

THE IMMORTAL FAUSTO: THE LIFE, WORKS, AND SHIPS OF THE VENETIAN
HUMANIST AND NAVAL ARCHITECT VETTOR FAUSTO (1490-1546)

A Dissertation

by

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ABSTRACT

At the beginning of the sixteenth century, the maritime power of the Republic of Venice was seriously threatened by the Ottoman Sultan Suleiman I in the East, and by the Holy Roman Emperor Charles V in the West. In order to regain its naval power in the Mediterranean, the Republic of Venice strongly encouraged Venetian shipwrights to submit new designs for war galleys. The undisputed founder and champion of this naval program was not a skilled shipwright but a young professor of Greek in the School of Saint Mark named Vettor Fausto (1490-1546), who in the heat of this renewal programme, proposed “naval architecture” as a new *scientia*.

In 1529, Vettor Fausto built a *quinqueremis* whose design, he claimed, was based upon the quinquereme “used by the Romans during their wars” and that he had derived the shipbuilding proportions “from the most ancient Greek manuscripts.” The recovery of Classical traditions resulted in major changes in many fields. It included shipbuilding practices as well, especially after Fausto introduced in the Venetian Arsenal a new *scientia*, that of “naval architecture”, in opposition to the *fabrilis peritia*, the empirical shipbuilding practice.

This study examines several Renaissance sources and archival material in order to illuminate the technical features and the design of Fausto’s quinquereme. Based on the study of the anonymous sixteenth-century Venetian manuscript *Misure di vascelli etc. di...proto dell’Arsenale di Venetia* from the State Archive of Venice, this dissertation presents a general overview of Fausto’s life and his cultural background in

order to better understand the humanistic foundations that led him to propose the construction of the quinquereme. Also presented here is a theoretical reconstruction of Fausto's quinquereme along with other types of vessels built by Fausto, namely light galleys and great galleys. Furthermore, it will be suggested that the anonymous manuscript *Misure di vascelli* records the shipbuilding instructions to build the ships that Fausto designed during his tenure in the Arsenal of Venice.

DEDICATION

To my family to whom I owe everything:

Gastone, Alberta, and Manuel Campana

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*Fragmentum quod uile putas et inutile lignum,
haec fuit ignoti prima carina maris.
Quam nec Cyanaeae quondam potuere ruinae
frangere nec Scythici tristior ira freti.
Saecula uicerunt: sed quamuis cesserit annis,
sanctior est salua parua tabella rate.*

This fragment, which you think a common and useless piece of wood,
was a portion of the first ship that ventured on unknown seas,
a ship which neither the Cyanean rocks, so fertile in shipwrecks,
nor the still more dangerous rage of the Scythian ocean, could formerly destroy.
Time has overcome it; but, though it has yielded to years,
this little plank is more sacred than an entire ship.

- Martial, *Epigrammata*, VII.19

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NOMENCLATURE

AGS	<i>Archivo General de Simancas</i> State Archives of Simancas, Spain
ASFi	<i>Archivio di Stato di Firenze</i> State Archives of Florence, Italy
ASVe	<i>Archivio di Stato di Venezia</i> State Archives of Venice, Italy
BA	<i>Biblioteca Ambrosiana di Milano</i> Ambrosiana Library, Milan, Italy
BAV	<i>Biblioteca Apostolica Vaticana, Città del Vaticano</i> Apostolic Vatican Library, Vatican City, Vatican
BCVe	<i>Biblioteca del Museo Civico Correr, Venezia</i> Correr Civic Museum Library, Venice, Italy
BdG	<i>Biblioteca dei Girolamini, Napoli</i> Girolamini Library, Naples, Italy
BE	<i>Biblioteca Estense, Modena, Italia</i> Estense Library, Modena, Italy
BN	<i>Biblioteca Nazionale di Napoli</i> National Library of Naples, Italy
BNC	<i>Biblioteca Nazionale Centrale di Roma</i> Central National Library of Rome, Italy
BNM	<i>Biblioteca Nazionale Marciana</i> Marciana National Library, Venice, Italy
BNP	<i>Bibliothèque Nationale de Paris</i> National Library of Paris, France
BL	British Library, London, England
LAM	<i>Libreria 'Angelo Mai,' Bergamo</i> 'Angelo Mai' Library, Bergamo, Italy

ONB	<i>Österreichische Nationalbibliothek, Vienna</i> Austrian National Library, Vienna, Austria
ULG	University Library of Glasgow, Scotland
Ms./Mss.	Manuscript/manuscripts
Fol./fols.	Folio/folios
Reg.	Register (<i>registro</i>)
Env.	Envelope (<i>busta</i>)
r	Recto (in manuscripts)
v	Verso (in manuscripts)
a	Recto (in rare printed editions)
b	Verso (in rare printed editions)
[...]	Omission in the text
[]	Integration/explanation by the author

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CHAPTER I

INTRODUCTION

Sailing is a noble thing, useful beyond all others to mankind. It exports what is superfluous, it provides what is lacking, it makes the impossible possible, it joins together men from different lands, and makes every inhospitable island a part of the mainland, it brings fresh knowledge to those who sail, it refines manners, it brings concord and civilization to men, it consolidates their nature by bringing together all that is most human in them.¹

- Georgius Pachymeres (1242-ca. 1310), *Progymnasmata*, 585.29-586.4

Few phenomena have shaped mankind as significantly as seafaring in human history. Maritime connections, for their intrinsic nature, promoted not only trade and commerce, but also the exchange of ideas and the circulation of knowledge. Venice, more than any other Republic that overlooked the Mediterranean, was, during the Renaissance, the maritime city *par excellence*. Commerce was the *raison d'être* of this small city state, and the mastery in shipbuilding and navigation made Venice “the Most Serene” Republic, the *Serenissima*. Venice’s supreme beauty lay precisely in its complexity and diversity made of different cultures and people arriving by sea, bringing goods and fresh knowledge.

Humanists prized knowledge as their most treasured achievement. They believed that cultural exchange could perfect them as human beings and regarded the encounter

¹ Μέγα ὁ πλοῦς καὶ τοῖς ἀνθρώποις ὑπὲρ ἄλλο τι χρήσιμον· τὸ περιττὸν ἐκφέρει, τὸ ἐνδέον ἐπινοεῖ, τὸ ἄπορον καθίστησιν εὐπορον, τὰ ἀναγκαῖα πορίζει, συνάπτει πρὸς ἀλλήλους ἄνδρας ἀλλοδαπούς, καὶ ἠπειρῶ μιγνύει πᾶσαν νῆσον ἀμιχθαλόεσσαν, προσπορίζει γνῶσιν τοῖς πλέουσιν, ἦθη ἐξημεροῖ, καὶ τὸ κοινωνικὸν προξενεῖ τοῖς ἀνθρώποις καὶ ἡμερον, καὶ συστατικὸν σχεδὸν γίνεταί φύσεως, οἷς ὅ τι τὸ ἡμερον αὐτοῖς συνιστᾷ. Greek text published by Walz 1968, 1: 585-86.

with the other as an occasion to broaden their horizons. More importantly, they were convinced that new ideas could change their world and greatly benefit the progress of mankind. During the Renaissance, new ideas and learning encouraged a pioneering spirit of curiosity that was fueled by the rediscovery of Classical culture. In the fourteenth century, Italian humanists rediscovered ancient Greek and Latin works that had lain buried and fallen into obscurity in many Italian and European libraries and monasteries.² The rebirth of Classical culture (*rinascimento*) and the spread of Classically-inspired values resulted in major cultural changes and achievements in art, literature, philosophy, and architecture.³ In Italy, the Renaissance led to the Scientific Revolution by promoting the application of the scientific method (*ratio*), which reached its peak with the scientist Galileo Galilei (1564-1642).⁴ The Renaissance idea of beauty, which derived from the Vitruvian harmony of proportions, led to major changes in the rules of Venetian naval architecture.

In Venice, the Renaissance had a major impact on the Doge Andrea Gritti (1455-1538), who promoted radical changes not only in the reassessment of old political institutions (*renovatio imperii*), but also in the renewal of urban buildings (*renovatio urbis*) and in the field of technology (*renovatio scientiae*).⁵ The historical juncture of these reforms was crucial. At the time, the maritime power of Venice was seriously threatened by the Ottoman Sultan Suleiman I in the East and the Holy Roman Emperor

² Weiss 1969 and 1977; Reynolds and Wilson 1975; Sabbadini 1967.

³ Ergang 1967; Wilson 1992, 124-57.

⁴ Butterfield 1962; Shapin 1996.

⁵ Tafuri 1984 and 1985; Concina 1988b, 159-60, 1989, 50-63; Concina and Molteni 2001, 75-157; Valeri 1958.

Charles V in the West, as well as by pirates.⁶ Therefore, the Republic of Venice, in order to reassert its naval power in the Mediterranean, strongly encouraged the master shipbuilders of the Arsenal to submit new war galley designs.⁷ The undisputed founder and champion of this naval program was not a skilled shipwright, but a young professor of Greek at the School of Saint Mark named Vettor Fausto, who, in the heat of this renewal scheme, proposed a new *scientia*, the *marina architectura*.

This study investigates the role that the Venetian humanist and naval architect Vettor Fausto (1490-1546) had in Renaissance Venice and examines his technological innovations in Venetian ship design, as well as his literary contributions to Venetian Humanism. Fausto's life and his extraordinary achievements, both as a scholar and as a naval architect, fully capture the spirit of the Renaissance. Fausto attracted the attention of many naval historians and earned a place of honor in the pantheon of the Renaissance innovators with the construction of his *quinqueremis* (quinquereme, or five-er).⁸ The French historian Fernand Braudel noted, "Venice [...] designs its own ships, and it is not very prone to change them."⁹ The conception and building of Fausto's new vessel type—the quinquereme—deserves careful investigation with regard to its technical features. In addition, Fausto's contribution to Venetian Humanism has been overlooked

⁶ Paruta 1718, 1: 301 and 528; Cessi 1988, 2: 526-28.

⁷ Lane 1973, 367-69; Concina 1990, 117-38.

⁸ Casoni 1838, 2: 307:401, Lane 1965, 59-65, Concina 1990, 1988a, 228-45; 1988b, 159-65; 1987a, 23-28; 1987b, 387-405; 2006, 99-125, Aymard 1980, 3: 302.

⁹ Braudel 1976, 1: 311: *Venezia [...] ha i suoi tipi di vascelli e non cambia volentieri*. For a most helpful overview of the types of ships built in the Venetian Arsenal during the Middle Ages and the Renaissance, see Concina 1991b, 211-58.

by modern scholarship, and a comprehensive study of all of Fausto's writings—both in Latin and Greek—has to be undertaken.¹⁰

This study complements previous scholarly literature. Although research on Vettor Fausto is far from complete, both in terms of literary sources and especially regarding his technical innovations in Venetian naval architecture, Ennio Concina's *Navis: Humanism on the Sea* (1990) provides significant information. Concina presents a fascinating insight into the historical context surrounding Fausto's world, although with some misconceptions and inaccuracies.

In 1525, Fausto proposed to the Venetian Senate to build a quinquereme. He claimed that his design was based on the *quinqueremis* “used by the Romans during their wars,”¹¹ and that he had derived the construction proportions for his ship “from the most ancient Greek manuscripts.”¹² A few months later the Senate granted Fausto permission to proceed with the project and assigned a ship-shed for his use in the Arsenal.¹³ In October 1526 Fausto began the construction of his ship, working alongside the other

¹⁰ Fausto's role as a humanist has been briefly discussed by Hodius and Jebb 1742, 32; Legrand 1885, 1: 102-5 and 115; Lowry 1979, 54; and King 1986, 72.

¹¹ ASVe, Consiglio di Dieci, Parti secrete, reg. 1, folios not numbered (see: APPENDIX I, doc. 2). However, this document immediately follows ASVe, Consiglio di Dieci, Parti secrete, reg. 1, fol. 62r (see: APPENDIX I, doc. 3). On the quinquereme and Fausto's work in the Arsenal, see: Concina 1990, 55; Bash 1998, 34; Hocker and McManamon 2006, 16-18. For the Roman *quinqueremis*, see: Casson 1971, 101-2, 105-6, 113-37, 140-44; Morrison and Coates 1986, 2, 9, 11, 23, 157; Casson 1994, 79-95; Morrison 1995, 68-9; Shaw 1995, 163-71; Morrison and Coates 1996, 57-66, 294-6 355-61.

¹² Supra n. 11. Morrison and Coates exclude any continuity of building quinqueremes from the Classical times to the sixteenth century. Renaissance scholars thought that the quinquereme had five superimposed levels of benches. The quinquereme built by Fausto was basically a “re-interpretation” of the Classical model adapted to the Venetian naval architecture, which involved galleys rowed at a single level. See also Eliav 2012.

¹³ ASV, Consiglio di Dieci, Parti secrete, reg. 1, fol. 62r (see APPENDIX I, doc. 3).

shipwrights in the Arsenal.¹⁴ Fausto's *quiqueremis* was designed as a 28-bench galley rowed *alla sensile* ("in the simple way") by five rowers on each bench on either side, each with his own oar.¹⁵ The quinquereme was completed in January 1529 and launched in April of the same year, amid a general skepticism, which Fausto soon dispelled when his quinquereme won a race against the light galley *Cornera*. The Venetian historian Marin Sanuto (1466-1536) wrote an enthusiastic report of the occasion, celebrating Fausto's revival of Greek science.¹⁶ Thus, the *marina architectura* was born.¹⁷

The *marina architectura*, "naval architecture," was based on the *navium ratio*, a shipbuilding principle applied to naval architecture. In the same way architects applied the principle of geometric progression in designing buildings, or painters used the rules of perspective in their drawings, Fausto applied the *navium ratio* when designing his ships. The *navium ratio*, however, differed substantially from empirical practices employed by Venetian shipwrights in the Arsenal, for it proceeded from a deep knowledge of ancient mathematicians' texts. Fausto, in a letter to his friend, the humanist Giovan Battista Ramusio (1485-1557), claimed that his naval architecture was based on *litterae et disciplinae*, the "knowledge" (*disciplinae*) that comes from the study of ancient works, the "erudite letters" (*litterae*).¹⁸ For this reason, according to Fausto,

¹⁴ In a letter to his friend Ramusio, Fausto compared the hard-working days in the Arsenal to Heracles's descent to the Underworld and to Aeneas's into Avernus; see also Weber 1894, 128-133.

¹⁵ For a description of Fausto's *quiqueremis*, see: Casoni 1838, 17; Jal 1840, 1: 377-84; 1848, 1248; Fincati 1881, 57; Concina 1990, 82; Lane 1992, 59-65.

¹⁶ Sanuto 1466-1536 (hereafter cited as Sanuto), L, column (hereafter col.) 347.

¹⁷ The phrase *marina architectura* was first used by Vettor Fausto in a letter dated 13 September 1530, and addressed to his friend Giovan Battista Ramusio; see also Weber 1894, 128-133. Barker (2007, 42) mistakenly wrote that Fausto never used the phrase in his writings. See discussion in CHAPTER III.

¹⁸ *Supra* n. 17.

“marine architecture” did not require the mere *fabrilis peritia*, “the craftsman’s practice,” but rather the *architecturae professio*, “the professional architecture.”¹⁹

During this period, traditional shipbuilding practices relied on empirical methods and shipwrights’ skills and experience.²⁰ Vettor Fausto thought naval architecture, just as with terrestrial architecture, might similarly be improved through the imitation of ancient shipbuilders. In Fausto’s work, one can see the influence of Vitruvius’s *De architectura*, Leon Battista Alberti’s *De re aedificatoria* (1450), and the works of several other ancient writers. Fausto was also familiar with the Aristotelian “Mechanics,” since he published a Latin translation of the work by Aristotle in 1517 in Paris.²¹

Extensive archival research was conducted by the author between 2006 and 2013 in the Marciana National Library and in other Italian and European archives and libraries in order to investigate significant aspects of Venetian maritime history and the Venetian Republic’s shipbuilding practices during the sixteenth and the seventeenth centuries.

