1, 2, 3, 4 de selve sullen doen een achtendeel keers altijt naer de rechterhant, blijvende al d'ander stilstaende, en is dan de gestaelt des hoops als inde form B. Daer na treet den

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2nd PARAGRAPH

Of the bevelling of the four corner troops

Since, to ensure good protection of the pike redoubt, one cannot be satisfied with only one man placed at the extreme corner, as in figure 3 (the first figure of this chapter), but that it is better to have instead of such a point a number of soldiers standing side by side, by which also the points of the pikes approach each other more closely, it is necessary to bevel this corner as follows:

Let in figure 4 the drawing A represent one of the corner troops, of the shape of the 1st section, which must be bevelled: To accomplish which I take only the four soldiers drawn at the corner as 1, 2, 3, 4, who shall make an eighth turn, invariably to the right, all the others standing still, after which the shape of the troop is as in drawing B. Subsequently the soldier drawn as 4 steps a

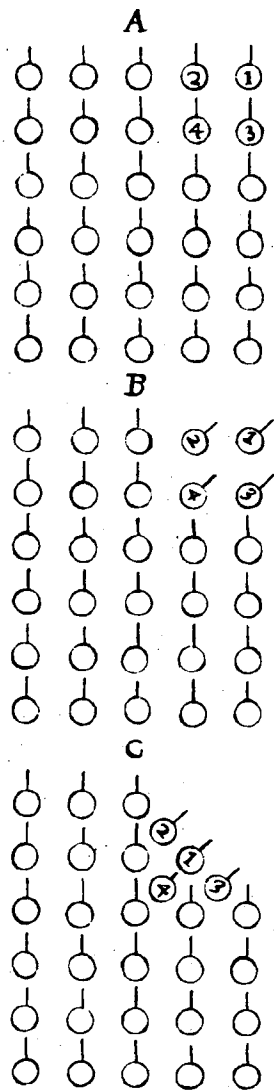


Fig. 4. Bevelling a corner troop of a pike redoubt.

Crijchsman geteijckent 4 een luttel achterwaert, tot dat hij is tusschen de twee Crijchslieën, die naest achter hem staen, en 1 comt achterwaert ter plaets daer eerst 4 stont 2 en 3 commen nevens 1, en is daer me de gestalt des hoops gelijk inde form C, als verplompten houckhoop, volgens het voornemen.

III. LIDT.

Te verklaren de manier van 't vellen der pijcken na een sekeren oirt.

Daer wort int vellen der Pijcken vereijst, datter tot d'een plaets niet te veel punten bij malcander en commen en daerom tot ander plaetsen te weijnich, maer soo verdeelt te sijn, datter over al goede bescherming sij, 't welck voor de Pijckiers niet wel doenlick en waer, als sij hen niet en gevouchde na seker gemeene regel. Om welcke te beschrijven, soo is te weten, dat de twee Pijckiers, die int tweede lit nevens de musquettiers staen, als in dese 2 from, an R en S haer Pijcken soo vellen, dat de Punten bijcans malcander geraken, als de twee pijcken RB en SB, en alsoo met dergelijcke ande punten bij D, F, H, K, M, O, Q, maer elck pijckier staende int middel der vijf pickiers van de voorsijde der vier hoopen C, G, L, P, velt sijn Pijcke rechthoekich op de selve voorsijde, en elck Pijckier staende in 't middel der 5 Pijckiers daer de vier houcken me verplompt sijn, als van A, E, I, N, velt sijn Pijcke oock rechthoekich op de selve sijde. Dit soo

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little backwards until he is between the two soldiers who are just behind him, and 1 steps backwards to where first 4 was, 2 and 3 come to stand beside 1, after which the shape of the troop is as in drawing C, a bevelled corner troop, as planned.

3rd PARAGRAPH

To explain the manner of charging the pikes in a certain direction

The charging of the pikes requires that not too many points come close to each other in one place, so that there are too few in other places, but that they are so distributed that sufficient protection is ensured everywhere, which would not be feasible for the pikemen if they did not conform to a certain common rule. To describe which it should be known that the two pikemen who in the 2nd rank are standing next to the musketeers, as in figure 5, at R and S charge their pikes in such a way that the points almost meet, as the two pikes RB and SB, and similarly at the points near D, F, H, K, M, O, Q, but each pikeman standing in the centre of the five pikemen of the front of the four troops C, G, L, P, charges his pike perpendicular to the same front, and each pikeman standing in the centre of the five pikemen by whom the four corners have been bevelled, as A, E, I, N, also charges his pike perpendicular to the

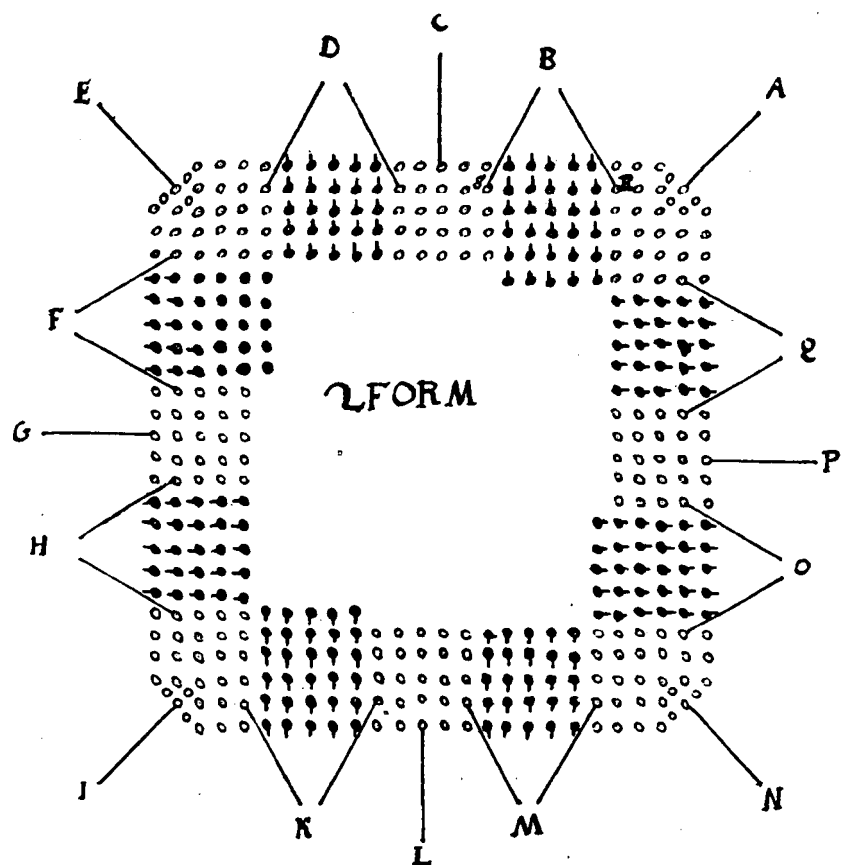


Fig. 5. Charging pikes for protection of the musketeers (1st stage).

verre gedaen wesende de gestalt is dan als de volgende form uijt wijst. Dese 24 Pijcken aldus gevelt sijnde, als gront daer d'ander pijcken, die der tusschen sullen commen na moeten gevelt worden, ter eender en ter ander sijden, soo sullen de vier uijterste pijckiers tusschen A en B, sgelijcx de vijf uijterste Pijckiers tusschen A en Q, en de twee tusschen B en C, oock de twee tusschen C en D met alle d'ander diergelijcke, haer Pijcken soo vellen dat de Punten bij cans even wijt van malcander sijn, als in dese 3e form tusschen welcke sullen commen de pijcken daer achter staende daer af wat nader gelijkheyt te sien is inde 1 form der eerste bepaling.

Merckt noch, dat de voorste Pijckiers haer Pijcken soo verre mogen intrekken, dat haer punten mette punten der achterste eve verre uijsteecken, waer me meerder naerderheijt der vorcken bij malcander valt.

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same side. This being done, the shape is as appears from figure 6. These 24 pikes thus having been charged, as a basis on which the other pikes, which will come in between, have to be charged, on the one and on the other side, so shall the four extreme pikemen between A and B, just like the five outermost pikemen between A and Q, and the two between B and C, as well as the two between C and D with all the others similarly, charge their pikes in such a way that the points are almost equally far apart, as in this figure, between which will come the pikes standing behind, the similarity of which can be seen in figure 1 (in the first definition).

Also note that the foremost pikemen may withdraw their pikes until their points extend equally far as the points of the hindmost, as a result of which the forks are closer together.

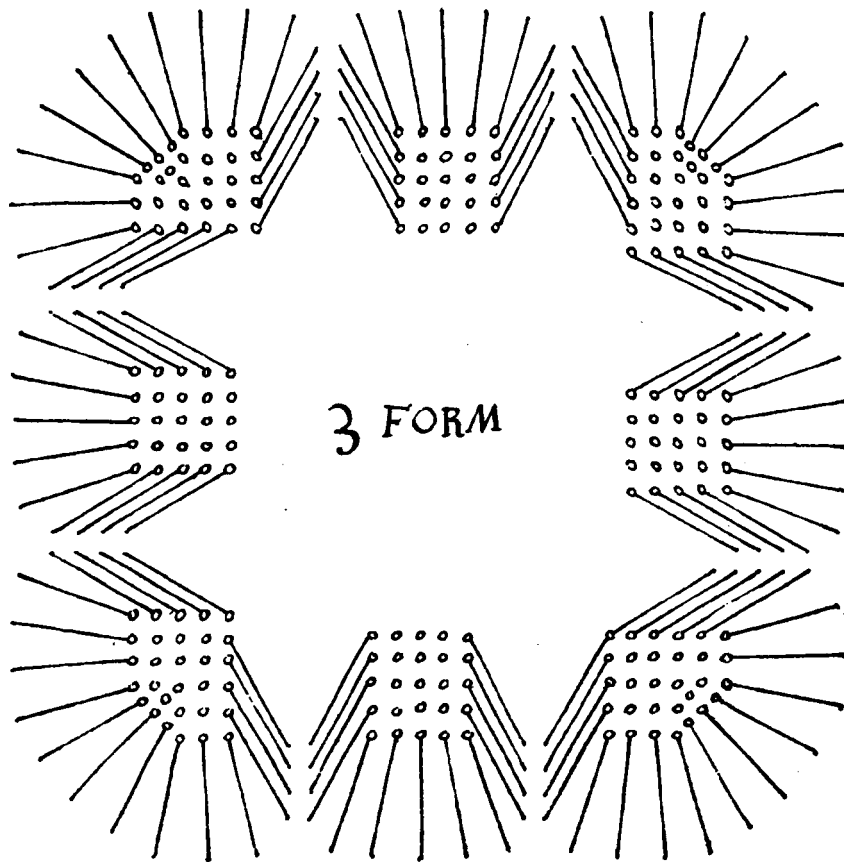


Fig. 6. Charging pikes (operation completed; the musketeers are not represented).

T'is oock oirboir de vorcken nevens malcander soo te houden als dese bijgevouchde form uijt wijst, wesende van drie vorcken A B C, D E F, G H I, diens plat der vorcken ewewijt licht vant plat des Horisont sichteijnders, 't welck soo beter is dan de platte sijden rechthoeckich op den sichteijnder te commen, om twee voornamelicke redenen, d'een dat de punten van verscheijde vorcken, als de punten C D en F G alsoo naerder malcander commen: Ten anderen dat men steeckende na de benen van des Viants Peerden de selve alsoo sekerlijcker den voortganck belet, want de benen tusschen de snijende sijden der vorcken wesende, worden daer af gequetst en het nader ancommen verhindert.

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It is also necessary to hold the forks, one next to the other, as is shown in this accompanying figure 7 of three forks ABC, DEF, GHI, the flat side of the forks being held parallel to the horizon, which is better than perpendicular to the horizon, for two important reasons, one being that the points of various forks, as the points C, D and F, G come more closely together: The other that thrusting towards the legs of the enemy's horses, one stops their advance with more certainty, for if the legs are between the cutting sides of the forks, they are injured by them and further advance is prevented.

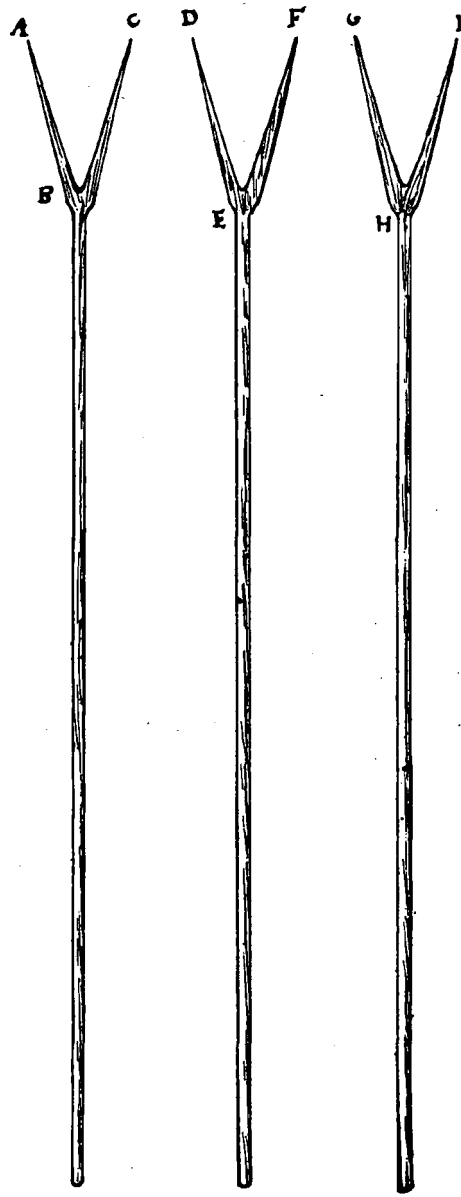


Fig. 7. Forked pikes, extended parallel to each other.

III. LIDT.

Van meerder en minder Pijckschansen dan van vier vendels.

Inde boveschreven drie leden is geseijt van het stellen der Crijchslie in haer vier sijden, van het verplompen der vier houckhoopen, ende van het vellen der pijcken, waer me de manier van d'oirdening der Pijckschansen mocht schijnen ghenouchsaem volbracht te wesen: Maer want daer toe genomen wiert alleenelick een voorbeelt van vier vanen, en dat Pijckschansen van meerder en minder menichte wat naerder verclaring vereijsschen, soo sal ick nu daer off int gemeen seggen. Ten eersten is te weten, dat alle menichte der hoopen van een sijde parich getal moet sijn, want onparich wesende, soo soude d'een van twee houckhoopen moeten van Musquetters sijn daer uijt geen wel gesloten pijckschans volgen can. Ten anderen soudent twee hoopen van een selve gheweer als beide Pijckiers of beide Musquetters bij malcander moeten comen, teghen de gheemeene regel, die in pijckschansen vereijst is.

Ten tweeden staet te anmercken, dat alle menichte van Vanen in parichtal bestaende, van binnen viercant mach vallen, of dat elcke der vier sijden eveveel hoopen mach hebben, te weten soo veel alsser vanen sijn:

Bij voorbeelt twee vanen geven in elcke sijde twee hoopen, vier vanen vier hoopen, ses vanen ses hoopen en soo voort met d'ander, waer af ick tot opentlicker verclaring stelle de drie formen A, B, C, te weten A van twee vanen, elcke sijde met twee hoopen, B van vier vanen, elcke sijde met vier hoopen, C van ses Vanen, elcke sijde met ses hoopen, doch sonder Musquetters daer bij te teijckenen, om dat sulcx deur 't voorgaende genouch te verstaen is.

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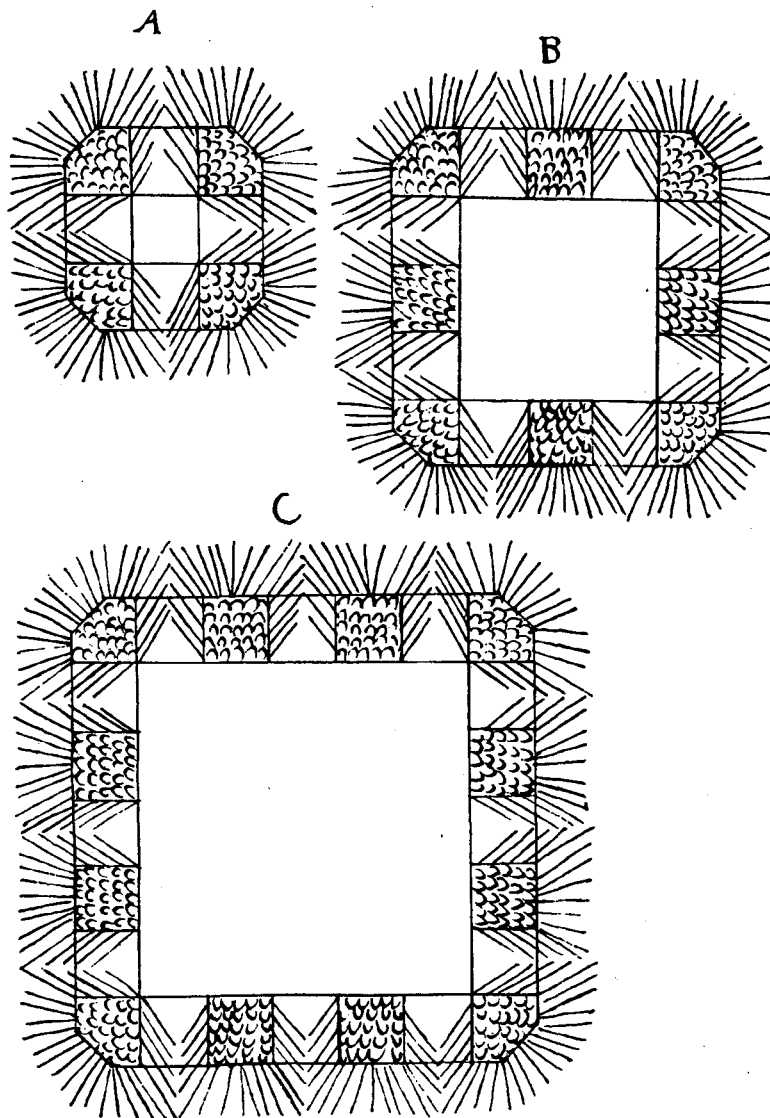
4th PARAGRAPH

Of pike redoubts with more or less than four companies

The preceding three paragraphs described the disposition of the soldiers on four sides, the bevelling of the four corner troops, and the charging of the pikes, by which the manner of arranging the pike redoubts would seem to be sufficiently explained: But since for this purpose was taken only an example of four companies, while pike redoubts with a larger or fewer number call for some further explanation, I will now discuss these in general. First, it should be known that all the troops on one side are to form an even number, for if they formed an odd number, one of two corner troops would have to be musketeers, from which cannot follow a closed pike redoubt. On the other hand, two similar armed troops, both of pikemen or of musketeers would have to stand side by side, against the common rule required in pike redoubts.