“If the truth is the soul of history, documents and reports are the sources of the historical truth.”²² Those engaged in archival research, however, soon learn that this is an optimistic approach, and that “the historical truth” does not exist. However, there is the interpretation of history. Manuscripts have to be interpreted while avoiding modern

¹⁹ *Supra* n. 17.

²⁰ Several studies have been devoted to empirical shipbuilding practices involving geometrical methods recorded in Venetian manuscripts. See, for example: Anderson 1925: 135-63; Sarsfield 1984, 86-88, and Chiggiato 1987. Recent studies include: Barker 1986, 161-78; Rieth 1998, 317-28; McManamon 2001, 17-26; Alertz 2003, 212-21; Bondioli 2003, 222-7; Castro 2005, 159-74 and 2007, 148-54; Bondioli 2009, 3: 243-80; and McGee 2009, 3: 211-42.

²¹ Venice, BNM, 2983: *Aristotelis Mechanica Victoris Fausti industria in pristinum habitum restituta ac latinitate donata. Parisiis: in aedibus Iodoci Badii (1517)*. Hereafter Fausto 1517.

²² Thus, the Venetian ambassador to France, Sebastiano Foscarini, stated before the Senators on 29 July 1684: *Se la verità è l’anima della storia, della verità storica le memorie e le relazioni possono dirsi la fonte*; Barozzi and Berchet 1863, 3: 353.

mental constructs that could be misleading. Thus, this work offers *an* interpretation of Vettor Fausto and his quinquereme.

For the purpose of this study, a thorough survey of documents in Italian and other European libraries and archives was undertaken. The State Archives of Venice contain several folders (*fondi*), each containing hundreds of manuscripts. Each *fondo* consists of registers (*registri*) and sub-folders (*filze*). In order to investigate Fausto's background and his ingenious contributions to naval architecture, records of different government councils were investigated: *Comuni* and *Secrete* from *Consiglio di Dieci Comuni* (Council of Ten), Registers and Strands from the *Senato Mar* (Senate of the Sea), *Maggior Consiglio* (Major Council), *Patroni e Provveditori all'Arsenale* (Lords and Superintends of the Arsenal), Notarial acts and Secret Deliberations from the *Collegio* (College), *Senato Terra* (Senate of the Land), *Avogaria di Comun* (Investigative Magistracy).²³ As a premise, it should be pointed out that all the documents presented in this dissertation have been transcribed by the author following the rules of paleography, with minimal alteration to the texts: abbreviated words are written out in full, *j* is represented as *i*, & is written as *et*, and punctuation modified to make reading the documents easier. Other letters, such as *ç* for *z*, and *z* for the doubling of *c*, are retained in their original spelling as they are typical of the Venetian dialect. Quotations from documents and primary sources are always italicized, whereas the translation into English is placed between quotation marks or in block quotation.

²³ A comprehensive overview of the State Archive of Venice is provided by Da Mosto 1937.

The most revealing document for this study is the manuscript titled *Misure di vascelli etc. di... Proto dell'Arsenale di Venetia* (“Measurements of vessels etcetera by...a master shipbuilder of the Arsenal of Venice”), which contains shipbuilding instructions for several types of ships.²⁴ The manuscript, originally belonging to the private collection of the erudite Giovan Vincenzo Pinelli (1535-1601), has never been fully studied and its author is not indicated. Perhaps, due to a lack of technical shipbuilding knowledge, modern scholars have failed to associate this manuscript with Fausto’s work in the Arsenal. This is all the more regrettable, considering that the manuscript was well known since the nineteenth century but is still misinterpreted.²⁵

The series of calculations contained in the manuscript are based on both ancient and modern mathematics, and requires an extensive knowledge of mathematics that only Fausto could have possessed. This study argues that the manuscript is the work of Fausto’s apprentice, Giovanni di Maria di Zanetto, nicknamed Zulle, who became *proto* (master shipbuilder) of the Arsenal in 1570. Zulle copied the shipbuilding instructions of his master and, at the eve of the Battle of Lepanto (7 October 1571), he built the last galleon *alla Faustina* (“in the Fausto way”). This vessel became the flagship of the Christian fleet led by Marcantonio Colonna against the Turks.²⁶ However, Fausto’s galleon and his *marina architectura* perished off the coast of Ragusa, when lightning struck and burnt the ship.²⁷ Additional research revealed new details concerning Fausto’s

²⁴ ASVe, Archivio Proprio Pinelli, folder 2.

²⁵ Fincati 1881, 80-81; Tucci 1964, 277-93.

²⁶ Concina 1990, 115; Hocker and McManamon 2006, 17.

²⁷ This information comes from the recently discovered and unpublished manuscript titled *Il Chartiggiatore* (1570) currently under study by the author.

cultural background and the period of his life before the construction of the quinquereme, hitherto poorly documented.

The archival sources, as official documents issued by the Venetian magistracies, recorded exact dates and offered solid chronological references. However, considering his fame in Venice, one does not encounter Vettor Fausto's name on the documents as often as one would expect. Fausto's name begins to appear only after 1519, when he made his entrance into the public life of Venice by his election to the Greek lectureship at the School of Saint Mark. Other biographical references to Fausto can be found in archival records only when Fausto appealed to some Venetian magistrate, such as in 1525 when he appealed to the Council of Ten and presented to the senators his proposal for building the quinquereme.

Chapter II traces Fausto's life from the first years of the sixteenth century until his death in 1546. Much of the information about his life comes from documents and official decrees in the Venetian Archives, and from the *Orationes quinque* ("Five Orations"), written by Fausto and "diligently published by his friends, with all the care possible."²⁸ The *Orationes*, printed posthumously in 1551 by the famous Aldine press, can be regarded as Venice's last homage to the undiscussed protagonist of its maritime history, and to one of the most active humanists of the Republic's cultural scene. The *Orationes quinque* opens with an anonymous dedicatory epistle that contains a short biography of Fausto. Addressed to Pier Francesco Contarini, Fausto's patron, it was

²⁸ Venice, BNM, Aldine 359: *Victoris Fausti Veneti Orationes quinque eius amicorum cura quàm fieri potuit diligenter impressae, apud Aldi filios Venetiis MDLI.*

attributed to the humanist Paolo Ramusio (1532-1600) by Giovanni Degli Agostini.²⁹ On the one hand, the dedicatory epistle traces the most relevant stages of Fausto's life, but on the other, it fails to provide any chronological references. Conversely, although the "Five Orations" cover a short time-frame (1519-1522), they provide significant information. In the opening decade of the sixteenth century, Fausto began his humanistic studies under Gerolamo Maserio from Forlì, who taught Greek at the prestigious School of Saint Mark. In 1509, the War of the League of Cambrai drastically changed the situation in the Republic and the School was temporarily closed. Fausto then undertook a six-year-long journey that brought him to the Mediterranean, other Italian maritime cities, Spain, and France. Upon his return to Venice, he wished to place his knowledge at the disposal of the *Serenissima*. In 1518, Fausto was appointed professor of Greek at the School of Saint Mark, which reopened after the war in 1511. In 1526, Fausto proposed to the Venetian Senate the construction of a quinquereme based on Classical proportions. With skepticism, the senators approved his request. In 1529, Fausto launched his quinquereme in the Grand Canal of Venice, where the ship won a race against a light galley. This chapter concludes by discussing sources and documents about the naval career of Fausto's quinquereme in Greek waters.

Chapter III focuses on the *marina architectura* and the influence of Classical culture on Venetian naval architecture. According to Fausto, the *marina architectura* has to be based on the knowledge that derives from the study of Greek mathematicians, and not just on personal experience and practical skills. This chapter defines the concept of

²⁹ Degli Agostini's 1754, 2:469.

proportion and symmetry in architecture and examines some passages from Vitruvius's *De architectura*. It discusses the impact of the rediscovery of the work of Vitruvius (80-15 B.C.E.) on Renaissance culture and humanists.

The Renaissance idea of beauty, which was derived from the harmony of proportions, led to major changes in the rules of naval architecture. "A galley" – said the sea captain Cristoforo da Canal sometime during the mid-sixteenth century – has to resemble "a graceful young lady who shows liveliness and readiness by her gestures."³⁰ Yet, the art of shipbuilding, like all crafts based on oral knowledge, has maintained its conservative character throughout the centuries. Only with difficulty have new techniques and design have been able to penetrate the mind of the shipwright, who relied on his practical expertise and repetitive gestures.³¹ Thanks to the past works of eminent scholars who studied naval architecture manuscripts, our knowledge and understanding of shipbuilding practices has significantly increased and improved.³² We know that at least starting from the second half of the fourteenth century, shipwrights designed ships by means of molds and gauges incised with progressive marks.³³ The marks were obtained by simple geometrical methods that are often graphically represented in

³⁰ Cristoforo da Canal, *Della milizia marittima*, Book 1: *Una giovane leggiadra la quale in tutti i suoi gesti dimostri prontezza e vivacità* (Nani Mocenigo 1930, 66).

³¹ An interesting portrait of the Renaissance shipbuilder is depicted by David Proctor (1987, lxxxvii-xcii) in his contribution to the study of the 15th-century Venetian manuscript *Ragioni antique*.

³² The list of scholars is very long, and they will be mentioned throughout this work. However, I would like to call attention to a brilliant and enlightening Italian article by Giuseppe Mercato (1998). The article is "Metodi di riduzione utilizzati dino alla prima metà del XVIII secolo" ("Reduction Methods Used until the First Half of the 18th Century"). The article provides a lengthy discussion on geometrical methods used in ship design, their corresponding formulas, and their theoretical application.

³³ The earliest manuscript that records the use of geometrical methods in ship design is *Libro di navigar*, "The Seafaring Book" (Bergamo, LAM, Ms. MA334). Franco Rossi (2009, 1: xv), in a recent contribution to the study of "The Book of Michael of Rhodes," thanked Raffaella Franci for drawing his attention to the manuscript, and anticipated his forthcoming publication of the *Libro di navigare*.

shipbuilding manuscripts, such as those in *Libro di Zorzi Trombetta da Modon* (“The Notebook of Zorzi Trombetta from Modon”) dated to 1444-1449.³⁴ The shipwright moved the molds (*sesti*) progressively along each frame, thus obtaining the narrowing and the rising for each frame.

These shipbuilding methods were based on rules of geometry, such as geometrically generated proportions, and are referred to in Venetian manuscripts as *ragioni fabbricatorie*, “building methods.” At this juncture, it is useful to recall the definition of *ars*, “art,” as provided by the Roman writer Cassiodorus (ca. C.E. 485-573) in his *De artibus ac disciplinis liberalium litterarum* (“On Arts and Liberal Disciplines”): “whatever confines and restrains us with its rules it is called art.”³⁵

However, the sixteenth century was a period of technical innovations in naval architecture. Fausto, “expert and capable of the most subtle reasoning,”³⁶ purported to introduce in naval architecture a shipbuilding principle that he applied in designing his quinquereme. Fausto codified the empirical shipbuilding methods of the Venetian shipwrights into a mathematical formula, known today by mathematicians and scientists as Gauss’s formula. Karl Friedrich Gauss (1777-1885) proved that every triangular number is a figurative number that can be represented in the form of a triangular grid of

³⁴ London, BL, Cotton ms., Titus A XXVI. The geometrical methods are on folio 45r. It is unfortunate that this important manuscript has yet to be fully studied and published along with its vibrant watercolors. The two main articles on the manuscript are those by Anderson (1925, 135-63), with some excusable inaccuracies in the transcriptions, and Rieth (2001, 81-104).

³⁵ Cass. *De art.* 1: *Ars vero dicta est quod nos suis regulis arcet atque constringat.*

³⁶ Galilei 1638, 1.1: *Peritissimi e di finissimo discorso.*

points, where the first row contains a single element, and each subsequent row contains one more element than the previous one.³⁷ Gauss's formula is expressed as follows:

$$\Sigma = n \times \frac{n + 1}{2}$$

where, Σ = sum and n = positive integer

Remarkably, Fausto had discovered this formula much earlier than Gauss.

Thus, the construction of the quinquereme had a revolutionary impact on the art of shipbuilding, for it was no longer an *ars* but rather a *scientia*, that of “marine architecture.” In historical terms, Fausto stands to the French architect Jean Mignot, as the Arsenal stands to the Cathedral of Milan. In 1399, Jean Mignot was consulted on the construction reliability of the Milan Cathedral as it was being built. Mignot argued that the cathedral would inevitably collapse if completed as planned. Somewhat irritated with the Italian masons and builders, Mignot claimed “art without science is nothing,” *ars sine scientia nihil est*.³⁸

Chapter IV of the dissertation presents Renaissance documents that provide descriptions of Fausto's quinquereme and illuminates its technical features, such as the number of benches, the rowing system, and the steering mechanism. Fausto claimed that

³⁷ Triangular numbers were first discovered by Pythagoras of Samos (sixth century B.C.E.).

³⁸ Ackerman 1949, 84-111.

he restored the ancient quinquereme used by Romans in their wars. Whether this was the case or not is discussed in this chapter, which also presents several Classical sources about the Roman quinquereme. Fausto claimed that the proportions of his quinquereme were based on ancient Greek texts. This chapter suggests a new hypothesis about the Greek sources Fausto might have consulted.

Chapter V discusses the sixteenth-century Venetian shipbuilding manuscript *Misure di vascelli etc. di...proto dell'Arsenale di Venetia* (“Measurements of ships by... master shipbuilder of the Arsenal of Venice”), which contains shipbuilding instructions for several types of ships. This anonymous manuscript, originally belonging to the private collection of the erudite Giovan Vincenzo Pinelli (1535-1601), has never been studied. The hypothesis proposed in this chapter is that the manuscript is the work of Giovanni di Maria di Zanetto nicknamed Zulle, who was Fausto’s pupil and became master shipbuilder of the Arsenal in 1570.

I consider this dissertation a starting point for a more in-depth research on Vettor Fausto, his brilliant career, his fascinating work as a humanist, and his contribution to Venetian naval architecture. It is hoped that future discoveries from archives and libraries will furnish new information to our knowledge, broaden our perspective, and even challenge the conclusions reached here.

CHAPTER II
THE LIFE OF THE VENETIAN HUMANIST AND NAVAL ARCHITECT
VETTOR FAUSTO (1490-1546)

Introduction

Paucis, certe, Victor Faustus nomine cognitus est. Thus, in 1750, Friedrich G. Freytag (1687-1761) wrote in his volume listing the most important books printed in Europe during the Renaissance.¹ In praising Fausto’s literary works and, above all, his *Aristotelis mechanica*—the first Latin translation of Aristotle’s treatise on mechanics made available to the Western world—Freytag also critiqued Fausto’s exclusion from the *Bibliotheca graeca* published in 1705-1728 by Johann Albert Fabricius (1668-1736).² Since then, valuable works have been produced that significantly contribute to our knowledge about the Venetian humanist Vettor Fausto.³

Although information about Fausto’s life and his career are scant, taken together the sources offer a unique perspective from which to better understand Fausto’s multifaceted world and the complex path he followed in order to succeed in his scholarly ambitions and professional goals. Despite being a man of humble origin and a parvenu,

¹ Freytag 1750, 336: “Vettor Fausto is certainly little known.”

² Freytag 1750, 337.

³ Brief biographical information on Fausto appeared in the works by Degli Agostini (1752-1754, 2: 448-72), Tiraboschi (1822-1826, 7: 1487-89), Casoni (1838, 2: 337-45), Cosenza (1962, 2: 1363-64), Lane (1965, 59-65), Piovan (1995, 398-401), and Wilson (1988, 89-95). The most authoritative work on Fausto is by Ennio Concina (1990), who provides fascinating insight into the historical context surrounding Fausto’s world, although with some imprecisions and misconceptions. Aymard (1980, 3: 302) wrongly identified Vettor Fausto as Fausto Venanzio of Sebenico, who is the author of the mechanical treatise entitled *Machinae novae*.