Secondly, it can be said that when the number of companies is even, the inside can be square, while each of the four sides can then have an equal number of troops, namely as many as there are companies:

For example, two companies give on each side two troops, four companies four troops, six companies six troops and so on, to explain which clearly I take the three drawings A, B, C in figure 8, to wit A of two companies, each side with two troops, B of four companies, each side with four troops, C of six companies, each side with six troops, omitting the musketeers from the drawing, because the foregoing has made this sufficiently clear.



*Fig. 8. Pike redoubts of 2, 4 and 6 companies
(the musketeers are not represented)*

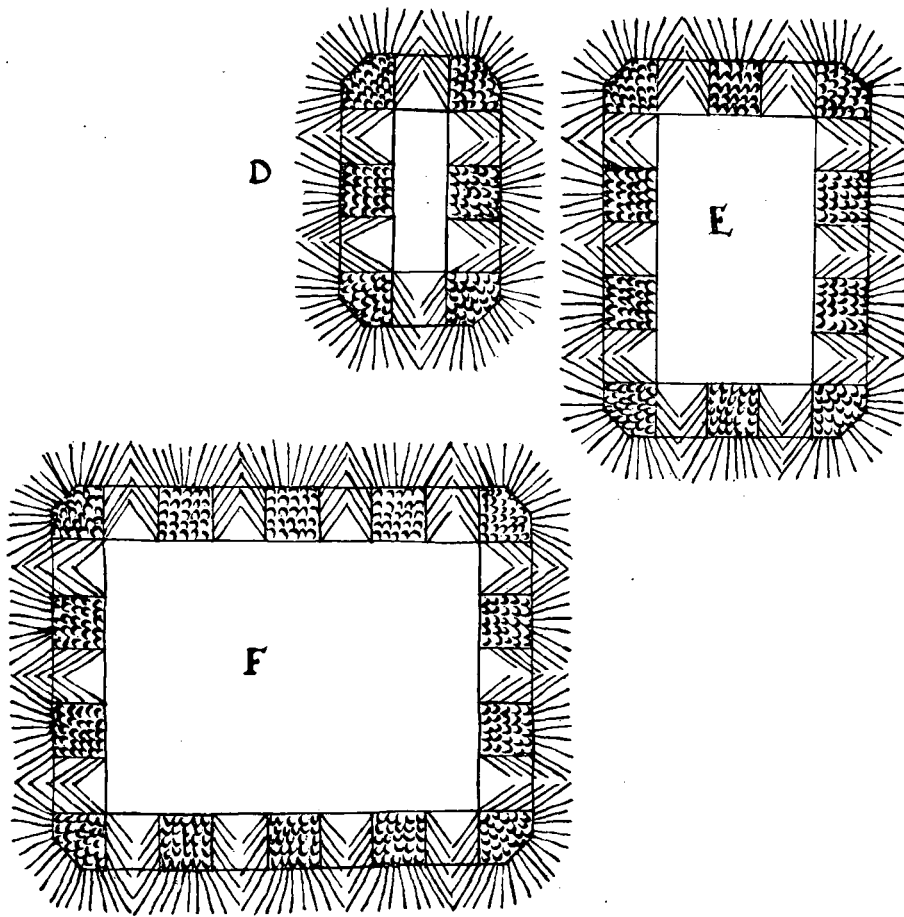
Ten derden alle menichte van Vanen in onparich ghetal bestaende, en wil van binnen niet viercant vallen, of elcke der vier sijden van eveveel hoopen hebben, uijt oirsaeck datter op twee houcken der Pijckschans Musquetters souden commen, tegen de ghemeene regel van d'oirden der Pijckschansen. Om dit te voorcommen, men sal in 't een paer sijden twee hoopen meer nemen als in 't ander, vallende daer me den inwendigen vierhouck op d'een sijde langer: Als bij voorbeelt met drie Vanen maectt men twee sijden van vier hoopen, en twee sijden van twee hoopen: Met vijf vanen maectt men twee sijden van ses hoopen, en twee zijden van vier hoopen: Met seven vanen, twee sijden van acht hoopen, en twee sijden van ses hoopen, en soo voorts, waer af ick tot opentlicker verclaring stelle dese drie formen D, E, F, te weten D van drie vanen, daer af de twee sijden elck hebben vier hoopen, en twee sijden elck twee hoopen: E van vijf vanen, waer af de twee sijden elck hebben ses hoopen, en twee sijden elck vier hoopen: F van seve Vanen, waer af de twee sijden elck hebben acht hoopen, en twee sijden elck ses hoopen, en soo voorts met dergelijcke.

De boveschreven voorbeelden sijn met verdeling der Vanen in tweeën, maer soo't ghebeurde dat men in seer groote pijckschansen, heele Vanen wilde ghebruijcken, maeckende hoopen van 55 Pijckiers en hoopen van 55 Musquetters, die over de tweemaal soo lanck als breed vallen, blijvende evenwel de openheden tusschen twee hoopen, alleenelick van 15 voet als van d'ander, dat soude mogen

* * * * *

Thirdly, if the companies form an odd number, the inside will not be square, or each of the four sides will have the same number of troops, because at two corners of the pike redoubt there would be musketeers, which is against the common rule of the arrangement of the pike redoubts. To prevent this, one shall on one pair of sides take two troops more than on the other, as a result of which the inner quadrangle will have one longer side: For example, with three companies one forms two sides of four troops, and two sides of two troops: With five companies one forms two sides of six troops, and two sides of four troops: With seven companies, two sides of eight troops, and two sides of six troops, and so on, to explain which clearly I take the three drawings D, E, F in figure 9, to wit D of three companies, two sides of which each have four troops, and two sides each two troops: E of five companies, two sides of which each have six troops, and two sides each four troops; F of seven companies, two sides of which each have eight troops, and two sides each six troops, and so on.

The foregoing examples are of companies divided in two, but if it happened that in very large pike redoubts one wanted to use whole companies, making troops of 55 pikemen and troops of 55 musketeers, which would be twice as long as they are wide, but keeping the spaces between two troops at 15 feet as before,



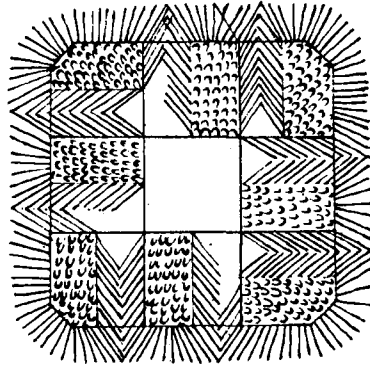
*Fig. 9. Pike redoubts of 3, 5 and 7 companies
(the musketeers are not represented)*

toegaen gelijk dese bijgevouchde formen G van acht vanen ende H van twintich vanen anwijzen, waer bij de regel op allen deur 't voorgaende ghenouch verstaen schijnt. Bij aldiender een groote Pijckschans te maecken viel als neem ick van hondert vanen, dat is een heele standaert van thien banieren, dat soude mogen geschien met twee Pijckschansen, d'een in d'ander, de buitenste van 60 vanen, de binnenste van veertich, elcken schanshoop van heele rijen als vooren, en soude plaets blijven tusschen de twee sijden der twee pijckschansen van 150 voeten. Hier me soudon de buitenste als sij te rugge mosten wijcken haer vertreck meugen nemen op de binnenste en daer af ontset worden na de wijze verclaert int 11 hoofdstick des 5e onderscheijts. Maer soo men vanden heelen hoop der hondert vanen een Pijckschans wilde maken om daer binnen te besluijten de wagens met al het nagevolch, en den viant an allen sijden het hooft te mogen bieden, die plaets soude op elke sijde lanck sijn 720 voeten. Soo der boven de hoopen der heele of halve vanen eens Pijckschans, eenich overschot van Crijchslie bleven, men soude die meugen stellen int vierhouckich perck, om bijstant te doen an sulcken oirt, als 't meest noodich viel: Off anders mocht men die na ghelegentheijt verdeelen tot vermeerdering der hoopen. De cleenste Pijckschans hier vooren geteijckent als A is geweest van twee vanen, waer me de ghemeene oirden van Rijeleijers rijen en leden der vanen in wesen blijven can, maer met minder menichte van Crijchslie en cannen die oirden niet volcommelick onderhouden.

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it would be as shown by the accompanying drawings G and H in figure 10, to wit G of eight companies and H of twenty companies, the rule of which would seem to be sufficiently clear from what has been said before. If therefore, a large pike redoubt is to be made of, say, one hundred companies, which is a whole standard of ten banners, this could be done with two pike redoubts, one in the other, the outer one of 60 companies, the inner one of forty, each redoubt of whole files as before, and between the sides of the two pike redoubts there would remain a space of 150 feet. Thus, if the outer one had to retreat it could withdraw to the inner one and there be relieved as explained in chapter 11 of the 5th subdivision. But if one wanted to make one pike redoubt of the whole troop of the hundred companies to enclose in it the waggons with everything pertaining to them, and to face the enemy on all sides, this place would on each side be 720 feet long. If the troops of the whole or half companies of a pike redoubt would leave a surplus of soldiers, they could be placed in the quadrangular park to assist where this would be most necessary: Or else one might distribute them, dependent on conditions, to strengthen the troops. The smallest pike redoubt drawn before as A in figure 8 was one of two companies, by which the common order of file-leaders, files and members of the companies can be retained, but with fewer soldiers that order cannot be fully maintained.