Fausto nonetheless established himself as a *literato* and was appointed professor of Greek at the prestigious School of Saint Mark, weaving himself tightly into a social and personal network of humanists. He also cleverly combined his literary activity with the patronage of influential politicians and noblemen as a career strategy. The sparse information about Fausto comes from official documents in the State Archives of Venice, and from the *Orationes quinque* written by Fausto and published posthumously in 1551 by the famous Aldine Press.⁴ The *Orationes* opens with a *dedicatio* containing a short biography of Fausto, penned by the humanist Paolo Ramusio (1532-1600) and addressed to Pier Francesco Contarini (1502-1555), Fausto's patron.⁵ A newly discovered document in the State Archives of Venice dated to the eighteenth century provides more detailed information and complements the list of Fausto's literary works.⁶

Fausto was a man of extraordinary intelligence, fluent in Greek and Latin, knowledgeable in Hebrew and Aramaic, pupil of Gerolamo Maserio and Marco Musuro, lecturer at the School of Saint Mark, and a philologist. Fausto earned a place of honor in the pantheon of Renaissance innovators with the construction of his *quinqueremis* and has attracted the attention, in particular, of many maritime and naval historians.⁷

⁴ Venice, BNM, Aldine 359: *Victoris Fausti veneti orationes quinque eius amicorum cura quam potuit diligenter impressae. Apud Aldi filios. Venetiis MDLI* (hereafter cited as Fausto 1551).

⁵ Fausto 1551, *Dedicatio*, 2a-5b. The attribution of the *dedicatio* to Paolo Ramusio has been debated among scholars since the edition in the Marciana National Library shows the name of Paolo Ramusio crossed out. For this reason, Vendruscolo (2005 41, n. 26) advises caution in attributing it to Paolo Ramusio. Conversely, Degli Agostini (1754, 2:469), Cicogna (1827, 2: 332), Concina (1990, 41, n. 1), and Piovan (1995, 398-401) all attributed it to Paolo Ramusio. In the edition preserved at the Ambrosiana Library in Milan, Ramusio's name is not crossed out (Milan, BA, S.Q.D. VI.16/1), and, thus, it is likely that he authored the *dedicatio*.

⁶ ASVe, Archivio Giusti del Giardino, busta 131, Memoria di fabbrica di navi, folios not numbered.

⁷ Fausto became the acclaimed genius of the *renovatio navalis* promoted by the Doge Andrea Gritti (1455-1538) by introducing technical innovations in shipbuilding practice to the Arsenal of Venice. In

Regrettably, Fausto's role as a *litterato* and his contributions to the study and teaching of Greek in Renaissance Venice have been neglected by modern scholarship.⁸ Fausto never achieved full recognition as a humanist and his fate suffered an unfortunate *damnatio memoriae*. This is because his brilliant mind engaged both the *studia humanitatis* as a humanist and the *artes mechanicae* as a naval architect, thus combining the separate Aristotelian categories of ἐπιστήμη (*epistēmē*, “theoretical knowledge”) and τέχνη (*technē*, “practical knowledge”). Despite the fact that Fausto paved the way for a scientific revolution in the conservative Venetian Arsenal, his polymath attitude veered dangerously toward eclecticism if framed within the boundaries of the modern mentality.⁹ A comprehensive study of Fausto's complex activity reveals that these two different curricula, which may appear as a discrepancy in his cultural background, are indeed intrinsically connected to one another.¹⁰

His literary production, both in Greek and in Latin, was remarkable and made significant contributions to Venetian Humanism during the first half of the sixteenth

1525, Fausto built a *quinqueremis*—a galley rowed by five rowers on a single bench, each pulling a separate oar—claiming he derived the shipbuilding proportions from ancient Greek sources; see ASVe, Consiglio di Dieci, Parti Secrete, reg. 1, fol. 62v. Galileo Galilei, in his *Discorsi e dimostrazioni matematiche*, mentioned “the great galleass” (*la gran galeazza*) built upon Fausto's design; see Rome, BNC, 68.3.D.17: Galilei 1638, 2.

⁸ An early attempt to shed some light on the life and career of Fausto was made by Wilson, who noted that “Fausto...paradoxical though it may seem, is all but unknown among classicists, despite having played a role of some note in the history of the *Serenissima*” (Wilson 1988, 89).

⁹ Patricia Labalme (2008, 249) referred to Fausto as “a colorful personage.”

¹⁰ A discussion on Fausto's training in mathematics, geometry, and naval architecture goes beyond the purpose of the present study. However, it is worthwhile to mention that Fausto based the design of his *quinqueremis* on several Greek authors, including Euclid, Archimedes, Apollonius of Perga, Pythagoras, and Aristotle, among others. Ramusio asserted that Fausto “since a young age, learnt mathematics, and he particularly enjoyed the study of architecture” (*a prima aetate mathematicas rationes imbibisset, et architectura mirum in modum delectatus*); see Fausto 1551, *Dedicatio*, 4a.

century. During his brief life, Fausto published several Greek epigrams;¹¹ an edition of Terentius' comedies (Venice, 1511), which included a short treatise on ancient comedy (*De comoedia libellus*);¹² an edition of selected works by Cicero (Venice, 1511);¹³ and the Latin translation of Aristotle's *Mechanica* (Paris, 1517).¹⁴ During his Greek lectureship at the School of Saint Mark, Fausto wrote the above-mentioned five *Orationes* (Venice, 1551).¹⁵ Most interesting is Fausto's extant letter collection, consisting of twelve letters, among those received and sent, scattered in various archives and libraries.¹⁶ Although the corpus of Fausto's letters is admittedly meager, it covers a period spanning from 1511 to 1537, and nonetheless reveals an extraordinarily intimate and conversational relationship with some of the most famous Venetian and Italian scholars, including Pietro Bembo, Giovan Battista Ramusio, Andrea Navagero, Lucilio Maggi (Philalteus), Giustino Decadio, Jacopo Sannazaro, and Marino Bezichemo.

¹¹ To date, there are four known Greek epigrams by Fausto. They can be found in the 1509 edition of Aulus Gellius' *Noctes Atticae* (Venice, BNM, Rari 0209, 2a); in the 1511 edition of Terentius' comedies (Venice, BNM, 123 D.213, 2a); in the 1512 edition of the *Grammaticae institutiones* by Urbano Bolzanio (Venice, BNM, Rari 0388, 2a); and in the Complutensian Polyglot Bible's New Testament (in Legrand 1885, 1: 115). An unpublished Latin epigram was found in a anonymous collection of poems (Modena, BE, Ms. Est. lat. 150, Alpha T6, 8, fol. 67v).

¹² Venice, BNM, 123 D.213: *Hoc pugillari Terentius numeris concinatus, et L(ucius) Victoris Fausti de comoedia libellus nova recognitione, litterisque novis continetur. Hasce Terentii fabulas censura cujusdam sane eruditi viri, sumptibusque assiduis imprimendas Lazarus Soardus curavit. Venetijs MDXI humanae salutis Anno mense Augusti Augustum initium auspicatus* (hereafter cited as Fausto 1511a). The complete Latin transcription of *De comoedia libellus* has been published by Lindenbrog (1820, 1: lx-lxxii) and by Weinberg (1970, 1: 7-19).

¹³ Venice, BNM, Rari 678: *M. T. Ciceronis tres de officiis libri, et aureum illud de amicitia senectuteque volumen una cum paradoxis hoc habentur pugillari. Venetiis anno salutis humanae MDXI mense Novembri codicillum hunc nec sumptui nec diligentiae parcens Lazarus Soardus impressit* (hereafter cited as Fausto 1511b).

¹⁴ Venice, BNM, Miscellanea 2983: *Aristotelis mechanica Victoris Fausti industria pristinum habitum restituta ac latinitate donata. Imprimebat Io(annes) Badius ad Nonas Aprilis. MDXVII.*

¹⁵ Supra n. 4.

¹⁶ Given Fausto's complex social network, both in Italy and in Europe, his epistolary corpus must have included a far larger number of letters.

Moreover, Fausto's letters indicate that he entertained correspondence in Latin, Greek, and Italian.

In order to establish Fausto's literary accomplishments and assess his impact on the study of Greek in Renaissance Venice, it is worthwhile to delineate his fascinating yet hitherto poorly-documented life and career, which illuminates the social and spiritual environment in which Fausto pursued his goal of expanding Greek education in Venice and beyond.

From Venice to Europe: Fausto's Cosmopolitan Intellectual World

Belonging to a modest family of Greek origin probably from Cephalonia, Fausto was a *civis venetus originarius*.¹⁷ He was born in 1490, as he recorded in his manuscript *Plutarchi vitas graece scriptas*, stating that in 1510 he was 20 years old.¹⁸ Fausto's year of death is more problematic to establish. On 18 January 1547, as he left no testament, wife, or children, his sole sister Apollonia claimed the few possessions—some books, clothes, and arms—once belonging to “Vettor Fausto, who had recently died.”¹⁹ However, a document from the State Archives of Florence proves that he was still alive

¹⁷ On Fausto's Venetian citizenship, see Venice, BCVe, Cons. IX, d. 1-2, Cittadini veneziani, fol. 190r; ASVe, Senato Terra, reg. 20, fol. 159r; Sanuto, XXVI, col. 127; Fausto 1551, *Dedicatio*, 3b; *ibid.*, *Oratio prima*, 1a, 10a, 17b, and 18b; *ibid.*, *Oratio secunda*, 19a. On Fausto's Greek origin, see Pesaro, Biblioteca Oliveriana, Ms. Ol. 2019, fol. 15v; Simancas, AGS, Catalogo XXVI, Papeles de Estado, Venecia, 1308, n. 110. See also Bataillon 1937, 2, 29; Tenenti 1962, 29 and 45.

¹⁸ Glasgow, ULG, Ms. Hunter 424, fol. 323v: *anno aetatis vigesimo 1510 mense junii*; see also Vendruscolo 2005, 39. Ferreiro (2010, 229) placed Fausto's birth in 1480; Concina (1990, 26), following Degli Agostini (1754, 2: 448), indicates that Fausto was born at the beginning of 1480s, whereas Piovan (1995, 398) generically suggests that the date has to be placed slightly afterward.

¹⁹ ASVe, Collegio, Notatorio, reg. 26, c. 51r: *Vettor Fausto ultimamente defunto*. On Fausto's possessions, see ASVe, Consiglio di Dieci, Parti Comuni, filza 27, document attached to document 257 (23 May 1540).

in July 1546.²⁰ Thus, Fausto likely died near the end of 1546. The cause of his premature death at the age of 56 is unknown. In a brilliant article, Fabio Vendruscolo demonstrated that Vettor Fausto's original name was *Lucius Victor Falchoni*.²¹ This assumption is based on solid lines of evidence, including some intriguing biographical congruences, particularly a calligraphic comparison of *Falchoni*' and Fausto's handwriting revealing they were indeed the same person. It was common for humanists to assume a pseudonym of classical reminiscence, and when Fausto signed his Greek epigrams he used the Greek version of his name, Νικητας ὁ Φαῦστος.²² Vendruscolo argues that Fausto changed his name when he left Venice and resolved to improve the course of his life.²³ This hypothesis is unlikely, as Fausto departed from Venice in 1512 and the earliest appearance of both the Latinized *Victor Faustus* and the Greek Νικητας ὁ Φαῦστος dates to 1511.²⁴ Rather, Fausto must have adopted his humanistic pseudonym while he was still in Venice, after he joined the cultural circle of Venetian *literati* which resulted in his first publications.

The beginning of Fausto's humanistic career followed an arduous path, since he was an *ignotus vir*, a parvenu of humble origins with few resources.²⁵ Fausto's juvenile years are obscure and nothing is known about his education in Venice and his cultural

²⁰ ASFi, Fondo Mediceo del Principato, 2967, fol. 188r.

²¹ Vendruscolo 2005, 37-50.

²² *Supra* n. 11.

²³ Vendruscolo 2005, 48.

²⁴ See the edition of the Terentian comedies dated to August 1511.

²⁵ Fausto defined himself an *ignotus vir*; see Vienna, ONB, Ms. Vindobon. Lat. 9737e, fols. 11r-v. See also Gualdo Rosa 2005, 25-36, and Mauro 1961, 407-408 and 496-97.

melieu.²⁶ Ramusio depicted Fausto almost as an *enfant prodige*, saying “he was, already in his childhood, so eager and devoted to the study of Latin and especially of Greek that is impossible to believe it.”²⁷ At the age of 18, Fausto became the pupil of Gerolamo Maserio from Forlì, who taught Greek at the School of Saint Mark from 1503 to 1509.²⁸ Fausto worked for Maserio as a copyist of Greek texts and the two lived together. In a manuscript containing the tragedies by Aeschylus dated to 1508/1509, Fausto wrote, “When I was eighteen and lived in Maserio’s house, I hourly copied the paraphrase by the grammarian Johannes Tzetze on Dionysus (*scil.* Periegetes) and some anepigraphic commentaries on Aeschylus.”²⁹ For Fausto, the apprenticeship under Maserio was very productive. Not only did Fausto make a living by copying rare Greek texts for his teacher but, more importantly, Maserio introduced Fausto to the selective circle of Venetian humanists. A few months before the departure of his teacher, Fausto published a Greek epigram in the edition of *Noctes Atticae* by Aulus Gellius printed by Giovanni

²⁶ Ramusio stated that “Fausto...for his social condition and for the meager fortune of his family easily could have remained in the shadows of history, except that a unique and great talent made him famous” (*Fuit omnino Faustus...tum genere ipso, tum rei familiaris tenuitate, facile potuerit esse semper obscurus, nisi uno tantum atque eo magno ingenio repente clarus extitisset*); see Fausto 1551, *Dedicatio*, 2b.

²⁷ Fausto 1551, *Dedicatio*, 2b: *iam inde a prima pueritia latinarum litterarum, atque adeo graecarum supra etiam quam credi possit, cupidus ac studiosus.*

²⁸ Fausto 1551, *Dedicatio*, 2b-3a. Maserio, formerly a professor at the University of Rome and Perugia, arrived in Venice toward the end of 1503, when he was appointed to the chair of Greek at the School of Saint Mark (Sanuto, V, col. 438). Maserio’s arrival in Venice must be connected with some services he had previously rendered in Rome for the Republic of Venice while attending the apostolic legate of Hungary (Sanuto, V, col. 592). However, he was forced to leave Venice after making a false astrological prediction at the outset of the war of the League of Cambrai (Sanuto, VIII, col. 384).

²⁹ Naples, BN, Neap. II.F.30, fol. 1r: *Anno aetatis meae 18 cum Maseri domum habitarem: Dion(ysium) et Eschylum ad clepsydrum exscriberem ex paraphrasi Ἰωάν(νου) τοῦ γραμματικοῦ τοῦ Τζέτζου in Dionysium, et ex Eschyli (commenta)riis ἀνεπιγράφοις.* See also Vendruscolo 2005, 39.

de Tridino Tacuino.³⁰ A few years later, in 1512, Fausto published another Greek epigram with Tacuino's printing press. The epigram was printed in the *Grammaticae Institutiones* by Urbano Bolzanio dalle Fosse (1443-1524), a friend of Maserio with whom Fausto was acquainted. Likely, Fausto had a role in the editing of the *Institutiones*, and his first literary works primarily focused on philological activity. Fausto's *marginalia* on the Codex Venetus A recording Homer's *Iliad* in the Marciana National Library indicate that he edited the *Iliad*.³¹

Maserio's departure in 1509 initiates quite a tumultuous period in the life of Fausto. During the war of the League of Cambrai, from 1509 to 1511, the School of Saint Mark remained closed and "public lectures were suspended for three years, with great shame and loss for everybody."³² Deprived of Maserio's protection and in need of a job, Fausto started working as a Greek copyist for Aulo Giano Parrasio (1470-1522), a scholar from Calabria.³³ Parrasio's arrival in Venice is documented at least as far back as 10 September 1510.³⁴ The events that occurred in Fausto's life between July 1509 and the end of 1510 were colored with gloomy tones and culminated in an indecorous episode: the theft of 90 texts by Parrasio—among which were printed books and 11 Greek manuscripts, an exceedingly valuable asset at that time—that belonged to Fausto. The episode is narrated by Fausto himself in a letter addressed to the Neapolitan

³⁰ Venice, BNM, Rari 0209: *Accipite studiosi omnes Aulii Gelii noctes micantissimas. Venetiis, per Ioannem de Tridino, alias Tacuino, 1509 die XX Aprilis.*

³¹ Venice, BNM, Codex Marcianus Gr. Z 454 (=822) (Venetus A).

³² ASVe, Senato Terra, reg. 17, fol. 117v.

³³ Gualdo Rosa 2005, 25-36.

³⁴ Parrasio wrote a letter in Venice dated 13 September 1510 and addressed to Giovanni Antonio Cesario, one of Parrasio's students; see Naples, BdG, Ms. XXIII 1.62, fols. 59v-60r, cited by Gualdo Rosa 2005, 30.

humanist Jacopo Sannazaro (1457-1530).³⁵ The letter is undated, but it was probably written in the first months of 1511.³⁶ As stated by Fausto, he did not personally know Sannazaro, although despite the lack of any personal acquaintance between the two scholars, Fausto was moved to write to Sannazaro by a mutual friend, the architect and Franciscan friar Giovanni Giocondo from Verona (ca. 1434-1515), who lived in Venice from 1506 to 1513.³⁷

As reported by Fausto in his letter to Sannazaro, Parrasio, while in Venice, “had accepted a position teaching Greek and Latin in the city of Lucca with a salary of 200 golden ducats per year.”³⁸ The position was offered by the Republic of Lucca to Parrasio on 10 August 1510 through Pandolfo Cenami (ca. 1490-ca.1540), a merchant from Lucca then living in Venice. In a letter addressed to the governors of Lucca and dated to 16 May 1511, Cenami wrote that in order to facilitate Parrasio’s departure from Venice, he gave him 50 ducats, plus 25 ducats from his own pocket, as Parrasio had demanded more money. Cenami wrote that in total, he advanced Parrasio 80 ducats, because in

³⁵ Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11r-v.

³⁶ Gualdo Rosa 2005, 26-32.

³⁷ Fausto’s letter to Sannazaro is particularly interesting as it documents Fausto’s claim that he is a friend of Fra’ Giovanni Giocondo from Verona (1433-1515), the celebrated architect who, in 1499/1500, was appointed royal architect by Louis XII, the King of France. Probably thanks to Maserio’s networking, Fausto and Fra’ Giocondo met in Venice, where the friar lived from 1506 to 1513. It is interesting to note that both Fausto and Fra’ Giocondo published with Tridino’s printing press. Fausto published a Greek epigram in the 1509 edition of Aulus Gellius’ *Noctes Atticae*, whereas the friar, in 1511, published with Tacuino his most outstanding work, the edition of Vitruvius’ *De architectura*. In addition to his interests in architecture, mathematics, geometry, and archeology, Fra’ Giocondo could have shared with Fausto his studies on Greek epigraphy. A document from the Ambrosiana Library in Milan shows a Greek epigraphy copied by Fausto from a building whose location is unfortunately still unknown (Milan, BA, Ms. D 199 Inf., fol. 91r).

³⁸ Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11r: *Is, conditione a Lucensibus oblata, ducentorum scilicet in singulos annos aureorum, se Graece et Latine professurum recepit*. Parrasio, in his letter to Cesario (13 September 1510), wrote that “(the governors of) Lucca invited (him to teach) with very favorable conditions” (*Lecenses invitant honestissimis conditionibus*); see also Gualdo Rosa 2005, 30.

addition to the 75 already mentioned, the scholar had also requested two carpets for his reading tables, which cost 5 ½ ducats.³⁹ Since the teaching load in Lucca was overwhelming for one individual, Parrasio offered Fausto the opportunity to share the job and salary equally. Fausto accepted the offer from Parrasio, who “knew well I had completely devoted myself to the study of Greek since I was young.”⁴⁰

In order to reach Lucca, Parrasio moved to Chioggia, together with two pupils and Fausto, who—in the words of Cenami to the governors of Lucca—was “a very erudite scholar, accompanying (Parrasio) as a lecturer, especially of Greek.”⁴¹ From Chioggia they were to continue their journey by land, crossing the Po Valley to arrive in Lucca. However, due to the bad wintry weather and the presence of Alphonse I d’Este’s army in Romagna preventing safe passage, they could not depart from Chioggia and remained there for 15 days before eventually deciding to return to Venice.⁴² Suddenly, Parrasio, “who already had in mind to break the promise he had made to the city of Lucca (to teach Classics)”—and consequently, to escape with the money Cenami advanced him—“became a sort of Proteus.”⁴³ In his letter, Fausto referred to Parrasio’s elusive nature: “Oh dear Gods!”—wrote Fausto to Sannazaro—“he (*scil.* Parrasio) deceived me so artfully! He used to tell me, almost in tears: ‘Oh, Vettor, stand by me!

³⁹ Barsanti 1905, 3-4, and 216-218; see also Ruggiero 2002, 177-187; Mandarini 1897, 269-70, n. 157. The total amount was exactly 80 ½ ducats.

⁴⁰ Vienna, ONM, Ms. Vindobon. Lat. 9737e, fol. 11r: *bene enim noverat me Graecis litteris ab ineunte aetate maximam dedisse operam.*

⁴¹ Barsanti 1905, 217: *Uno molto dotto, qual menava per ripetitore maxime del grecho.* See also Gualdo Rosa 2005, 31.

⁴² Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11v: *Clodiam...Fossam...ubi cum per quindecim dies moraretur, praecluso brumali tempestate mari nec minus terrestri itinere Ferariensium latrociniiis infesto, Venetias reverti decrevit.*

⁴³ Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11v: *Siquidem Lucensibus fidem fallere semper machinabatur...in aliam quasi Proteus speciem se convertit.*

Protect me against whoever puts me in danger!”⁴⁴ Upon their return to Venice from Chioggia on a fast boat to avoid further delay and so they would not perish from hunger and cold—Fausto continued in his letter—“a ship arrived during the night, and he (*scil.* Parrasio) secretly loaded on board all our belongings, and the day after, setting sail, he left, abandoning me almost naked.”⁴⁵ In reference to Cenami’s 80 ducats stolen by Parrasio, Fausto claimed he had not been party to such a crime, and did not receive any money from Parrasio.

For the purpose of the present study, this letter is extremely significant, as Fausto listed the titles of the Greek texts stolen by Parrasio. Fausto sadly wrote to Sannazaro: “He (*scil.* Parrasio) stole from me about ninety books; I will list a great number of those which he looked at avidly. The *Lives* by Plutarch written in Greek; the *Tragedies* by Aeschylus; some commentaries on Theocritus; a very rare commentary on the *Iliad* by Johannes Grammaticus, written—I believe—600 years ago; a fair volume in parchment of handwritten letters; the complete (work) by Athenaeus; many grammar books not yet printed; a paraphrasis of Theocritus and a very old bound volume in parchment comprising Lucian, (Nikephoros) Blemmydes, Cyril (of Alexandria) and other printed books in Greek. The majority of my books, as well as my studies, are in Greek.”⁴⁶ Fausto

⁴⁴ Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11v: *Dii boni, quibus non artibus me decepit? Pene lachrymans dictabat: ‘Ah, Victor, noli me perdere. Praesta te eum quem semper expertus sum.’*

⁴⁵ Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11v: *Dum vero domi meae corpori necessaria curarem (eram enim defessum), is per noctem navigio obviam factus, quicquid utriusque nostrum erat navi clam me conductae imposuit, postridie solute ora discessit ac me pene nudum reliquit.*

⁴⁶ Vienna, ONB, Ms. Vindobon. Lat. 9737e, fol. 11v: *Volumina librorum mihi fere nonaginta surripuit, quorum nonnulla, quibus ille maxime videbatur inhiare, percensebo. Plutarchi scilicet vitas Graece scriptas, Aeschyli tragoedias, in Theocritum commentaria, rarissimum Ioannis grammatici in Iliadem commentarium, sexcentos, ut arbitror, abhinc annos scriptum, epistolarum volumen iustum in*

concluded his letter by appealing to Sannazaro's *humanitas* and *auctoritas* over Parrasio so that he could have convinced him to return the Greek books to their legitimate owner. A letter written by Parrasio to Cesario dated "in Naples, 13 February 1511" proves that the humanist's final destination was Naples.⁴⁷ Fausto wrote to Sannazaro certainly because he came to know that Parrasio had reached Naples, where Sannazaro lived at that time.⁴⁸ Sannazaro's reaction to Fausto's letter is unknown, and it is unlikely that Fausto ever received his valuable books and manuscripts back.

As the prospect of teaching Greek in Lucca had vanished, Fausto remained in Venice.⁴⁹ In 1511, he became the pupil of the famous Cretan scholar Marco Musuro (ca. 1470-1517), who had just been appointed to the lectureship of Greek at the School of Saint Mark after its reopening at the end of the War of the League of Cambrai.⁵⁰ Fausto worked for Musuro as a copyist in Greek, and it is likely that the Cretan scholar introduced Fausto to the printer Aldo Manuzio at the Aldine Academy. In the preface of the *editio princeps* of Pindar's poems (1513), Aldo Manuzio recalled how Marco Musuro, Fra' Giocondo, and Andrea Navagero—his closest collaborators and members of the Aldine Academy—urged him to reopen his printing press and return to Venice

membranis manu scriptis, Athenaeum integrum, grammaticos complures adhuc non impressos, Theocriti paraphrasim antiquissimumque contextum Lucianum in membranis, Blemymdem, Cyrillum et reliqua impressa Graecorum volumina; maior enim meorum librorum pars Graeca est sicuti et studiorum.

⁴⁷ Gualdo Rosa, 32.

⁴⁸ Kidwell (1993, 120) suggests that Fausto wrote to Sannazaro begging him to use his influence in Venice; however, this hypothesis is unlikely as Parrasio left Venice and fled to Naples.

⁴⁹ Fausto 1551, *Oratio secunda*, 36b.

⁵⁰ The Cretan scholar Marco Musuro, disciple of Janus Lascaris, was appointed by the Venetian Senate to the lectureship of Greek of the School of Saint Mark with a salary of 150 ducats per year on 23 January 1511; see ASVe, Senato Terra, reg. 17, fol. 118r. Musuro taught Greek at the School of Saint Mark until 1516, after which he moved to Rome at the invitation of Pope Leo X, who wanted to "restore the study of the Greek language and literature, which had almost disappeared and been forgotten"; see Venice, BNM, D 012D 015: Bembo 1535, 34.

after the War of the League of Cambrai. Although Fausto did not print any works with Manuzio, it is noteworthy that in 1511, when he started working for Musuro, he adopted his humanist pseudonym, which may indicate that Fausto joined the Aldine Academy.⁵¹ In the same year, Fausto published in Venice a revised edition of the six comedies by Terence, which also included *De comoedia libellus*, and some philosophical works by Cicero (*De officiis*, *De amicitia*, and *Paradoxa*), both printed by Lazaro de Soardi.

In order “to further the study of Greek that was about to eclipse from the face of the earth,” Fausto started travelling all over the Mediterranean.⁵² Fausto’s previous cooperation with the printer Tridino led him to Spain in 1512.⁵³ Fausto’s presence in Spain is revealed by the Greek epigram he published in the fifth tome of the six-volume Complutensian Polyglot Bible, which was printed in Alcalá de Henares (the old *Complutum*).⁵⁴ A brief discussion of the Polyglot Bible composition will help clarify

⁵¹ Fausto personally knew all three scholars mentioned by Manuzio in the preface of Pindar’s works. Indeed, besides Musuro and Fra’ Giocondo, Fausto was a dear friend of Andrea Navagero as well. The two probably met at a young age, when both were studying Greek with Marco Musuro. A letter in Latin written by Fausto to Andrea Navagero documented the deep friendship that tied the two humanists together. Dated to 1 June 1527, the letter was written in order to wish Navagero a prompt recovery from gout and to tell his friend about his progress regarding the construction of his *quinqueremis*; see Venice, Biblioteca Nazionale Marciana, Aldine 767: Manuzio 1556, 106a-108a.

⁵² Fausto 1551, *Dedicatio*, fol. 3a: *graecas litteras quasi toto orbe fugientes persequeretur*.

⁵³ On the date of Fausto’s arrival in Spain, see discussion below in this CHAPTER.

⁵⁴ The epigram, in Greek elegiac couplets, has been published by Legrand (1885, 1: 115). It is not, as Concina noted (1990, 30), the earliest Greek epigram composed by Fausto, since Fausto had previously published Greek epigrams in the *Noctes Atticae* (Venice, 1509), in the edition of the Terentian comedies (Venice, 1511), and in the *Grammaticae institutiones* by Urbano Bolzanio (Venice, 1512). As indicated by the colophon, the fifth tome of the Polyglot Bible, containing the New Testament, was printed on 10 January 1514, but the entire work was not actually completed until July 1517, and published in its entirety in 1520. On the Complutensian Polyglot Bible, see the study of Revilla Rico (1917), and Lyell (1917).

certain aspects of Fausto's voyage to Spain and also rectify some misconceptions that have been prevalent in past scholarship.⁵⁵

The Polyglot Bible was by far the most ambitious printing venture since the invention of the printing press in 1450.⁵⁶ The Bible consisted of six volumes: the first four were devoted to the Old Testament, the fifth contained the New Testament, and the sixth volume comprised Hebrew, Aramaic, and Greek dictionaries and grammars, aids for pronunciation, a critical apparatus, and various footnotes. In 1502, Francisco Ximénez de Cisneros (1436-1517), Cardinal and Grand Inquisitor, promoted the publication of the Polyglot Bible.⁵⁷ In 1498, inspired by the humanistic intellectual climate, Ximénez had established the *collegium trilingue* (Latin, Greek, and Hebrew) of

⁵⁵ Previous bibliography dismissed or misinterpreted the significance of Fausto's role in the edition of the New Testament of the Complutensian Polyglot Bible. Concina (1990, 30) omitted any discussion of the topic, and vaguely stated that "Fausto was involved in the preparation" of the New Testament. Likewise, Wilson (1988, 89) cautiously notes, "It is sometimes alleged that he went to Spain with Demetrius Ducas in order to collaborate with him in the production of the Alcalá Polyglot Bible." Bataillon (1937, 1: 42) writes that "probably Fausto was the typographer that arranged the text under the direction of Doukas," which is unlikely, since Ximénez hired Brocar for this complex task. On the other hand, Legrand (1885, 1: cv) stated that the Greek text of the New Testament was due "to the joint effort of Demetrius Ducas and Niketas Faustos."

⁵⁶ In 1501, the Venetian printer Aldo Manuzio conceived the publication of a trilingual Bible (Hebrew for the original text, Greek for Septuagint, and Latin for the *Vulgata* by Saint Gerome) with the page layout on three columns. After Manuzio made a trial print (a few lines from the *Genesis*), the project was aborted. The first chapter of the *Genesis* (1-14) has been published by Bigliuzzi (1994, document n. 54).

⁵⁷ In 1492 Ximénez, when still a friar of the Franciscan order, was chosen as the confessor to Queen Isabella of Castile (1451-1504), thus playing a pivotal role on matters of the Church and State. Soon afterwards in 1495 he became the archbishop of Toledo and chancellor of the kingdom of Castile, gaining immense power and income. In 1507, Ximénez was elected Cardinal and Grand Inquisitor. A detailed biography of Cardinal Francisco Ximénez de Cisneros is provided by de Alvaro Gomez Castro; see Rome, BNC, 8.48.E.8: Gomez de Castro, 1569.