G



H

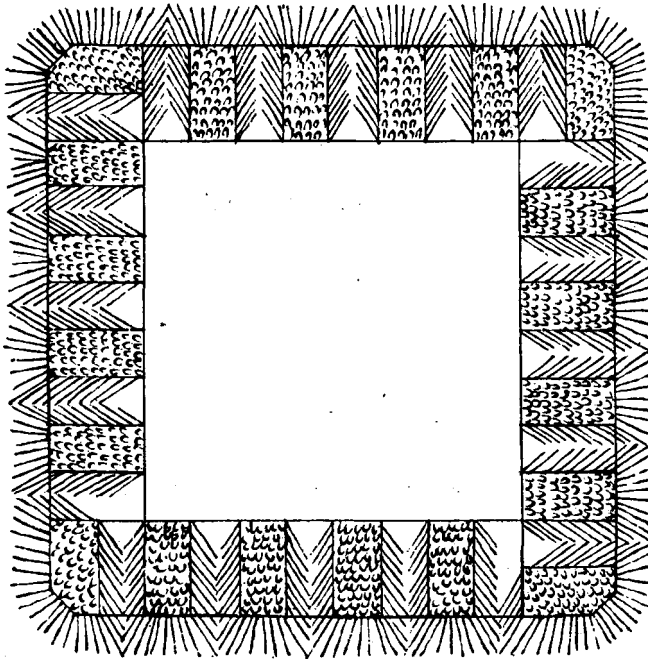
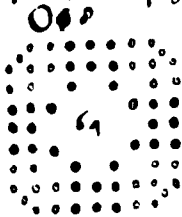


Fig. 10. Pike redoubts of 8 and 20 companies.
(the troops of whole files)

Nochtans angesien het dickwils gebeurt, dat weijniger dan twee vanen voetknechten van Ruijterije opt velt ontmoet worden, en daer op oock regel dient, soo sal ick er nu mijn gevoelen af verclaren, deur dese vijf formen I, K, L, M, N, d'eene cleender als d'ander, hebbende elcke (gelijck de Pijckschans van twee vanen) alleenelick acht hoopen, te weten elcken hoop van I 20 Crijchslien, van K 16, van L 12, van M 9, van N 4: 'T welck volbrenght voor al de Crijchslien der pijckschans van I 160, van K 128, van L 96, van M 72, van N 32: Daerom bij aldien ijmant een pijckschans te veroirdenen hadde van 160, 128, 96, 72 of 32 Crijchslien, soude daer me meughen volgen sulcken form als daer zijn menichte me over een quam.

Maer ander menichte van Crijchslien voor handen sijnde dan eenige van dese, ick neem 64, dats voor elck der 8 hoopen 8 Crijchslien, hij soude meugen volgen de form die daer me naest over een quam, dats van 72, die stellende als in dese form O, en soo voorts met anderen.

Maer ander menigste van Crijchslien voor handen sijnde
dan eenige van dese, ick neem 64 dats voor elck der
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die daer me naest over een quam
dats van 72, die stellende als in
dese form O, en soo voorts met
anderen



However, as it often happens that less than two companies of foot meet cavalry in field, for which also a rule should be given, I shall now give my opinion on it by figure 11, consisting of five drawings I, K, L, M, N, one smaller than the other, each having (like the pike redoubt of two companies) only eight troops, to wit each troop of I 20 solidiers, of K 16, of L 12, of M 9, of N 4: Which for all the soldiers of pike redoubt I amounts to 160, of K 128, of L 96, of M 72, of N 32: Therefore, if somebody should have to arrange a pike redoubt of 160, 128, 96, 72 or 32 soldiers, he would follow such a drawing as corresponded with his number.

But if a number of soldiers different from any of these is available, I take 64, which is 8 soldiers for each of the 8 troops, he might follow the drawing which corresponds most closely with it, which is 72, arranging it as in the drawing O, and so on with others.

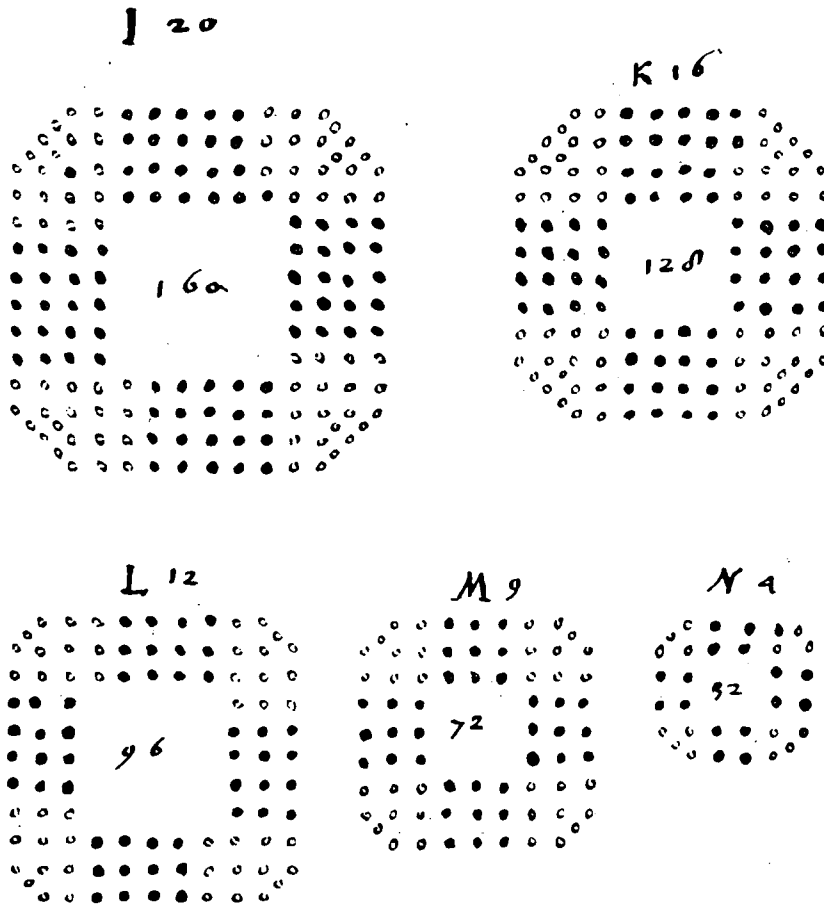


Fig. 11. Pike redoubts of smaller bodies than companies of 100 men.

Angaende ijmant mocht seggen, dat met soo weijnich voetknechten als dese laetste voorbeelden genomen sijn, geen groot tegestant en can gedaen worden, tegen veel Ruijterije op een vlack velt. Daer op dient tot antwoordt, dat de menichte der Ruijters soo cleen can sijn, dat sij oirboir verstaen en besluijten tegenstant te willen doen, in welcken gevalle goede oirden voorderlick is. Daerom soo lange men gheen bequamer dan dese en weet, soudet billich sijn die te gebruijcken, maer een beter te anveerden als een beter bekendt waer.

II. HOOFTSTICK.

Te verclaren de maniere vant marcheren, voorttreden, en swencken
der Pijkschansen.

De voorttreding der pijkschansen is oirboir in verscheijden ansien: Ten eersten om eerlick te vertrecken sonder vluchten, tot dat men uijt het vlack velt gecommen is tot verseeckerder plaetse, als tot Steden, Sterckten, Bosschen, of gebroocken Waterege, marassige landen, daer de Ruijterije achterdeel heeft, en voor het voetvolck wijcken moet; Ten anderen om een gecregen buijt int ansien van machtiger Ruijterije wech te krijen: Om (Convoij) gheleij of ander reijse met verseeckertheijt te volbrengen: Om een cleene menichte van haer eijgen Ruijterije onder haer pijkschans door 't behulp der Musquetiers te beschermen, tegen grooter menichte van Ruijterije des viants; Om Ruijterije opt plat velt self te doen wijcken, met diergelijcke. Het swencken is oirboir om de voorsijden te brengen na den oirt daermen na toe wil trecken. De manier om dese voorttreding en swencking te doen is dusdanich: Bij aldien de Musquetiers buijten haer percken waren, sullen hemlien in slachoiden weerom daer in stellen, opdat int voorttreden de behoorlicke wijde en form haerder percken te beter in wesen blijve:

Daer na sal men de vier verplompte houckhoopen weerom tot haer eerste rechtheijt brengen, met elcke vier mannen der selve weerom te doen staen in haer rijen en leden, ghelijckse voor de verplomping waren, om bequamelick te mogen gaen. Eintlick 't bevel gedaen sijnde van voort te treden of swencken, na eenigen sekeren oirt, soo sal elck Crijchsman hem keeren na den eijsch vanden, en voorttreden soo langhe tot datter stilstant bevolen wort: En bij aldiender dan weerom Pijkschans oirdening noodich viel, en na de boveschreven voorttreding bevonden wierde meerder openheijt of nauwer verdrucking der Crijchslien, of cromheijt der sijden, of scheefheijt der houcken, dan na 't behooren, 't welck na een langhe voortganck lichtelick gebeuren mocht, dat can men terstont verbeteren, oock me de vier houcken verplompen, pijcken vellen, en al de rest als vooren. Maer om de boveschreven pijkschans int voorttreden of swencken noch seeckerder in oirden te doen blijven, 't welck meer of min nodich can sijn, na dat de Viants Ruijterije verre of na is, soo meugen de uijterste Pijckers en uijterste Musquetiers, soo wel op de vier binnesijden als op de vier buijtensijden der pijkschans, de hant slaen an pijcken ewewijdich metten (Horisont) sichteijnder, ter hooghde van der Crijchslien handen, en soo veel in getal alst nodich is gaende deur sulck behulp gheduerlick recht en ewewijt van malcander in goede oirden.