Saint Ildefonso.⁵⁸ In 1508, Ximénez founded the *Academia Cancellarium*, which was entitled to grant degrees.⁵⁹

Within the institution of the *collegium* and the *academia*, Ximénez conceived the idea of an edition of the Polyglot Bible containing the original texts in Hebrew, Greek, and Aramaic, along with the Latin *Vulgata*. Such a complex enterprise posed enormous technical problems. Not only did Ximénez need the original biblical texts, but he also needed scholars who were experts in ancient languages and, most of all, the special characters necessary to print the Polyglot Bible. In 1502 Ximénez built a printing establishment close to the *academia* for the production of the Polyglot Bible, and, in order to cut new typefaces for the Hebrew and Greek characters, he hired the Spanish typographer Anrao Guillé de Brocar (1460-1523), who was one of the few to use Greek characters at that time in Spain.⁶⁰ For amending the biblical texts he had gathered, Ximénez hired excellent collaborators who were experts in Latin, Greek, and Hebrew.⁶¹ The selected scholars were the same professors teaching at the *academia*: Antonio de Nebrija (1441/44-1522) and Francisco Vergara (1490-1545), who were in charge of the Latin texts; and Antonio Zimara of Córdoba (1460-1523), along with Paulo Nuñez

⁵⁸ Gomez de Castro 1569, 4: 82b. Gomez, who had been a student at the *collegium*, noted that Ximénez possessed self-taught Latin, Greek, and Hebrew during his youth. The *collegia trilingua* of Leuven in Belgium (1518) and of Paris (1530) were modeled upon the school of Alcalá.

⁵⁹ Gomez de Castro 1569, 4: 83b: (*Ximenius*) *constituit etiam, ad Parisiensis scholae exemplum, Academiae Cancellarium, qui honorum titulos, (quos vulgo gradus vocant) studiosis tribueret.* The *Academia Cancellarium* became later the Complutensian University of Madrid.

⁶⁰ Irigoín 1996, 65.

⁶¹ A complete description of the manuscripts used for the composition of the Complutensian Polyglot Bible is in Revilla Rico 1917, 83-89. For the original texts of the Old and New Testaments, Pope Leo X provided Ximénez two very old manuscripts from the Vatican Library. From the Marciana Library of Venice, Ximénez obtained a rare codex from the collection of the cardinal Bessarion. The section listing the names of the professors of the *academia* of Alcalá is based on Gomez de Castro 1569, 4: 81b-82a.

Coronel of Segovia (1480-1534) and Alfonso of Alcalá (fl. 1510) were in charge of the Hebrew texts.⁶² For the New Testament Greek texts, Ximénez brought together Juan de Vergara (1492-1557), Bartolomeo de Castro, and Demetrios Doukas from Crete (1480-1527). Ximénez also hired Hernán Nuñez de Guzmán *el Pinciano* (ca. 1470-1553) and, successively, Fausto. The five names—those of Vergara, Castro, Doukas, Guzmán, and Fausto—appear at the beginning of the fifth volume devoted to the New Testament as authors of five epigrams dedicated to Ximénez.⁶³ As Geanakoplos pointed out, the placing of Doukas' epigram first suggests that Doukas was not only the author of the preface, but also responsible for editing the Greek text of the New Testament volume.⁶⁴

From 1506 to 1509, Doukas worked with Aldo Manuzio in Venice and edited the first volume of the *Rhetores graeci* and the *Moralia* by Plutarch.⁶⁵ At the invitation of Ximénez, Doukas moved to Alcalá, where he held the chair of Greek until 1519.⁶⁶ When Doukas arrived in Spain, the text of the Old Testament had already been edited and the typographer Brocar had cut the newly designed typefaces for the Hebrew and Greek texts. Doukas, however, accustomed to the high Venetian typographical standards and to

⁶² Actually, Coronel, Zimara, and Alfonso of Alcalá were very young and almost unknown when they joined the University. Their conversion to Christianity has to be connected with the edict expelling the Moors from Spain in 1492. The majority of Jews departed, and those remaining converted to Christianity. Not coincidentally, Coronel, Zimara, and Alfonso of Alcalá converted just before the cardinal appointed them to the Hebrew and Aramaic chairs.

⁶³ The two epigrams signed by Doukas and Fausto are written in Greek; the other three, signed by Juan de Vergara, Bartolomeo Castro, and Hernán Nuñez, respectively, are written in Latin; see Lee 2005, 273.

⁶⁴ Geanakoplos 1962, 243. Doukas was the only native Greek among the five scholars.

⁶⁵ On Dimitrios Doukas and his work in Venice, see Geanakoplos 1962, 223-55, and Layton 1994, 276-80.

⁶⁶ It is not known exactly when Doukas arrived in Spain, but it must have been during the first months of 1511. His arrival coincides with the outbreak of War of the League of Cambrai, when the Aldine press ceased its printing activities on May 1509; see Balsamo 2002, 181.

Greek cursive characters employed by Manuzio using a different diacritical system, refused to print the text of the New Testament with the types created by Guillé de Brocar and proposed that Ximénez print the text of the New Testament with different Greek typefaces, which displayed a new, simplified accentuation system.⁶⁷ Doukas eventually succeeded in winning Ximénez's approval by arguing that the Greek typefaces had already been designed and cut, and therefore would not incur any further expense.⁶⁸

Not coincidentally, the Greek characters displayed in the New Testament are the same as those used by the Venetian printer Tridino for the *Grammaticae institutiones* by Urbano Bolzanio. The *Institutiones* were printed on 20 August 1512, but Tridino had cut the typefaces as early as 1509.⁶⁹ Fausto had published a Greek epigram in the 1512 edition by Tridino.⁷⁰ Thus, Fausto's arrival in Spain and his successive involvement in the publication of the New Testament must be connected with Doukas' decision to use Tridino's Greek characters. Likely, Doukas asked the typographer Tridino to lend him the typefaces, and Fausto was either requested, or he offered, to bring them from Venice to Alcalá. This appears to be the real reason for Fausto's voyage to Spain.

⁶⁷ Indeed, while the text of the Old Testament displays a regular system of breathings and accents, the New Testament shows a simplified system. The monosyllables have no accents, the tone syllables are marked only in the case of acute accents, and the grave and circumflex are omitted; see Lee 2005, 250-290. In the preface of the New Testament, Doukas explained that "the most ancient of the Greeks were accustomed to writing without these points" and "since the whole New Testament...was written down in the Greek language from the beginning, just as it was imparted by the Holy Spirit, we too decided piously to preserve the archaic antiquity and majesty of the same language." The original Greek text was first published by Legrand 1885, 1: 115-17. The translation is by Lee 2005, 261-63.

⁶⁸ This is what Doukas asserted in the postface of the Greek grammar he published for his students at the University of Alcalá on 10 April, 1514; see Geanakoplos 1962, 234, and Irigoín 1996, 68.

⁶⁹ Irigoín 1996, 69.

⁷⁰ *Supra* n. 11.

Closer examination of the 1512 edition of the *Grammaticae institutiones* gives significant insight into Fausto's pivotal role in the New Testament. This 1512 edition was a revised and improved version of the *Grammaticae institutiones linguae Graece* that Urbano Bolzanio had previously published in 1497 with Aldo Manuzio.⁷¹ This edition was expanded with new sections and improved with a new diacritical system. The diacritical system used in the 1512 edition could not have been the typographer's initiative, but rather the work of Urbano, who possessed the capacity for such a task. The fact, however, that Fausto published a Greek epigram in the edition suggests that Fausto contributed to the metrical apparatus. Through the years, Fausto became a renowned metrical expert in Venice. In 1520, Fausto revised the metrics of the *Parakliti* (better known as *Oktoikhos*). This book contains hymns to the Virgin in the eight-tone cycle. In the preface of the *Parakliti*, Fausto asserted that he contributed to the edition as a metrical expert.⁷² Although Fausto was not part of the initial group of Greek experts invited by Ximénez, and even though he played a minor role compared to the other four scholars (Vergara, Castro, Doukas, Guzmán), it seems plausible that he revised the metrics of the New Testament. However, during his stay in Spain, Fausto built such a strong reputation as an esteemed scholar that Ximénez offered him a position as a Greek teacher at the University, although Fausto declined.⁷³ He left Spain in 1513, in

⁷¹ Irigoien 1996, 69.

⁷² Lee 2005, 274.

⁷³ Fausto 1551, *Oratio secunda*, fols. 36a-b.

concomitance with the arrival in Alcalá of Hernán Nuñez, who became Doukas' assistant and was later appointed as a professor of Greek at the *academia*.⁷⁴

The year 1513 was a period of turbulence for Fausto. He experienced military life under the mercenary captain Baldassare Scipione, commander of a squadron of knights in the army of the Venetian general Bartolomeo d'Alviano (1455-1515).⁷⁵ Fausto remained in the army until 1515, as he noted in the dedication of the Aristotelian *Mechanica* addressed to Giovanni Badoer (1465-1535).⁷⁶ Badoer had a decisive role in Fausto's life and career as his patron.⁷⁷ The two befriended one another in Spain, where Badoer was sent as ambassador in June 1512.⁷⁸ A few years later, in 1516, when Badoer was appointed ambassador to France, he requested that Fausto be part of his diplomatic entourage.⁷⁹ Fausto lived in France for about two years and joined the circle of French

⁷⁴ In 1513, Nuñez was appointed professor of Greek and assumed the lectureship that was first offered to Fausto until 1517; see Nader 1978, 481. Doukas taught Greek in Alcalá until 1519, when he left for Rome.

⁷⁵ Fausto 1517, *Dedicatio*, 1a and 3b. Bartolomeo d'Alviano was captured by the French in 1509 after the defeat of Agnadello. He was released in 1513, the same year in which he came to service and placed in charge of the military affairs in the Venetian *Terraferma*, in particular in Friuli, Padua, and Brescia; see Sanuto, IX, col. 241, 400, 537; X, col. 36, 37, 330, 362, 548, 578, 788; XX, col. 141, 485; XXI, col. 269, 345, 350.

⁷⁶ Fausto 1517, *Dedicatio*, 1a.

⁷⁷ Giovanni Badoer (1465-1535) was a prominent Venetian politician. After his studies in Padua, he became resident ambassador in Spain (1498-1499; 1512-1524), Naples (1500-1501), Hungary (1501-1503), Rome (1507-1508), and France (1516-1517; 1520-1524), and a special envoy to Poland in 1502 and to Rome in 1534. He became Proveditor of Chioggia (1504-1506), Brescia (1518-1519), and Padua (1531-1532), and captain of Verona (1525-1526). He was a senator and member of the Council of Ten and of the Great Council.

⁷⁸ Sanuto, XIV, col. 316. Fausto dedicated his Latin translation of the Aristotelian *Mechanics* to Giovanni Badoer, and addressed him as "mindful of (our) companionship in Spain." Concina (1990, 30) writes that Fausto went to Spain in order to accompany Badoer in his diplomatic mission. As we have already discussed, this was not the reason why Fausto moved to Spain.

⁷⁹ Sanuto, XXVI, col. 52.

humanists in Paris led by Guillaume Budé (1467-1540).⁸⁰ In 1517, while in Paris, Fausto published the first Latin translation of the Aristotelian *Mechanica*.⁸¹ In his dedication to Badoer, Fausto claimed he had collected more than 20 copies of the text while travelling in Italy in order to emend obscure passages and recover the original visual apparatus.⁸²

Undoubtedly, the *Aristotelis Mechanica* is Fausto's most outstanding, impressive literary work, as he made the *Mechanica* in Latin available for the first time in the Western world. During the Renaissance, few people could master Greek, and considering that the text presented linguistic difficulties because of its technical vocabulary, few humanists could undertake such a difficult task. The *Mechanica*, along with other Greek sources, was a fundamental and formative text for Fausto in the conception of his *quinqueremis*. In a broader perspective, Fausto's authorship greatly contributed to the restoration of Greek science in the Western world and inaugurated a new field of study devoted to mechanical questions. It also enacted a cultural process that gradually led to the legitimization of the *artes mechanicae*, paving the way for the scientific revolution started by Galileo Galilei (1564-1642), who lectured at the

⁸⁰ Given Fausto's acquaintance with France it was not by chance that at the death of François La Rouge, the French ambassador in Venice, Fausto was assigned to publicly deliver his funeral eulogy (*Oratio in funere Francisci Rubrii oratoris Regii*), which corresponds to the fourth oration of the *Orationes*.

⁸¹ It is fascinating to note that Badoer was particularly interested in the recovery of technical Classical tradition, and he had been the patron of Giorgio Valla (professor of humanities at the School of Saint Mark) who dedicated to Badoer a translation of several mathematical Greek texts.

⁸² Supra n. 14. Fausto claimed that Aristotle's *Mechanica* was a fundamental source in the conception of his *quinquereme*. In this period, indeed, Fausto was working on the technical features of his ships and he used the 'Fifth Question' of the *Mechanica*, focusing on the mechanical aspects of the rudder to design the steering apparatus of his *quinquereme*. The famous scholar Niccolò Leonico Tomeo (1456-1531), who taught at the University of Padua from 1497 to 1506, published in 1525 a Latin translation of the pseudo-Aristotelian *Quaestiones mechanicae*, which was primarily based on Fausto's edition of 1517; see Rose 1976, 22, n. 58; Rose and Drake 1971, 78-9; Grendler 2002, 273-74.

University of Padua on Aristotle's work and on which he wrote a commentary, now lost. Giuseppe Moleti (1531-1588), who also lectured at Padua, wrote a treatise on mechanics (*Dialogo intorno alla meccanica*), and recalled that "Vettor Fausto, a famous peripatetic and mathematician, and an outstanding professor of Greek, translated the *Mechanics* into Latin."⁸³ It was because of Fausto's contribution to Renaissance science that sixteenth-century Venetian Humanism, in its last phase, embraced topics focusing on banausic arts and, in doing so, legitimized the *ars mechanica* into a *scientia*.⁸⁴

In 1518, Fausto, desiring to apply his new knowledge to the service of the Republic, returned to Venice.⁸⁵ It was during this period that the city of Ragusa in Dalmatia offered Fausto a Greek lectureship, which he refused since a better opportunity had arisen in Venice.⁸⁶ In 1518, Marco Musuro, who held the chair of Greek at the School of Saint Mark, had died in Rome, leaving the position vacant.⁸⁷ In June 1518, the Venetian senators decreed that they wanted "to appoint a new lecturer to replace the Reverend Marco Musuro, with a salary of 100 ducats per year, in accordance with the previous conditions and terms; and to declare publicly that all candidates for the lectureship in Greek have to register their names with the Chancellery within two months; the candidates are required to deliver a public lecture in Greek, after which,

⁸³ Milan, BA, Ms. S 100 Sup., fol. 158v: *Victor Faustus et peripateticus et mathematicus insignis, ac linguae graecae professor eximius, transtulit latinum mechanicorum.*

⁸⁴ The integration of mathematics, mechanics, and other scientific topics into Venetian Renaissance culture is affirmed by the organization of the *Accademia Veneziana* in 1557; see Rose 1969, 54.

⁸⁵ ASVe, Consiglio di Dieci, Parti Secrete, reg. 1, folios not numbered.

⁸⁶ Fausto 1551, *Oratio prima*, 7a-b, and *Oratio secunda*, 36a.

⁸⁷ Actually, vacancy for the Greek lectureship at the School began in 1516 when Musuro left Venice for Rome at the invitation of Pope Leo X to help him establish the "Roman Academy," modeled upon the Aldine Academy. Musuro's departure was meant to be temporary, but his stay in Rome lasted longer than expected and he eventually passed away.

there will be the election.”⁸⁸ The Greek lectureship was an extremely prestigious position, and the competitors were highly renowned scholars: Costantino Paleocapa, Giovanni Ettore Maria Lascaris, and Giovan Battista Egnazio.⁸⁹ On 4 October 1518, Fausto lectured on *De laudibus patriae* by Lucian in the auditorium of Saint Mark in Terranova.⁹⁰ Three days later, Egnazio lectured on Demosthenes’ “Against Meidias,”⁹¹ and performed a second time on 9 October.⁹² The day before, Fausto was requested to deliver a second lecture, for which he was greatly praised:

In this day, in the auditorium, Vettor Fausto lectured in Greek, and delivered an oration in which he displayed a vast memory and knowledge of the sciences. He performed *De Argonautis* by Orpheus. At the lecture, there was the ambassador from France, the ambassador from Ferrara, the procurator Alvise da Molin, three councilors, *sier* Luca Trun, *sier* Francesco Bragadin, and *sier* Antonio da Mula, two Sages of the Council, the doctor and knight *sier* Zorzi Pisani, and the knight *sier* Francesco Donado. Moreover, there were all these doctors: *sier* Sebastian Foscarini professor of philosophy, *sier* Andrea Mocenigo, *sier* Hironimo da Ca’ Tajapietra, *sier* Marco Antonio Venier, *sier* Nicolò Tiepolo, *sier* Zuan Baxadona, *sier* Hironimo Polani, *sier* Lorenzo Venier, *sier* Nicolò da Ponte, and many other noblemen, among which were I, Marin Sanudo, and many other senators. There was also Raphael Regio, the public lecturer at the chair of humanities, and many other people who enjoy the sciences. (Fausto) performed extremely well, concluding that he should be given the chair by virtue of his merits. He is young, and he has done nothing but study, and he wishes to be given this test: let him be given a subject in Latin or Greek, verse or prose, to develop, and let the same be given to anyone else who so wishes. If what he does is not more learned, let him not be given the chair.⁹³

⁸⁸ ASVe, Senato Terra, reg. 20, fol. 132v: *eleger se deba uno lettor in loco del predicto Reverendo Marco Musuro, cum salario, cum salario de ducati cento alanno, modi, et condition consuete, et sia publice proclamato che qualunque pretenderà essere provato alla lectura predicta deba fra termine de duo mesi haversi dato in nota alla cancellaria nostra et avanti la ballotacione deba cadauno de quelli che se metterano alla prova leçer publicamente una lection greca*. The same decree is reported by Sanuto (XXVI, col. 502-503). See another passage from Sanuto (XXV, col. 120), who reported the previous decree that established the salary at 150 ducats and the registration period within eight days.

⁸⁹ Sanuto, XXVI, col. 127.

⁹⁰ Sanuto, XXVI, col. 52. The School of San Marco was located in Terranova, an area behind the Marciana Library in Saint Mark’s square (approximately were the modern Royal Gardens stand now); see Tassini 1863, 426.

⁹¹ Sanuto, XXVI, col. 108.

⁹² Sanuto, XXVI, col. 110.

⁹³ Sanuto 1466-1536 (hereafter cited as Sanuto), XXVI, col. 107 and 108: *In questo zorno, in l’auditorio, Vettor Fausto fece un principio a lezer in Greco, et fece una oration: monstra gran memoria et*

Unexpectedly, on 16 October, while the competition was still going on, Egnazio went before the College and told the Senators that he resigned from the competition, as the name of the winner was already known and his machinations (*archimie*) would soon be revealed.⁹⁴ Sanuto did not comment on this episode, but he candidly recorded that on the very same day, the senators appointed “*dominus* Vettor Fausto, doctor and a Venetian citizen by birth, an expert both in Greek and Latin,”⁹⁵ thus suggesting some sort of machinations by Fausto. It is not known to what specifically Egnazio was referring to, but certainly the intrigue claimed by Egnazio should probably be identified with the political and humanistic connections that Fausto built over the years.

In this period, however, Fausto had already begun to work on the quinquereme, at least on a theoretical level. He formally presented his project to the Arsenal in 1525,⁹⁶ and in the following years, built several other ships. In 1530, Fausto was appointed librarian of the repository that became the modern Marciana Library, which housed the valuable collection of Cardinal Bessarion (1403-1472)—replacing Andrea Navagero

cognition di scientie. Lexe Orpheo de Argonautis. Vi fu l'orator di Franza et quel di Ferara, sier Alvixe da Molin procurator, tre consieri, sier Luca Trun, sier Francesco Bragadin e sier antonio da Mula, do savii dil Consejo, sier Zorzi Pixani dottor, cavalier, sier Francesco Donado el cavalier, e tutti questi doctori: sier Sbastian Foscarini leze philosophia, sier Andrea Mozenigo, sier Hieronimo da chà Tajapietra, sier Marco Antonio Venier, sier Nicolò Tiepolo, sier Zuan Baxadona, sier Hironimo Polani, sier Lorenzo Venier, sier Nicolò d aPonte, et altri patricii, tra i qual io marin Sanudo, e molti di Pregadi. Vi fu domino Raphael Regio lector publico in humanità, et assa' altri che hanno piacer de scientia. Et si portò benissimo, concludendo, per meriti se sia da dar questa lectura. È zovene, ma non ha fato altro che studiar, e vol far questa experientia li sia dato latin o greco, versi o prosa da far, et sia dato questo istesso tema a chi si voglia; si quello farà lui non sarà più docto, non li sia dà dicta lectura.

⁹⁴ Sanuto, XXVI, col. 122.

⁹⁵ ASVe, Senato Terra, reg. 20, fol. 159v: *Dominus Victor Faustus doctor civis venetus originarius grecae et latinae linguae peritus*. Ferreiro (2009, 7), in referring to Fausto's Greek lectureship, confused the School of Saint Mark, which was the School of the Chancellery, with the Scuola Grande of San Marco, which was one of the six major sodalities in Venice.

⁹⁶ ASVe, Consiglio di Dieci, Parti Secrete, reg. 1, fol. 31r.

(1483-1529), who had died the year before.⁹⁷ It is not known how long Fausto held the Greek lectureship.⁹⁸ Sanuto recorded that in November 1524, Fausto was lecturing on Hesiod and Pindar in the auditorium.⁹⁹ However, Pietro Bembo (1470-1547), in a letter to Giovan Battista Ramusio (1485-1557) dated 29 May 1529, wrote that, at that time, Fausto was still “professor of Greek in this our city, which paid publicly (his) salary.”¹⁰⁰

The year 1539 was an *annus horribilis* for Fausto, as he was arrested, incarcerated, and tortured under the charge of treachery and conspiracy against the Republic.¹⁰¹ A cyphered letter sent by the Spanish ambassadors to Charles V (1500-1558) reported that Fausto arranged to move to France at the service of the House of Valois—allied with the Ottoman Sultan against Venice and the Holy Roman Empire—in order to build “galleasses and other big ships” (*galeaças y otros navios grandes*). Rumors that Fausto was secretly murdered started spreading.¹⁰² Although Fausto was released soon afterwards and declared innocent, the Republic’s suspicion was not completely groundless. As far back as 1530, the French ambassador in Venice, Lazare de Baïf (1496-1547), on behalf of King Francis I (1494-1547), negotiated with Fausto regarding the prospect of moving to France.¹⁰³ De Baïf’s mediation probably failed,

⁹⁷ ASVe, Consiglio di Dieci, Parti Comuni, reg. 5, fols. 39v-40r. On Bessarion’s Greek manuscripts, see Zorzi 2002, 93-121.

⁹⁸ Piovan (1995, 399) notes that Fausto held the Greek lectureship until 1524, whereas Targhetta (1995, 611) claims that it was until 1525.

⁹⁹ Sanuto, XXXVII, col. 195.

¹⁰⁰ Vatican City, BAV, Fondo Borghese I, 175, fol. 244v: *ora tuttavia essendo professore delle (lettere) Greche, pubblicamente salariato da lei*. This letter has been published by Travi (3: 45-47, n. 975).

¹⁰¹ ASVe, Consiglio di Dieci, Parti Criminali, filza 8, 29 November 1539; ASVe, Consiglio di Dieci, Parti Criminali, reg. 5, fol. 98v, and 99v.

¹⁰² Simancas, AGS, Catalogo XXVI, Papales de Estado, Venecia, 67, fol. 34v.

¹⁰³ Paris, BNP, Ms. Fr. 3941, fol. 82r.

because in the same year Fausto was appointed librarian to the Library of Saint Mark.¹⁰⁴ After a series of delusions related to his work at the Arsenal, Fausto was frustrated and no longer driven by the desire to serve the *Serenissima*. In July 1546, Fausto contacted the Florentine ambassador in Venice and negotiated the possibility of moving to Tuscany and working at the service of the Medici, but nothing materialized.¹⁰⁵

Toward the end of his life, Fausto was working on a re-edition of Aristotle's *Mechanica*, which was enriched by a more detailed visual and exegetical apparatus.¹⁰⁶ Unfortunately, this work never came to light. Fausto's return to his origins with the *Mechanica*—his first important work that launched him as a humanist and decreed his fame at an international level—highlights his restless effort to produce quality work in an attempt to reestablish his reputation as a humanist. This effort, along with the frustrations in the Arsenal and his unsuccessful attempts to leave Venice, epitomized Fausto's resentful last years.

Fausto and His Teaching of Greek at the School of Saint Mark

Upon his appointment to the Greek lectureship at the School of Saint Mark, Fausto wrote an enthusiastic oration (*Oratio qua gratiae aguntur pro impetrato graeae profitendi honore*), which he delivered before the Senators in April 1519.¹⁰⁷ The oration praised Venice as an *altera Byzantium*, a literary *topos* celebrating “the myth of Venice,”

¹⁰⁴ Supra n. 97.

¹⁰⁵ ASFi, Fondo Mediceo del Principato, 2967, fol. 188r.

¹⁰⁶ Fausto 1551, *Dedicatio*, 5a.

¹⁰⁷ Fausto 1551, *Oratio prima*, 1a-18a.

which had flourished since the thirteenth century and was formally theorized in the fifteenth and sixteenth century.¹⁰⁸ Venice is described as a cosmopolitan city at the crossroads of Europe, where the study of the *literae humaniores* flourish, the printing press makes new valuable books available, and scholars of different nationalities arrive from all over to acquire and share fresh knowledge. “You, noble Senators”—Fausto wrote in 1519—“are the lords of Greece, you have not only so many Greek books, preserving the venerable past, but also the greatest and the most eminent printing presses for the Greek language, you bring here professors from other regions of Italy.”¹⁰⁹ Commerce was the *raison d’être* of the tiny Republic, “founded in the middle of water, whose magnificent harbor...can accommodate altogether 1,000 Greek ships that once were captained by Agamemnon, and the fleet of King Hieron and Philadelphus.”¹¹⁰ According to Fausto, the *Serenissima*, located in the northernmost extremity of the Adriatic Gulf and naturally by the sea, had never been conquered by enemies—unlike

¹⁰⁸ The definition of Venice as *altera Byzantium* is by the Cardinal Bessarion, who thus referred to the Republic in a letter dated to July 1468 to the Doge; see Geanakoplos 1962, 116. Modern historiography refers to the so-called “myth of Venice” to indicate the *Serenissima*’s supposed perfection in possessing an exemplary political constitution and civic harmony that created a distinctive historical identity and set Venice apart from the other Italian Republics. The literature on this topic is extensive, but the following works are particularly significant: Fasoli 1958, 1: 445-79; Gaeta 1961, 58-75; Grubb 1986, 43-94; Queller 1986, 17-28; Finley 1999, 294-328.

¹⁰⁹ Fausto 1551, *Oratio secunda*, 31a: *Vos autem o magnanimi patres, quum terrae graeciae domini sitis, graecorumque librorum non solum ingentem numerum, antiquitatis venerandae reconditum habeatis, sed etiam maximas atque optimas officinas graecarum litterarum, professori qui ab alii Italiae populis ducentos.*

¹¹⁰ Fausto 1551, *Oratio prima*, fol. 11a: *mediis aquis fundatam quae, si nihil aliud, certe quod ea magnitudine portum habet, ut non millae Graecorum naves, quibus olim praefuit Agamemnon, aut classem regum Hieronis et Philadephi...capere queat.*

Athens, or Byzantium—and, thus, it was the sole city capable of preserving the legacy of the ancient Greeks.¹¹¹

His appointment to the Greek lectureship was a great achievement for Fausto. “Senators, this privilege, which I owe to you and to this very name of mine, is great; great, and never to be forgotten,” wrote Fausto.¹¹² The Greek scholar Giustino Decadio from Corfu (b. ca. 1472), one of Aldo Manuzio’s collaborators, in 1518 wrote a letter to Fausto congratulating him on his new appointment. Quoting a famous verse from the seventh *Olympian Ode* by Pindar, Decadio addressed Fausto as μακαρίος and ὄλβιος, “blessed” and “happy,” for the results achieved in teaching (παιδεία).¹¹³ Fausto indeed stated that “teaching Greek is wonderful, but teaching Greek in Venice, with such a large attendance by noble people, is even more wonderful.”¹¹⁴ The School of Saint Mark (*Gymnasium literarium*), located “in Saint Mark square, close to the bell tower,”¹¹⁵ had a prestigious history; it was established in 1443 for “children and the young boys of Venice, who are twelve years old or older...who want to learn grammar, rhetoric, and other subjects useful for the Chancellery, and to learn to write well.”¹¹⁶ Besides grammar and rhetoric, the School focused also on the study of Latin and Greek, with an emphasis

¹¹¹ Fausto 1551, *Oratio prima*, 12b-13a.

¹¹² Fausto 1551, *Oratio prima*, 2b: *Magnum est hoc beneficium patres, magnum atque immortale, quod vobis vel hoc ipso nomine debeo.*

¹¹³ Pind., *Olymp.* 7. 10. Decadio’s letter has been published by Legrand (1885, 2:238).

¹¹⁴ Fausto 1551, *Oratio prima*, fol. 16b: *Perpulchrunque est litteras publice docere; sed Venetiis, in tanta frequentia, tantaque nobilitate, pulcherrimum.*

¹¹⁵ Fulin, 1880, 51: *a San Marco, a presso il campaniel.* For the history of the School of Saint Mark and its teachers, see also: Gozzi 1849, 2: 303-305; Romanin 1856, 4: 498-500; Paternoster 1883, 12-16; Cecchetti 1886, 343-57; Foffano 1892, 456-57; Segarizzi 1916, 637-45 and 650-52; Nardi 1971, 31-51; Ross 1976, 526-27; Lepori 1980, 600-605; Labalme 2008, 429-78.

¹¹⁶ ASVe, Maggior Consiglio, Deliberazioni, Ursa, fol. 144r (16 April 1443): *pueri seu iuvenes Veneti ab annis duodecim vel circa supra, cum salario ducatorum decem pro quolibet in anno...discant gramaticam, rethoricam et alias scientias aptas ad exercitium Cancellariae ac bene scribere.*

on philological and linguistic analysis.¹¹⁷ It was specifically intended to supply the Chancellery with notaries, and 12 students were admitted to the School every year and subsidized by the Venetian Republic with an “annual scholarship in the amount of ten ducats.”¹¹⁸ The School was originally created as a high school, but as early as the beginning of the sixteenth century it had evolved into a university-level institution.¹¹⁹ Despite the difficult start after the School’s foundation,¹²⁰ in 1460, the Senate added to the “chancellery chair” a second chair of humanities.¹²¹ By the sixteenth century the School was well-grounded and the number of students increased to 16.¹²²

Although the School was specifically designed for students who would become notaries and secretaries of the Chancellery, the necessity to provide young members of the prospective ruling class with a solid and homogeneous humanistic education led the Senate to expand the curriculum by adding a Greek lectureship in 1504.¹²³ By the first half of the sixteenth century the *studia humanitatis* at the School of Saint Mark became

¹¹⁷ Lepori 1980, 604.

¹¹⁸ ASVe, Maggior Consiglio, Deliberazioni, Ursa, fol. 144r (16 April 1443): *cum salario ducatorum decem pro quolibet in anno*. However, five ducats were withheld from each of the students in order to pay the teachers; see Ross 1976, 527, and Segarizzi 1916, 641-42. The Renaissance term for attending school was the casual *stare a dozzina*, which literally means “to be in twelve.”

¹¹⁹ Grendler 1985, 201.