If somebody should say that with so few foot-soldiers as taken in these last examples one cannot offer a strong resistance to many horse in an open field, the answer is that the number of horse may be so small that it is thought expedient to offer resistance, in which case a good array against it is advantageous. Therefore, as long as one does not know a better order, it would be reasonable to use this, but to accept a better one if a better were known.

CHAPTER 2

To explain the manner of marching and wheeling of the pike redoubts

The marching of the pike redoubts is necessary for various reasons: First of all to make an honourable retreat without a flight, until one has come from the open field to a more protected place, such as towns, fortresses, woods or interrupted watery, marshy lands, where cavalry is at a disadvantage and must yield to the infantry: Secondly to remove a conquered booty within sight of more powerful cavalry: To accomplish a convoy, or other march with certainty: To protect a small number of one's own cavalry under one's own pike redoubt with the aid of the musketeers against a larger number of enemy cavalry; To make cavalry retreat in the open field itself, etc. Wheeling is necessary to bring the front in the direction where one wants to march. The manner of this march and wheeling is as follows: If the musketeers have left their parks, they are to return to them in battle-array in order that while marching the proper width and shape of their parks are better maintained:

Subsequently one shall bring the bevelled corner troops back to their previous straight shape, each four men returning to their files and ranks as they were before the bevelling, in order to advance adequately. When at last the order has been given to march or wheel in a certain direction, each soldier shall turn as required and march until the command is given to halt; And if then the pike redoubt is to be re-arranged, and after the aforesaid marching is found to have more openness or closeness of the soldiers, or bent flanks or slanting corners than is required, which may easily occur after a prolonged march, one can at once improve this, as well as bevel the four corners, charge pikes and all the rest as before. But in order even better to ensure that while marching or wheeling the above-mentioned pike redoubt better retains its array, which may be necessary to a greater or lesser extent according as the enemy cavalry is far off, or near, the outermost pikemen and outermost musketeers, both on the four inner sides and on the four outer sides of the pike redoubt, charge their pikes parallel to the horizon, at the level of the soldiers' hands, and as many as are necessary, by such means constantly to march straightforward and parallel to each other in good order.

III. HOOFTSTICK.

Inhoudende manier van onvolkommen Pijkschans oirdeningh,
die men buijten vlacke velden na gelegentheijt der plaetsen met voordeel
can gebruijcken.

Bij aldien 't voetvolck waer ontrent een rechte sloot, gebou, of ander beschutsel, sulcx datse vandie sijde verseeckert waren de Ruijters hemlien niet te connen anvallen, sij souden dat tot haer voordeel mogen nemen: Laet tot naerder verclaring van dien A B een rechte gracht sijn: Om de selve tot sijn voordeel te nemen, men mach de pijkschans als C, alleenelick van drie sijden veroirdenen.

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CHAPTER 3

Containing the manner of irregular pike redoubt array, which outside open fields, according to circumstances, can be used to advantage

If the foot were near a straight ditch, building or other protection, such that on that side they would be safe from cavalry attack, they could take advantage of this circumstance: Let for further explanation in figure 12 AB be a straight ditch: To use it to advantage the pike redoubt C need to be arrayed on three sides only.

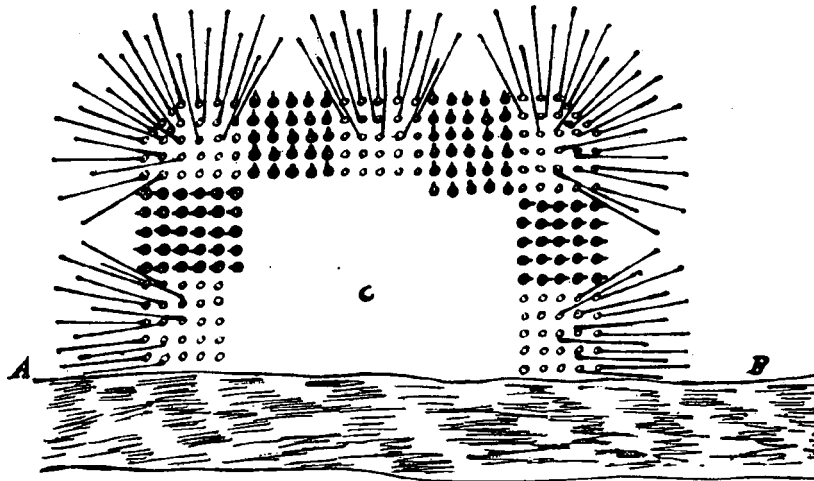


Fig. 12. *Irregular pike redoubt of 2 companies and 1 troop of pikemen, used as a bridge head.*

Soo de Gracht een bocht hadde, of dat twee grachten op malcander een houck maeckten, ghelijck hier nevens de gracht AB, makende op de gracht CD een houck ABC, in sulcken gevalle soude men met alleenelick een sijde volcx als EF connen bewaert sijn. Maer om die effen te doen passen van 't een einde tottet ander, 't is kennelick, dat men mette heele rechte sijde E F soo na B mach commen, of soo verre daer af wijcken, tot daer men 't dadelick bevint te passen.

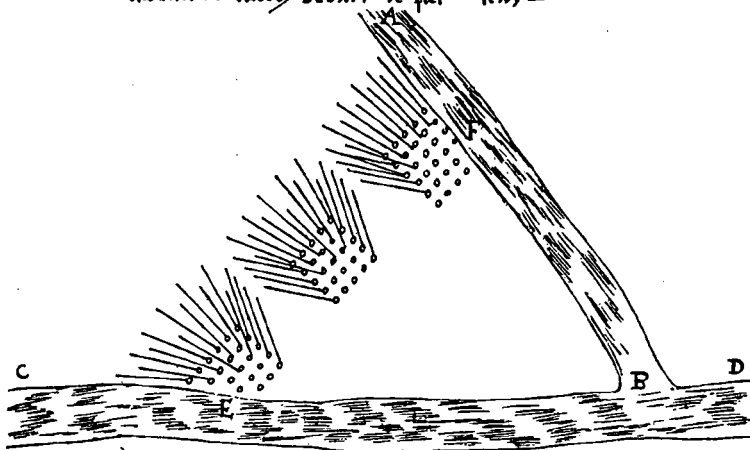
Deur 't geene hier geseijt is vanden houck veroirsaeckt uijt twee rechte slooten op malcander, mach men verstaen, hoe men ander bochten ghelijck van rivieren of beken tot sijn voordeel can nemen: Als bij voorbeelt inde volgende form der rivier anden bocht ABC, gestelt de Crijchslien AC.

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If the ditch had a bend, or if two ditches formed an angle with each other, as the ditch AB in figure 13, branching off from the ditch CD by an angle ABC, in such case one would be safe with only one side of foot EF. But to make it fit from one side to the other, it is obvious that the entire straight line EF must be so near B, or so far away from it, as is found to fit in practice.

From what has been said here of the angle formed by two straight ditches, one can understand how other bends of rivers and brooks can be used to advantage: As for example in figure 14 of the river at bend ABC, the soldiers being arrayed between A and C.

die ~~st~~ ten te doen pa ten van ten einde tot het ander,
 his heimeliche dat men met de Boole rechte lijn EF so
 na B mag comen, of so ver door af wijken, tot
 daerment dadel begint te pa ten, —



Deur tegeve hier geseyt is vanden Boole veronfaetelyk nijt
 twee rechte slooten op malcander, mag men vers laen
 Boemen ander bochten gelyck van rivieren of beken tot
 sijn voorderl can nemen: Als by voorsiet in de volgende pons
 de rivier anden bocht ABC, gestelt de Crigstien A C.

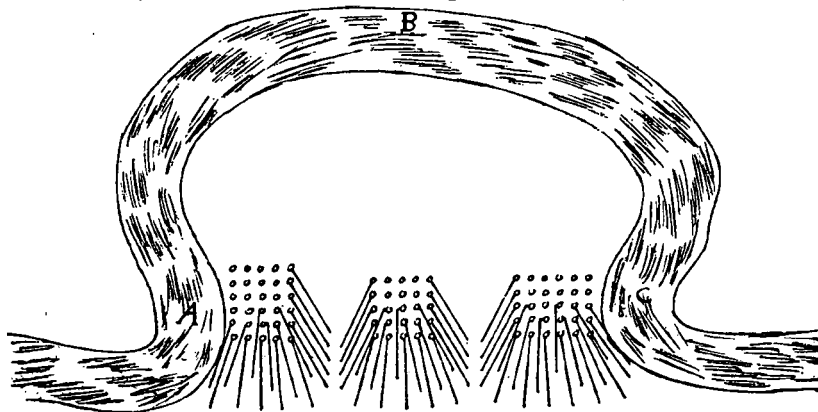


Fig. 13. Irregular pike redoubt for enclosing the confluence of two watercourses.

Fig. 14. Irregular pike redoubt for enclosing a bend of a river.

Merckt dat de onvolcommen manier van Pijckschansen, als der drie voorgaende formen, daer in verschilt mette volcommen vierhouckighe, dat men der na sijn wille soo niet me voorttreden en can, als int 2e hoofdstick geseijt is, maer men moet tot die plaets blijven, daerom alsser volck genouch is, om een volcommen vierhouckige pijckschans te maecken, dat can in sulck ansien met meerder voordeel gheschien, doch het volgende voorbeelt en heeft sulcken dwanck niet.

Sooder waer een wech tusschen twee slooten of ander beschutselen, over welcke de Ruijterije niet commen en can, men soude daer oock maer een sijde voetvolcx behouven. Laet tot voorbeelt AB en CD twee sulcke slooten sijn: Hier tusschen gestelt de sijde voetvolcx EF sij sijn besloten. Maer soo sij meer volcx hadden dander noodich is om sulcken sijde te maken, men macher meer veroirdenen, d'een achter d'ander, gelijk GH met IK en diergelijcke, sulcx, dat d'eerste EF moetende wijcken, haer vertreck meugen nemen en loopen deur de openheden der tweede GH, en dat de viant in onoirden vervolgende, bejegent wort van oirdentlicke Crijchslie versch volck sijnde.

Merckt noch, dattet oirboirder is, opde uijterste einden ande grachtanten hoopen Pijckiers te stellen, gelijk inde voorgaende formen gedaen is, dan daer open plaetsen te laten voor Musquetiers, uijt oirsaeck dat de viant trachtende daer deur in te breecken en soude dan van beijden sijden met Pijckiers niet connen verhindert worden, noch de Musquetiers en soudent als sij daer stonden, soo seeckerlick op beijden sijden van Pijckiers niet beschermt sijn.

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Note that the manner of irregular pike redoubts, as of the preceding three figures, differs from the regular quadrangular one, in that one cannot march with them after one's will as said in chapter 2, so that one must remain in that place; therefore, if there are sufficient men to make a regular quadrangular pike redoubt, this can be done for this reason with more advantage; for the next example, however, this is not necessary.

If there were a road between two ditches or other protections, which could not be crossed by the cavalry, one would also there need only one side of foot. Let, for example, AB and CD in figure 15 be such ditches: The line of foot EF placed in between closes the space between them. But if they had more men than are necessary to make such a side, one could make more, one behind the other, as GH and IK, etc., so that if the first EF must fall back, they can retreat through the openings of the second GH, while the enemy, pursuing in disorder, is met by orderly arrayed soldiers, being fresh men.

Also note that it is better to place troops of pikemen at the extreme ends along the ditches, as done in the preceding figures, than to leave open spaces there for musketeers, because the enemy, trying to break through there, could then not be prevented from doing so by two sides of pikemen, while musketeers, placed there, would not be so safely protected on both sides by pikemen.

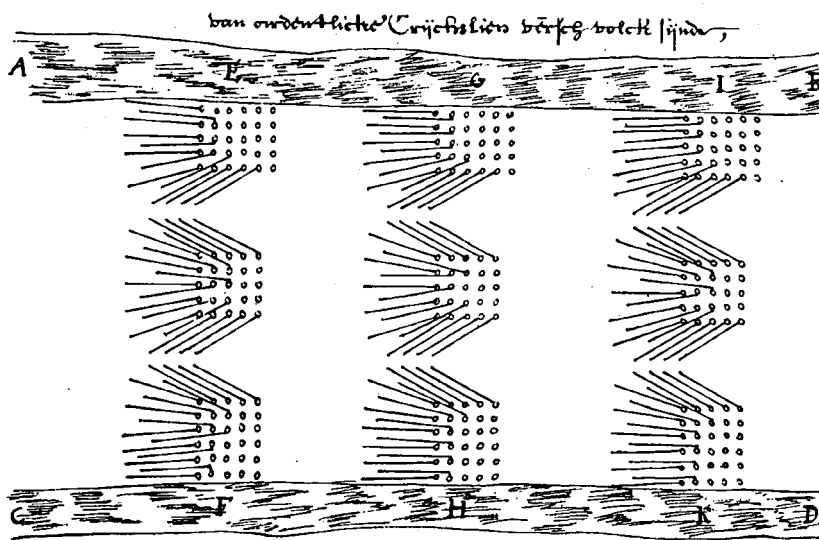


Fig. 15. Irregular pike redoubt for mobile defense of an access between two water-courses

III. HOOFSTICK.

Te verclaren de manier der oeffening int leeren van 't gebruijck de pijckschans angaende.

Want het gebruijck van pijckschansen, om daer me dadelick een viant te weerstaen, niet wel geschien en can door Crijchslie, die noijt pijckschansen en sagen, noch en weten, hoe dat toegaet, soo is daer toe nodich voorgaende oeffening, door welcke elck van te vooren weten mach, wat hij te doen heeft, waer af mijn voornemen is nu te seggen.

Eerstelick is't nodich, dat de Crijchslie altemael ervaren sijn in slachoidenen, dat is sich te stellen in haer rijen en leden na de manier beschreven in't 1e hoofdstick des 5 onderscheijts. Maer want ick sulcx deur 't selve 1 hoofdstick voor bekent neem, soo en valt daer af hier niet te seggen: Nu dan voor handen sijnde eenige Crijchslie, die dagelicx bij malcander verkeerren, en verdeelt wesende in soo veel hoopen als de menichte toelaet sij sullen eerst leeren de oirdening der vier sijden, na de manier beschreven in 't 1 hoofdstick 1 lidt.

Ten 2e 't verplommen der vier houckhoopen als in't 1 hoofdstick 2 lidt.

Ten 3den het vellen der Pijcken als in't 1 hoofdstick 3 lidt.

Ten 4e connende de leerlinghen sich daer me brengen in oirden van Pijckschans, sullen voort leeren de ghemeene regel der oirdening van verscheijden pijckschansen cleen ende groot, als in't 1 Hoofdstick 4 lidt, op dat elck alsoo in alle voorvallende pijckschansen verstae, watter behoort gedaen te sijn, en wel na can commen 't bevel, datter gedaen wort.

Ten vijfden sullen leeren het voorttreden en swencken der pijckschans als in 't 2 hoofdstick niet alleen sacht gaende, maer oock seer gaende en loopende.

Ten sesten de Musquetters sullen leeren het uijt en in loopen der pijckschans, blijvende daerentusschen de Pijckiers vast in haer oirden, ghelijck men doen soude alsser de Viant ontrent waer, 't welck moet toegaen gelijck doet mette musquetters, die uijt een schans loopen, op de schermutse te weten soo verre als sij mejnen verseeckert genouch te sijn van weerom in te cunnen commen sonder omcingelt te worden.

Ten sevenden, elcken hoop musquetters sal in't uijt en in loopen ga slaen haer eijgen openheijt, op datter als men anders deede niet te veel voor een openheijt en vergaren, en ongeval daer uijt en volge.

Ten achsten elcken hoop Musquetters sal ga slaen haer eijgen hoop Pijckers, sulcx dat wanneerse binnen de Pijckschans sijn daer achter staen, of alst de saecke vereijst daer nevens op haer slinckerhandt.

Ten negenden de Pijckiers sullen met haer Pijcken de openheden leeren beschermen, of sluijten en ontsluijten, om metter haest haer Musquetters uijt en in te connen laten, en den Viant daer uijt keeren, 't welck bequamelick geschien can met de punten der pijcken, die in en voor de openheden commen, te doen rijsen en dalen, want mettet rijsen ontsluijt men ende mettet dalen sluijt men de openheden.

Ten thienden, de Musquetters sullen inde openheden leeren schutgeveert houden, sonder malcander te beletten, na de manier van't 7 hoofdstick des 5 onderscheijts.

Ten elfden, de Musquetters sullen leeren buijten de Pijckschans achter de Ruijters loopen, en die beschieten wel verstaende als de Ruijters alleenlick op een sijde der Pijckschans an commen, soo mach men al de Musquetters, of soo

CHAPTER 4

To explain the manner of exercise in learning the use of the pike redoubts

Since pike redoubts by which an enemy is to be in practice resisted, cannot be used by soldiers who have never seen pike redoubts, neither know how this is done, this requires previous exercise, by which everybody may know in advance what he is to do, which it is now my intention to say.

First of all it is necessary that the soldiers are all experienced in forming battle arrays, to wit lining up in files and ranks according to the manner described in chapter 1 of the 5th subdivision. But as I assume this to be known from the same chapter 1, there is nothing more to be said about it: If there are now some soldiers available who are daily together, and divided in as many troops as their number permits, they shall first learn the array of the four flanks, after the manner described in chapter 1, paragraph 1.

Secondly the bevelling of the four corner troops as in chapter 1, paragraph 2.

Thirdly the charging of the pikes as in chapter 1, paragraph 3.

In the fourth place, if the pupils have thus learned to line up in pike redoubt array, they shall further learn the common rule of arranging different pike redoubts, large and small, as in chapter 1, paragraph 4, in order that every one in any pike redoubt that may occur understands what is to be done and can obey the order given.