¹²⁰ The Senatorial decree of 7 June 1446 recorded that “many of the students neither attend the school nor learn, and, since they failed to attend the tutored classes, the number of students is insufficient to cover their expenditure, which renders it useless and unsuccessful” (*multi eorum non vadunt ad scholas nec adicunt, et, deffectu preceptoris, efficient insufficientes, et expensa que sit in eis est inutilis et infructuosa*); in ASVe, Senato Terra, reg. 1, fol. 193r.

¹²¹ For this position, the Senate appointed Gianmario Filelfo; see Segarizzi 1916, 650.

¹²² Segarizzi 1916, 643-48.

¹²³ The Senate decided to elect “an honest and clever teacher... who has to lecture on Greek authors in a suited course, which is necessary to introduce the pupils to the study of humanities” (*eligatur unus probus et idoneus vir... teneatur etima legere in hac urbe nostra auctores graecos per commodam lectionem et veluti necessariam ad introductionem studiorum humanitatis*); see ASVe, Senato Terra, reg. 15, fol. 36r. This newly-appointed third chair was Niccolò Leonicensi of Vicenza, who held the position from 1504 to 1506; see Sanuto, VI, col. 117 and 433.

synonymous with classical education, and the humanities became the ideal instrument for forming a perfect citizen. The great success of the humanities in Venice resulted from a series of favorable circumstances: the donation of Bessarion's library, the growing interest in antiquarian and philological studies, the presence of many émigré Greek scholars, and the Aldine press. Aldo Manuzio (1449-1515) and his "New Academy" (Νεοακαδημία) promoted the ideal humanities curriculum that combined the study of Greek and Latin, and his printing press played a pivotal role in the spread of classical culture.¹²⁴ In 1495, Manuzio published a Latin translation of the Greek grammar by Constantinos Lascaris. In 1497 he published the first Greek dictionary (*Dictionarium graecum*) by Giovanni Crastone, followed by *Grammaticae institutiones graecae* by Urbano Bolzanio, which became so popular during the sixteenth century that it was re-edited and reprinted 23 times.¹²⁵

For Fausto, the appointment to the Greek lectureship must have been recognition of all of his efforts to learn and master Greek, "the letters studied during many nights by lamp-light."¹²⁶ The *studia litterarum* held a paramount significance for Fausto as they shaped and refined the "features of the soul" (*animi lineamenta*).¹²⁷ Considering literary *otium* a virtuous occupation, Fausto claimed, "Who could indeed deny that the study of

¹²⁴ Lowry 1976, 378-85; Pertusi 1980, 3: 177-264; Margolin 2002, 203; Celenza 2009, 155-57.

¹²⁵ Balsamo 2002, 180.

¹²⁶ Fausto 1551, *Oratio prima*, 12a: *litterae tot lucubratis noctibus acquisitae*.

¹²⁷ Fausto 1551, *Oratio prima*, 15a. The *studia humanitatis* were considered to represent the ideal education because they "perfect and adorn the man," as stated by Leonardo Bruni in his letter to the Florentine nobleman Niccolò Strozzi; see Baldassarri 1994, 7.

Greek and Latin is the only (activity) that can adorn the soul to a highest degree?”¹²⁸ Ideologically close to the civic humanistic paradigm, Fausto’s commitment to the Greek lectureship is strongly characterized by the firm belief that the teaching of Greek served as a *publica utilitas*, having a prominent role in the education of Venetian youth, the future ruling class. The study of Greek can lay down the foundation for an honorable life, as it provides young pupils with moral values through the *infinita exempla* that can be found in the works of ancient authors and philosophers.¹²⁹ Virtues, consisting of *iustitia*, *fortitudo*, *prudentia*, and *temperantia*, form the ethical system underlying all human behaviors. “Ethics, which disciplines the youth in public, should not only be perfectly mastered, but should always be part of the curriculum of life.”¹³⁰ For this reason, Fausto urged that teachers in charge of the education of young pupils be carefully chosen, as students can be easily distracted by the ephemera and vanities of society.¹³¹

Fausto adopted the pedagogical method in use at that time in Italian humanistic schools, teaching Greek by explaining it in Latin. “He who teaches Greek in this time, shares everything with (he who teaches) Latin,” Fausto wrote, “especially because, in adapting his teaching (of Greek) into Latin for the audience, it is necessary that he first

¹²⁸ Fausto 1551, *Oratio tertia*, 45a: *Enimverum quis neget litterarum cognitionem, vel solam esse, quae animum apprime possit ornare?*

¹²⁹ This is main topic of Fausto’s third oration (*Oratio qua bonarum litterarum studia commendatur*).

¹³⁰ Fausto 1551, *Oratio secunda*, 23a: *Mitto morum scientiam, quae publico iuventutis moderatori, non solum debet esse notissima, verum etiam semper toto vitae curriculo.*

¹³¹ Fausto 1551, *Oratio secunda*, 28b.

introduces in Latin every single topic he is going to lecture on (in Greek).”¹³² The indirect method of teaching Greek in Latin reflects the general lack of competence in Greek during the first half of the sixteenth century in Venice, which Fausto vehemently reproached. “In Venice...there are more people who carry Greek corn from Achaia, or wine from the island of Crete, than those who can speak Greek.”¹³³ According to Fausto, the *auctoritas* of a teacher of Greek derives from his mastery of both Latin and Greek, and his ability to combine them in his teaching both languages,¹³⁴ saying “only he who is a profound expert in Greek can claim to adequately know the letters.”¹³⁵

Fausto used the indirect method of teaching Greek in Latin also when tutoring privately. During his life, Fausto was a private teacher of Greek and, even after he obtained the lectureship of Greek in 1518, he taught the rudiments of Greek and Latin in his house.¹³⁶ It is possible that Fausto, like his colleague Giovan Battista Egnazio (ca. 1478-1553), opened a private school in his house.¹³⁷ The 1511 edition of Terence’s comedies, containing *De comoedia libellus* written by Fausto and dedicated to Andrea Trevisan, is particularly revealing of Fausto’s private tutoring, as it opens with a witty Greek epigram translated into Latin. The name of Andrea Trevisan points to one of the

¹³² Fausto 1551, *Oratio secunda*, 29a: *Is, qui graece hac tempestate docet, Omnia cum latinis habet communia, praetequam quod, ut latinis auditoribus operam suam accomodet, necesse est prius latina faciat singular, quae expositurus sit.*

¹³³ Fausto 1551, *Oratio secunda*, 28b: *Esse Venetiis...multos, qui graecum ex Achaia frumentum, aut vinum e Crete insula vehant, quam qui graecam possint agree fabulam.*

¹³⁴ Fausto 1551, *Oratio secunda*, 29a.

¹³⁵ Fausto 1551, *Oratio tertia*, 37b: *satis vere dicatur is litteras scire, qui graecarum omnino sit expers.*

¹³⁶ Fausto 1551, *Oratio secunda*, 35a: *multos etiam domi a primis elementis instituo.* Fausto lived in the neighborhood of San Severo, where he rented an house from the nuns of San Lorenzo; in ASVe, Giudici del Piovego, busta 21, libro 1, fol. 11v. I would like to thank Dr. Jan-Christopf Rössler for this reference.

¹³⁷ Ross 1976, 537.

most powerful Venetian families, and in 1511, Fausto addressed him in his *libellus* as a young boy, an *adulescens*.¹³⁸ The Trevisan family was particularly concerned with the education of their sons, who would one day attain the highest offices of the Republic,¹³⁹ and, as gathered from the 1511 edition, Fausto was entrusted by the Trevisan family with the education of their son Andrea.¹⁴⁰ The Greek epigram, four couplets of iambs written in Doric dialect, is signed by Fausto as Νικήτα ὁ Φάύσος (*sic*), and includes Andrea Trevisan's Latin translation (*metaphrasis*), which reads as follows:

Everybody knows what (Ovid) Naso says in his verses, regardless if they tell the plain truth or are inspired by the prophetic flutes: 'So long as the servant deceives the master, and the severe father forces his son to starve far from home, and the outrageous procuress feeds the little birds in the woods, or the prostitute ties the charming heart of her lover, Menander will not die.' Fate, although rough and careless, spares no one; for nothing is granted to us this day, either with the consent of the Nemesis, or by chance. Nonetheless, our dear Terentius, by mocking those Greek comedies, preserved from the jaws of fate and from the hands of time what once made him laugh.¹⁴¹

¹³⁸ Concina (1984, 5, 7, 53, and 208, n. 46) identified Andrea Trevisan of the *libellus* with Andrea Trevisan *el cavalier* son of Tommaso, who, in 1516 became the Chief Magistrate (*podestà*) of Brescia. This hypothesis has to be rejected since Andrea Trevisan *el cavalier* was born in 1458 (Key and Bucholz, 2009, 16), and, therefore, he could not have been an adolescent in 1511. More likely, Andrea Trevisan has to be identified with Andrea Trevisan, son of Michele, who was born in 1497 and, thus, in 1511, he was 14 years old. He was enrolled in the Golden Ballot in 1517, at age 20; see ASVe, Avogaria di Comun, Balla d'Oro, reg. 165-IV, fol. 363v.

¹³⁹ The Venetian historian Francesco Sansovino, in his *L'avvocato*, reported that, at the beginning of the sixteenth century, the Trevisan family even built a miniature model of the speaker's stand (*renga*) that was in the Senate, and that their sons practiced their rhetorical skills in front of their friends; see Venice, BNM, OLD 3729: Sansovino 1554, 15b.

¹⁴⁰ The richest patricians educated their sons at home; see: Freschot 1709: 260.

¹⁴¹ Fausto 1511a, 1a: *Nasonis illud omnibus iam cognitum/ id habuit in se: quod vel ipsa veritas,/ vel flexa phoebi praecinentis carmina./ Dum servuus herum fallit, immitis pater/ gnatum peregre coget obfamescere,/ numisque ocellos lena pascet improba/ scortum ve amantis cor ligabit blandulum,/ Menandros ille suavis usque vixerit./ Nam dura quamvis sors, et ulli parcere/ nescia dies hunc ad nihil redegerit/ Nemesi volente, vel vicissitudine,/ hic noster attamen bonus Terentius,/ postquam hasce graecis sustulisset fabulas,/ ab fauce sortis atque temporis manu/ adseruit olim quidquid ille luserat.*

The *vis comica* of this short poem reveals a wonderful sense of humor and was a playful way for Fausto to gain his pupil's sympathy and interest in learning. Despite the fact that Fausto signed the Greek epigram, he did not compose it, but rather he simply supervised it. In the *libellus*, Fausto claimed that the Greek epigram was authored by his pupil Andrea. Under Fausto's guidance, Andrea was reading the comedies by Terence and Menander—Fausto used his *libellus* as a guidebook—and Fausto expanded on the topic by including the verses from Ovid's *Amores*: *Dum fallax servus, durus pater, inproba lena vivent et meretrix blanda, Menandros erit.*¹⁴² After reading Ovid's hexameters, Fausto assigned Andrea the exercise of writing a Greek poem focusing on the verses, to give his pupil "an opportunity to compose very beautiful iambs."¹⁴³ In order to complement the exercise, Fausto assigned Andrea the task of translating the Greek poem into Latin. The composition of a Greek poem with its corresponding Latin translation was one of the assignments carried out during the lessons in Italian humanistic schools. The translation from Greek to Latin, and vice versa, was a common exercise performed by students, since it provided them with a homogeneous background in ancient literature and civilization, and allowed them to improve their vocabulary by comparing the morphology and the syntax of both languages.¹⁴⁴ In teaching Greek, Fausto asserted that the indirect method is most useful, since the students, by comparing the two languages, can more easily learn the meaning of Greek verbs and the rules of Greek grammar and syntax, even if they were not particularly gifted with a good

¹⁴² Ovid, *Amores*, 1.15.17-18.

¹⁴³ Fausto 1511a, *De comoedia libellus*, 5a: *tibi pulcherrimos condendi iambos dedisse ansam.*

¹⁴⁴ Ciccolella 2008, 149.

memory.¹⁴⁵ Moreover, Ovid and Terence—the latter had a prominent educational role in the Renaissance Veneto for his moral content—were part of a well-established “canon” of Latin authors for intermediate students.¹⁴⁶ The Greek poem written by Andrea Trevisan reveals a good mastery of the language and proves that he had an advanced knowledge of both Greek and Latin.

Fausto’s pedagogical program, which he expounded in his second oration, was largely inspired by Quintilian and Varro. Following Quintilian, Fausto divided grammatical studies into two parts: *gramaticae methodice* or *horistiche*, consisting of the theoretical part of grammar, and *gramaticae exhegetice* or *historice*, concerning the interpretation of authors and the rules for correct speaking and writing (*ratio recte loquendi et scribendi*).¹⁴⁷ Fausto, given his position as a lecturer of Greek, devoted a lengthy discussion on the *ratio recte loquendi*. Adopting Varro’s four-part division of grammar, Fausto claimed that an effective teacher lecturing in public should excel in the *lectio* (reading aloud), *enarratio* (explanation), *emendatio* (textual criticism), and *iudicium* (literary judgment).¹⁴⁸ “Reading aloud,” Fausto wrote, “is not something that everybody can do.”¹⁴⁹ According to Fausto, the oral performance involved much more than the accuracy in expression, punctuation, and accent (*actio oratoria*). A fundamental component in the *lectio* was, for Fausto, the *actio scenica*, a theatrical ability to play

¹⁴⁵ Fausto 1551, *Oratio tertia*, 55a.

¹⁴⁶ Besides Ovid and Terentius, the list of Latin authors suggested for intermediary students comprised Cicero, Lucan, Seneca, Martial, Juvenal, Sallust, and others. See: Ciccolella 2008, 69-73. Whilst Terentius was part of the Latin curriculum since the medieval period, more lascivious texts, such as the *Amores* by Ovid, were added in the fifteenth century; see: Black 2001, 247.

¹⁴⁷ Fausto 1551, *Oratio secunda*, 21a.

¹⁴⁸ Fausto 1551, *Oratio secunda*, 22a.

¹⁴⁹ Fausto 1551, *Oratio secunda*, 22a: *lectionem non omnis hominis esse*.

different roles by changing inflection and tone. The exposition of the textual content and the explanation of its obscure passages (*enarratio*) was essential, especially when reading poetry. Fausto urged students to pay particular attention to difficult words and to explain the text section by section, repeating content from the beginning if necessary. In the *enarratio*, Fausto advocated a complete knowledge of history and mythology, and, for this reason, a teacher with a good memory was preferable. The *emendatio* encompassed not only textual criticism, but also the correction of the language, as “there are several errors embedded in books, either for the inaccuracy of printers, for unfavorable circumstances (in the transmission of the text) over the years, or for the boldness of some pretentious teacher.”¹⁵⁰ The first three stages—*lectio*, *enarratio*, and *emendatio*—were functional to *iudicium*, which Fausto considered the most important, and consisted of the assessment of the aesthetic and literary value of a work.