In the fifth place shall be learned the marching and wheeling of the pike redoubt as in chapter 2, not only when going slowly, but also quickly and in double-march.

In the sixth place, the musketeers shall learn making sallies from the pike redoubt, whilst the pikemen strictly maintain their array, as one would do if the enemy were near, which must be done as with musketeers who leave a redoubt for skirmishes, to wit as far as they think they can, while being certain that they can return without being surrounded.

In the seventh place, each troop of musketeers, in leaving and returning, shall watch their own gap, lest otherwise too many would gather before one opening, from which trouble would arise.

In the eighth place, each troop of musketeers shall watch their own troop of pikemen, such that when they are in the pike redoubt they stand behind the pikemen, or if circumstances require, beside them on the left-hand side.

In the ninth place, the pikemen shall learn with their pikes to protect the openings, or close and open them, in order to allow their musketeers to leave and return hurriedly, and to keep the enemy out, which can be effectively done by raising and lowering the points of the pikes, which come in and before the openings, for by raising one opens the gaps and by lowering one closes them.

In the tenth place, the musketeers shall learn to hold skirmishes in the openings, without hindering each other, after the manner of chapter 7 of the 5th subdivision.

In the eleventh place, the musketeers shall learn outside the pike redoubt to pursue the cavalry and to fire at them, but only if the horse come towards one flank of the pike redoubt; thus one may bring all the musketeers, or as

veel als men oirboir verstaet, buijten de Pijckschans na dien oirt brengen, want dat voor de Ruijterije op de selve een vreeslick ancommen sal sijn, wetende dat sij ten uijttersten hemlien tusschen de Pijcken beschermen connen en daer uijt als uijteen haeghe geduerlich schieten. Doch alleenelick soo verre lopende, dat se met verseeckerheijt weerom daer in meugen commen.

Ten twaelfden op dattet vluchten der Musquettiers als de saeck ernst is geen schrick en veroirsaeckt ande Pijckiers, en de selve niet me op de vlucht ende brenghen, soo sullen de Pijckiers te vooren leeren in haer slachoidentkens blijven, om de Musquettiers te ontfangen, en malcander te beschermen, want alsoo leerende datter gheen meerder verseeckerheijt des levens en is dan bij de Pijckschans te blijven, 't geeft hemlien een vaster besluit van d'oirden t'onderhouden, ende Ruijterije vrijmoedich het hooft te bieden. Want angesien de Ruijters verveert sijn van Musquettiers liggende achter stilstaende houten hagen, soo en is't niet vreemt noch verveerder te sijn van Musquettiers beschermt met ijseren hagen, niet stilstaende als d'ander, maer van steeckende, en dienvolgende en gebreecker niet dan kennis des oirden hoe men hem daer op betrouwen sal.

Ten xiiie sullen de Crijchslien soo wel Musquettiers als Pijckiers leeren hun haestelick begraven met haer spabijlhauwen, om als't noot is, noch meerder verseeckerheijt tegen de Ruijterije te hebben: Sulcken begraving wesende alleeneelick een cleen grachtken, om den loop der paerden te verhinderen, can op seer corten tijt geschien, alsoo der veel volcx voorhanden is tot weijnich grachts, want alleenelick twee voeten diep gegraven, geeft mette opgeworpen eerde lichtelick vier voeten hoochde.

Ten 14e sal men tegen de pijckschans doen commen Ruijters als vianden, om daer me beter proeve te sien en leeren, hoe't in de saecke self toegaet.

Ten 15e, Inde 4e form des 3 hooftsticx is voorbeelt gestelt van drie sijden volcx, d'een achter d'ander, als EF, GH, en IK, tusschen twee watersloten, en geseijt, dat soo d'eerste EF mosten wijcken, haer vertreck meugen nemen en loopen deur de openheden der tweede GH, en dat de viant in onoiden vervolgende, bejegent wort van oirdentlicke hoopen versch volck sijnde: Sulcx is oirboir in de oeffening oock t'ondersoucken, om daer me te leeren 't gebruijck van 't geene de Romeinen dickwils met groot voordeel dadelick versocht hebben, en nu bij veelen voor ondoenelicke dinghen ghehouden worden.

Ten 16e, Daer soo veel Crijchslien niet bij malcander en sijn om hoopen van 25 mannen te maken, mach men de oeffening doen en de manier leeren met hoopkens van minder menichte, als daer in't laetste des 1 hooftsticx 4 lidt af geseijt is, want men daer deur oock siet de manier hoe't in grooter toegaet.

Ten 17e is te weten, dat eenpuntige pijcken geen goede besluytinge en connen maecken om te weerstaen den anval van Rondassiers en ghebardeerde peerden, die sulcke pijcken van malcander doen wijcken, en daertusschen in dringen: Maer mette tweepuntighe die dese Pijckiers gebruijcken ist anders gestelt, welcke in menichte nevens den anderen wesende, houden t'samen als een ijser hage, diens tacken eer breken soudent, dan van malcander scheijden. Twelck anmerckt, soo is't oirboir hier af oock proeve te doen, en t'ondersoucken, hoe lichtelick dat men deur de eenpuntige inbreekt, en hoe beswaerlick sulcx inde tweepuntighe valt, waer benevens noch te anmercken staet, dattet steken mette tweepuntige na der peerden en voetvolcx beenen, al ander seeckerheijt heeft, en meerder schade inden viant doet, dan de eenpuntige, want hoewel gheen der twee punten het been en raect, soo wordet ghesneen van de sijden der tacken,

many as are considered necessary, outside the pike redoubt to that place, because this will be there a terrible meeting for the cavalry, the musketeers knowing that in the extreme case they can be protected between the pikes and fire therefrom continually as from a hedge, but going out only so far as they can safely return in between.

In the twelfth place, in order that the flight of the musketeers, if conditions become serious, shall not cause the pikemen to panic and to join the flight, the pikemen shall in advance learn to maintain their battle arrays, in order to receive the musketeers and to protect one another, for, as in this way they will learn that there is no better way of safeguarding one's life than to stay in the pike redoubt, it makes them firmly resolved to maintain the arrays and boldly to face the cavalry. For, since the cavalry are afraid of musketeers lying behind immobile wooden hedges, it is not surprising that they are even more scared of musketeers protected by iron hedges, not immobile as before, but of thrusting ones, and consequently the only thing needed is the knowledge, how confident one may be in the array.

In the thirteenth place, the soldiers, musketeers as well as pikemen, shall learn to entrench themselves hurriedly with their spade-pick axe, in order if necessary, to have even better protection against the cavalry: Such entrenching, being only a small trench, to hinder the running horses, can be done in a very short time, as there are many men available for few trench; for, digging only two foot deep gives, with the earth thrown up, easily a height of four feet.

In the fourteenth place, one shall make cavalry attack the pike redoubt as enemies, thereby better to experience and learn how things happen in practice.

In the fifteenth place, in figure 15 (chapter 3) an example was given of three sides of soldiers, one behind the other, as EF, GH and IK, between two ditches, and it was said that if the first EF had to fall back, they could retreat through the openings of the second, GH, while the enemy pursuing in disorder is met by orderly troops of fresh soldiers: Also this is to be practiced by exercise, thereby to learn the use of what the Romans often tried in fact with great advantage and is now by many held to be unfeasible.

In the sixteenth place, if there are not enough soldiers to make troops of 25 men, one may exercise and learn the method with smaller troops, as was said in the last part of chapter 1, 4th paragraph, because by doing so one also learns how things happen on a larger scale.

In the seventeenth place, it should be known that one-pronged pikes cannot make an effective closure to repel the attack of curassiers and armoured horses, who force such pikes apart and penetrate them: But with the two-pronged ones which these pikemen use it is different, because when there are many side by side they form as it were an iron hedge, whose branches would break rather than being forced apart. This being said, it is necessary also to practice in this respect and to investigate how easily one breaks through the one-pronged ones and how difficult it is with the two-pronged pikes, to which must still be added that thrusting with the two-pronged one towards the legs of the horses and infantry is more effective and causes the enemy more harm than the one-pronged one, for even if neither of the two points touches the leg, this is cut by the sides of the prongs, and if the legs are in between, one causes both horses and men readily to fall: Of which matters the above practical experience gives better knowledge.

en diens beenen daer tusschen sijn, doet men lichtelick vallen, soo wel peerden als menschen: Van alle welcke dingen de voorschreven dadelicke ondersoucking seeckerder kennis gheeft.

Ten 18e soo is't oirboir, dat elck Crijchsknecht daer verstants genouch in is, soo wel Musquettier als Pijckier, geleert hebbende 't geene hij na den eijsch van sijn dienst behoort te weten, boven dien noch leer, al dat in stoff van pijckschans moet ghedaen sijn, om alsins, soo wel in cleene pijckschanskens als groote te connen gebruijckt worden, en te weten wat ijgelic behoort te doen: Eerstelick, dat elck sich leer stellen als Vaendrager op een der vier houcken, om te beginnen d'oirdening der vier sijden daer in't 1e hoofsticx 1 lidt af geseijt is. Ten anderen, dat elck leer de langde van elcke sijde veroirdenen met stappen, en oock met lonten, en die op rechthouckige form brengen: Bovendien, dat elck leer doen de verplomping der houckhoopen, die alleenelick door vier mannen op elcken houck gedaen wort als in't 1e hoofsticx 2 lidt: Daer na dat elck leer het vellen der pijcken, soo wel in houckhoopen als in ander hoopen, na de manier beschreven in't 1e hoofsticx 3 lidt. Voort, dat elck leer de bescherming of sluijting en ontsluijting der openheden tusschen de hoopen, daer in't 9 lidt deses hoofsticx afgeseijt is. Tot besluit of ijmant in dese oirdening der pijckschansen noch eenige swaricheijt maeckte of vonde, soo segh ick nochtans, dat men daer bij behoort te blijven, soo lange tot datter een ander wijse zoo goet of beter gevonden wort.

In the eighteenth place, it is necessary that every soldier who is clever enough, musketeer and pikeman alike, having learned what he should know according to the requirements of his service, should learn moreover everything that is to be done in relation to pike redoubts, in order that he may be used in small as well as in large pike redoubts, and knows what each has to do: First, that every one learns to line up as ensign bearer at one of the four corners, starting with the array of the four flanks as discussed in chapter 1, paragraph 1. Secondly, that everyone learns to determine the length of each flank with steps, and also with matches, and to make it into a rectangular shape: Also, that everyone learns how to bevel the corner troops, which is done by four men only at each corner as in chapter 1, paragraph 2. Then, that every one learns how to charge the pikes, both in corner troops and in other troops, according to the manner described in chapter 1, paragraph 3. Besides, that everyone learns the protection, or closing and opening of the gaps between the troops, which has been discussed in paragraph 9 of this chapter (p. 513). In conclusion, if anybody should raise or find some difficulty about this array of the pike redoubts, I say nevertheless, that one should stick to it until another, equally good or better method has been found.

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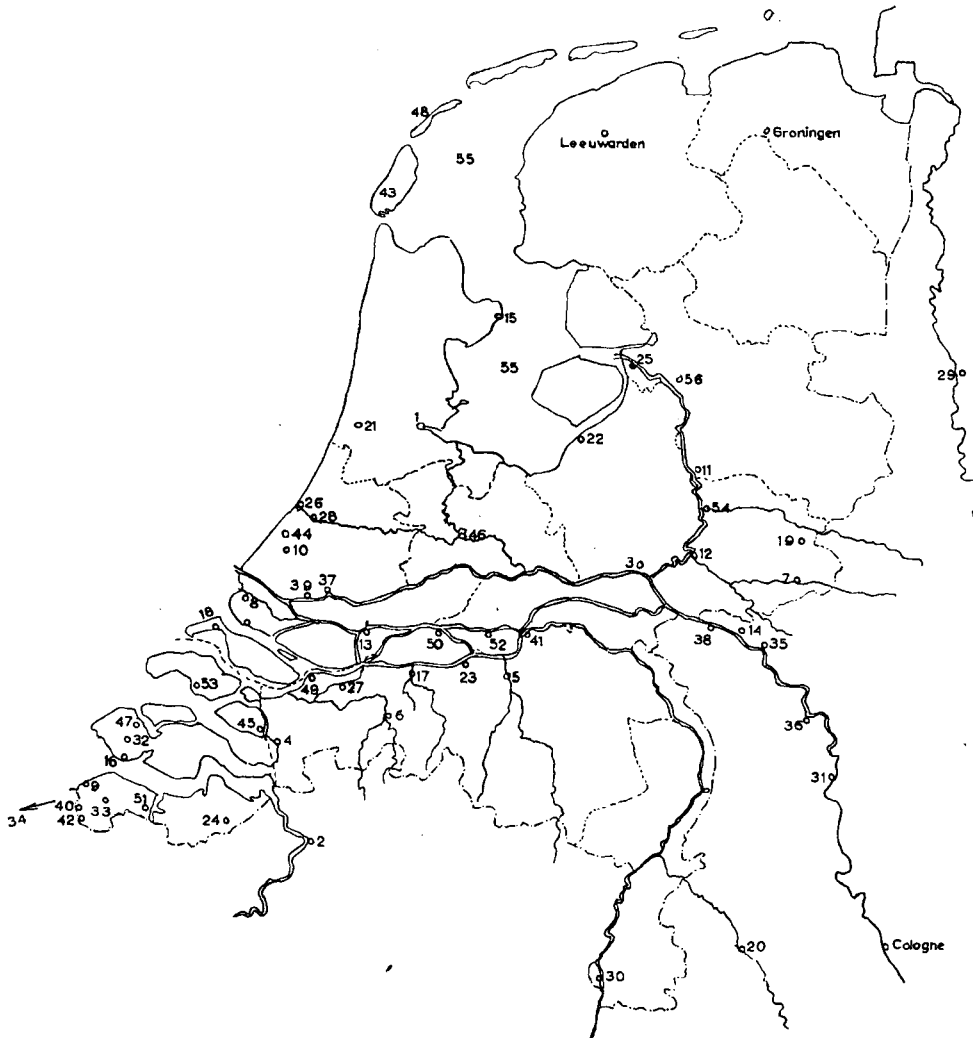
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| 4. Bergen op Zoom | 31. Meurs |
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| 6. Breda | 33. Oostburg |
| 7. Bredevoort | 34. Ostend |
| 8. Brielle | 35. Rees |
| 8a. Hellevoetsluis
(south of Brielle) | 36. Rijnberk |
| 9. Cadzand | 37. Rotterdam |
| 10. Delft | 38. Schenkenschans |
| 11. Deventer | 39. Schiedam |
| 12. Doesburg | 40. Sluis |
| 13. Dordrecht | 41. St. Andries |
| 14. Emmerik | 42. St. Anna ter Muiden |
| 15. Enkhuizen | 43. Texel |
| 16. Flushing | 44. The Hague |
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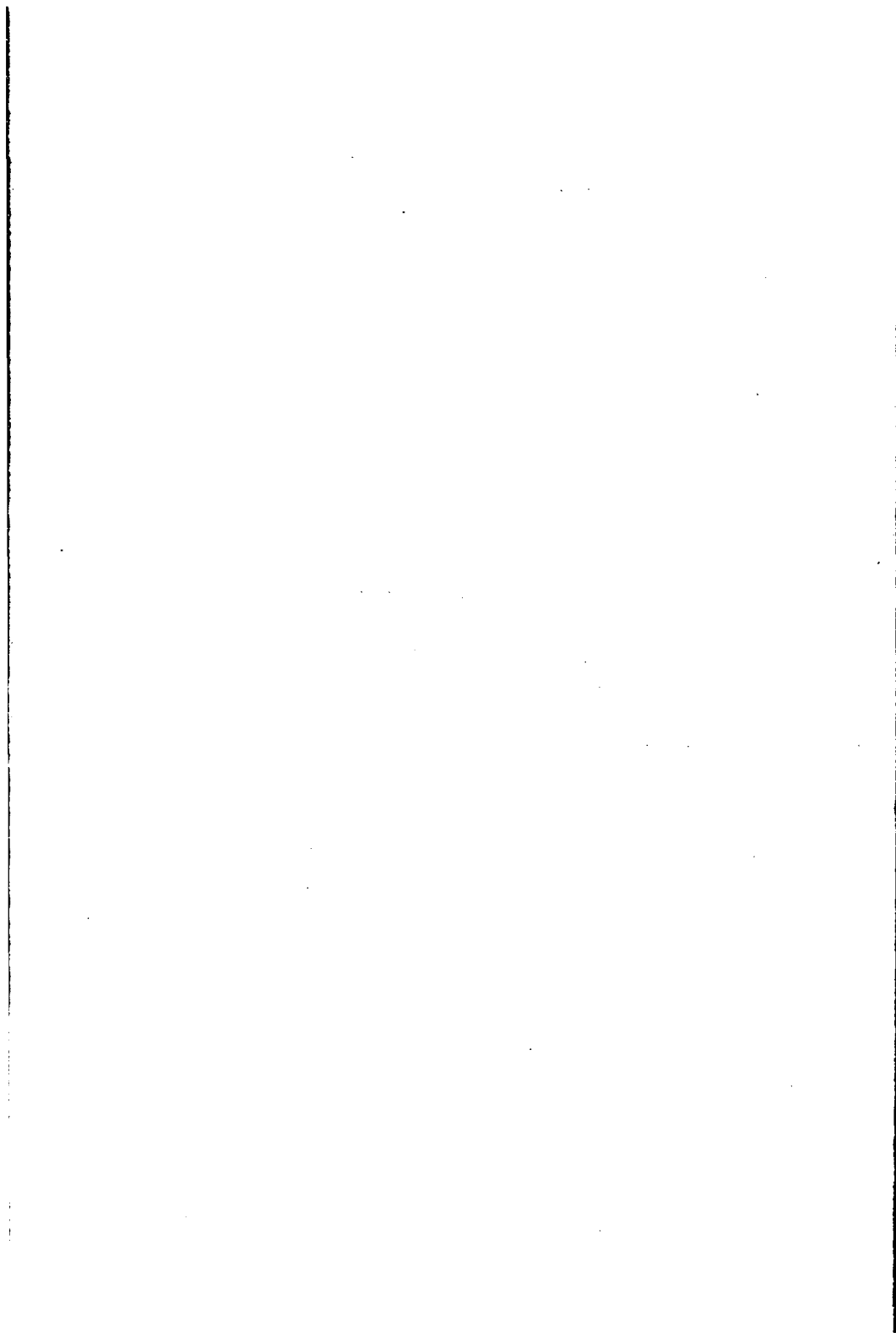


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