For Fausto the Greek lectureship required a great commitment and effort on his part. He compared the *magister* to a *remigis*, the helmsman of a ship:

Who could ever deny that the teacher is like the helmsman who is in charge of controlling a ship? (The helmsman), only after he has retracted the steering oar onto the boat, can sleep peacefully and safely. Often he runs from the highest point of the stern up to the bow, sometimes exhorting some sailors and reprimanding others; he exerts so much effort that he wears himself out at times; at night, he gazes at the sky and observes the winds and the weather; he is so experienced that he can predict dangerous circumstances. So, if the honor is great, also the effort that is required is great.¹⁵¹

¹⁵⁰ Fausto 1551, *Oratio secunda*, 26b: *ut multi errors in libri, vel librariorum incuria, vel temporum iniquitate, vel arrogantis alicuius litteratoris temeritate inolescunt.*

¹⁵¹ Fausto 1551, *Oratio prima*, 15a: *Quis neget in navi praestare, magistrum, esse quam remigem? Sed ille brevi temporis spatio remum trahit, deinde dormit ociosus atque securus. Hic vero interdum e summa puppi ad proram usque discurret, et nautas modo hortatur, modo castigat, tanta contentione, ut latera quandoque deficiant. Noctu coelum contemplatur, ventos ac tempestates observat. Natura enim*

In 1520, two years after Fausto was appointed to the Greek lectureship, “some men, driven by envy and ill-will,”¹⁵² secretly dropped an anonymous accusation against him into the Lion’s Mouth.¹⁵³ The *ridiculum et falsum crimen* consisted of several charges: Fausto was accused of leaving the lectureship unattended for extended periods, that his lectures were poorly attended and little appreciated, and that he was not completely devoted to the Greek lectureship as he also attended to other matters.¹⁵⁴ In the same year, Fausto delivered a second oration, in which he rejected the accusations and asked the Venetian Senators for a raise in his salary (*Oratio qua maius stipendium petitur*). First, Fausto admitted that there were occasions when he had been unable to lecture, but only because he had fallen ill twice due to his precarious health condition. Secondly, he stated that the other matters he had attended to were the private tutoring sessions he carried out in his house, which were necessary in order to supplement the meager income (*stipendii parvitate*) he earned from his Greek lectureship. As stated by Fausto, he lived in austere condition in a humble house, always wearing the same old robe, both in summer and in winter, with a sister to marry, with no wife and no children, doomed to solitude. *O miseram sortem*, claimed Fausto.¹⁵⁵ Unfortunately, Fausto never obtained a salary raise, despite the fact that his request was not entirely unjustified, as his predecessor Marco Musuro was paid 150 ducats, whereas Fausto only received 100.

comparatum est, ut omnia contrariis aequè pensetur. Si igitur summus est honor, summos etiam labores afferat necesset est.

¹⁵² Fausto 1551, *Oratio secunda*, 20a: *Certi homines malignitate ac invidia ducti.*

¹⁵³ The Lion’s Mouth, still visible in the Hall of the Compass in the Doge’s Palace, was a repository that received secret accusations, usually at night, against criminals.

¹⁵⁴ For Fausto’s charges, see Fausto 1551, *Oratio secunda*, 20a, 23a-b, 27b, and in particular 31a-36b.

¹⁵⁵ Fausto 1551, *Oratio secunda*, 19b-20b, and 29b-30a; ASVe, Consiglio di Dieci, Parti Comuni, filza 27, document attached to document 257.

Although Fausto's meager income was not commensurate with the burden imposed by the Greek lectureship, during his life he enjoyed an honorable reputation, both in Venice and throughout Europe. The Venetian historian Marin Sanuto the Younger (1466-1536), who often attended Fausto's lectures in Terranova, asserted that Fausto was extremely fluent in Greek.¹⁵⁶ Giovan Giacomo Leonardi (1498-1562), ambassador in Venice for the Duke of Urbino, recorded in his *Principe cavaliere* his regret for the premature death of his friend Fausto, "a man extremely knowledgeable in Greek and Latin."¹⁵⁷ The French ambassador in Venice, Lazare de Baïf, in a letter addressed to the King Francis I dated 6 February 1530, wrote that Fausto "was a man very learned, both in Greek and in Latin."¹⁵⁸ The King of England Henry VIII, who wrote a letter to the Council of Ten on 2 March 1530, praised Venice as one of the most illustrious Italian cities for the many brilliant men excelling in the study of the letters, among whom he included Vettor Fausto.¹⁵⁹ The Spanish ambassador in Venice, in a letter to Charles V written in 1530, praised Fausto for being "a man of great knowledge, both in Latin and in Greek."¹⁶⁰ The Italian poet Ludovico Ariosto (1474-1533) dedicated to Fausto a verse in his 1532 revised edition of the *Orlando Furioso*, "Rejoices Vettor Fausto, and so does Tancred, to see me again."¹⁶¹ Paolo Ramusio indeed wrote the truth when he claimed that "Fausto was held in great honor and prestige, not only by the

¹⁵⁶ Sanuto, XXVI, col. 52.

¹⁵⁷ Pesaro, Biblioteca Oliveriana, Ms. 218, fol. 4r: *uomo di gran litteratura greca et latina*.

¹⁵⁸ Paris, BNP, Ms. Fr. 3941, fol. 82r: *il est homme bien sçavant, tant en grec que en latin*.

¹⁵⁹ Pocock 1870, 1: 510.

¹⁶⁰ Simancas, AGS, Catalogo XXVI, Papeles de Estado, Venecia, 1308, fols. 2r-3v.

¹⁶¹ Venice, BNM, Rari 0440: Ariosto 1532, canto 46, 19.

(Venetian) senators and the entire city (of Venice), but also by all the (European) princes and kings.”¹⁶²

Yet the most sincere homage to Fausto as a teacher of Greek is paid not by a foreign ambassador or by a famous humanist, but by one of his students, Gerolamo Muzio (1496-1576). In his *Letters* addressed to his friend Vincenzo Fedeli (ca. 1496-ca. 1565), Muzio recalled with nostalgia the period of their youth during which they befriended each other while attending the School of Saint Mark. “Together,” wrote Muzio to Fedeli “we started studying the letters in our juvenile years, and together we attended the lectures by Regio, Egnazio, and Fausto.”¹⁶³

The Proposal of Building the Quinquereme

On the afternoon of 15 August 1525, Fausto was admitted to the Ducal Palace for an audience with the Doge Andrea Gritti. Fausto proposed to the Venetian Republic constructing a quinquereme that he himself designed. Unfortunately, none of Fausto’s drawings have survived, and the only recorded reference to this is in *I Diarii* by the Venetian historian Marin Sanuto. Sanuto narrated the circumstances of the event as follows: “Vetor (*sic*) Fausto, who is lecturing in Greek in this city, came to the Doge, and showed a wonderful model for building a galley that was rowed with five oars per

¹⁶² Fausto 1551, *Dedicatio*, 4b-5a: *in summo honore atque autoritate non solum apud patres et universam civitatem, sed apud omnes principes ac reges fuit Faustus.*

¹⁶³ Venice, BNM, D 007D 266: Muzio 1551, *Dedicatio*, 2b: *Che noi da giovenile età insieme demmo opera à gli studij delle lettere, insieme fummo uditori del Regio, et appresso dell’Egnatio, et del Fausto.*

bench, while the light galley is rowed with only three [oars], and he showed the rowing system. Thus, the decision was entrusted to the College.”¹⁶⁴

For the maritime history of Venice, Fausto represents uniqueness, as he was the first and the only humanist in Venice who was interested in naval architecture and who proposed to the Republic a project for building a special ship. Despite the fact that Fausto could rely on the support and protection of influential politicians, his proposal did not receive immediate acceptance; the Senators discussed Fausto’s proposal for nearly a year.

On 17 September 1525, the Senators and the Doge held a meeting to discuss Fausto’s proposal.¹⁶⁵ However, the Venetian senators invited to the meeting the Patrons of the Arsenal and the master shipbuilders of the galleys who were encouraged to participate in the discussion regarding the technical aspects of the quinquereme. Sanuto wrote that “...the Doge and the Senators met in the saloon of the College where proposals are presented with the participation of the Sages, and they evaluated the model of the five-oared galley designed by Vetor Fausto, who lectures in Greek in this city, at Terranova, with public salary. There were also Lunardo Emo, Superintendent of the Arsenal, and Antonio da Pexaro, Patron [of the Arsenal], since the others were not in Venice; [there were also] Lunardo and Mathio Brexan, and other master shipbuilders of

¹⁶⁴ Sanuto, XXXIX, col. 322: *Vene dal Serenissimo Vetor Fausto leze in greco in questa terra, e monstrò uno bellissimo modello di far una galia qual vogerà 5 remi per bano, che le sotil vuoga solum 3, et qui monstrò il modo; sichè lo rimesse ad aldirlo in Collegio.*

¹⁶⁵ Sanuto, XXXIX, col. 440. The correct date is 17 September 1525, and not 7 September, as given in Concina 1990, 67, n. 16.

the galleys in the Arsenal, and they discussed for a long time...[Lunardo] Brexan praised [the model], whilst [Mathio] Brexan condemned it.”¹⁶⁶

The debate about the technical aspects of the quinquereme, and especially about the rowing system, was highly pitched. The Senate was inclined to believe the opinion of Lunardo Brexan (1498-1540), a skilled shipwright. Toward the end of the fifteenth century he had built heavy *barze* of 1,200 tons, the first of the great round ships that sailed from the Venetian Arsenal for military purposes.¹⁶⁷ However, on 23 September 1525, a few days after the meeting with the naval architecture experts of the Arsenal, the Senate deliberated a proposal in favor of Fausto’s project of building a quinquereme:

Our faithful Venetian *dominus* Vetor (*sic*) Fausto has been here, in our presence, and he had presented a model of a quinquereme, which is rowed by five oars per bench, and it has been examined and discussed by our master shipbuilders from the Arsenal. It would be beneficial to have in our Arsenal a ship for the safety of our overseas dominions, such as that of the quinquereme, and [it would be beneficial] also to hire the above mentioned *dominus* Vetor for our service. On the authority of this Council, it is proposed that the Superintends and the Patrons of the Arsenal provide [Fausto] with a ship-shed in which to build the above mentioned quinquereme, and with all the necessities in order to accomplish it. Furthermore, [it is proposed] that our ambassador in Rome ask the Blessed Pope to satisfy our request of 500 ducats of income for the above mentioned *dominus* Vetor (*sic*) as a favor from the Knights of Rhodes, since he had no such income. Moreover, in the event that this request is accepted, the above mentioned Vetor Fausto is bound to produce the rowing system of the quinquereme and to demonstrate it to the Superintends and Patrons of the Arsenal, and to the master shipbuilders. Once the quinquereme is approved by our experts, [Fausto] can start building his quinquereme and complete it. Furthermore, it is proposed that, while *dominus* Vetor (*sic*) is waiting for the above mentioned benefit, he will have for his sustenance the yearly amount of 100 ducats, which he no longer will be given upon receiving the above mentioned income. These provisions will be effective from the day in which the above mentioned quinquereme is

¹⁶⁶ Sanuto, XXXIX, col. 440: [...] *il Serenissimo con la Signoria si ridusse in Collegio in sala dove s fa il Pregadi con i Savii, et veteno il modello di la galia di 5 remi fatto per Vetor fausto, leze in greco in questa terra in Terranova a salario pubblivo. Era etiam sier Lunardo Emo proveditor a l’Arsenal e sier Antonio da Pexaro patron, perchè li altri è andati fuora; Lunardo e Mathio Brexan e altri prothi di galie di l’Arsenal, e quì fo parlato assai...Brexan laudava et...Brexan biasemava.*

¹⁶⁷ Lane 1992, 50.

completed, fully armed, and shown that the rowing system works, upon which it will be praised and approved. Finally, *dominus* Vetor (*sic*) will be allowed to carry arms and to hire a guard for his safety and protection, as he has rightly requested.¹⁶⁸

The Senate voted twice on this deliberation. Of the 25 Senators present at the Council, 16 voted in favor (*de parte*), eight voted against Fausto's proposal (*de non*), and one voted *non sinceri*, literally "not sincere," meaning that the Senator was not able to make an educated vote, or abstained. Unfortunately, the deliberation failed since Venetian legislation required a senatorial decree to secure three quarters of the votes for approval. Basically, the majority of the Senators favored Fausto, but the decree did not pass for being one vote short.

On 17 January 1526, the Senators invited Fausto to speak a second time. Sanuto recorded that Fausto talked for a long time praising his quinquereme. He claimed that it would be "the mistress of the seas" for its seaworthiness and for the great advantage and prestige that the Republic would gain from its construction.¹⁶⁹ But among the senators, skepticism and dubiousness that a man of letters could succeed in building a ship had been spread by the incredulous shipwrights.

The master shipbuilders' main concern was the *alla sensile* rowing system of the quinquereme. It consisted of five rowers per bench, each with an oar. From the end of the thirteenth century to the middle of the sixteenth century the standard Venetian galleys were triremes (light galleys), developed from the Byzantine bireme in 1290.¹⁷⁰

¹⁶⁸ ASVe, Consiglio di Dieci, Parti secrete, reg. 1, fol. 31r. See: APPENDIX I, doc. 1.

¹⁶⁹ Sanuto, XL, col. 123.

¹⁷⁰ Sanuto the Elder (from Torcello) 1411, 57.

The triremes were single-banked ships with 25 or 30 benches on either side and three rowers per bench, each pulling a separate oar.¹⁷¹ The benches (or thwarts) were arranged obliquely to form an acute angle with the longitudinal gangway (or *corsia*) of the ship, so that the inboard extremity of each bench was positioned farther toward the bow than the outboard end. Thus, the three rowers, sitting on the same bench and each pulling his own oar, did not interfere with one another during rowing. Baldissera Quintio Drachio, in his *Vision* (1594), referred to a light galley with 24 benches, each arranged obliquely (*sbiasso*) towards the bow by 28 *dita*, that is to say 60.85 cm.¹⁷²

Cristoforo da Canal, in his *Della militia marittima*, notes that “[...] the *pianero* is longer than the other two [oars], and it is 32 *piedi* long and pulled by the rower who sits closest to the gangway; the second oar is the *posticcio*, it is 30 ½ *piedi* long, and pulled by the rower who sits in the middle of the bench; the third oar, which we call *terzicchio*, or named *terzarolo* by Westerners, and the rower who pulls it is called by the same name, is 29 ½ *piedi* long. All three oars are arranged in order and run outboard parallel to one another, and they are slightly different in length.”¹⁷³ Thus, the *pianero* was 11.12 m long, the *posticcio* 10.60 m long, and the *terzicchio* 10.25 m long.

¹⁷¹ Jal 1848, 749 and 752; Fincati 1881, 22.

¹⁷² Baldissera Quintio Drachio, *Visione*, in ASVe, Archivio Proprio Contarini, env. 2. The description and the construction rules (*ragioni fabricatorie*) of light galleys are in fols. 5v-13v. The mention of the benches is in folio 11r. The manuscript has been transcribed and translated by Theodore Lehmann (1992).

¹⁷³ Cristoforo da Canal, *Della militia marittima*, book 1: [...] *il pianero, maggiore degli altri due, cioè di lunghezza di piedi trentadue, et è quello che vuoga il galeotto che siede a canto alla corsia, il secondo chiamato il posticcio di lunghezza di trenta e mezzo, et è vogato da quel galeotto che siede per ordine secondo al banco, et il terzo, che noi terzicchio et i ponentini terzarolo chiamano, et così è detto parimenti il galeotto che lo tira, di lunghezza di piedi ventinove e mezzo, i quali tutti e tre sono anco dalla parte di fuori con giusto ordine assettati et si veggono apparire secondo le loro lunghezze l'uno alquanto più lungo dell'altro*. In: Nani Mocenigo 1930, 79. *Della Milizia marittima* is a dialogue among Vincenzo Capello, Alessandro Contarini (Venetian sea captains and experts on naval affairs), and Marc'Antonio

According to the historian Marin Sanuto the Elder of Torcello (1260-1343), the Venetian galley, or trireme, evolved from a one-decked bireme.¹⁷⁴ Sanuto recorded that

In 1290, almost all the galleys that sailed over the sea were rowed by two rowers per bench: but after some ingenious men experimented that three oarsmen could have rowed on each of the above mentioned [bench], now almost all the galleys are rowed by this system. For this reason, no one should believe that it would be [too] heavy to add a fourth oar or even a fifth oar on a single bench of a galley, regardless of the size of the galley, after it has been proved [that the rowing system works]. Indeed, it is mentioned in some literary sources that, in ancient times, the Romans had three rowers pulling [each oar]. Vegetius, in his *De re militari*, where he talks about naval warfare, said that, in ancient times, some ships, which he called *liburnae*, had a single level of rowers; those ships that were slightly bigger had two levels of oars; some others, which were accordingly designed, had three, or four, or even five levels of oars.¹⁷⁵

Although ancient texts on naval warfare such as *De re militari* by the Late Roman writer Vegetius mention multi-banked galleys, during the Renaissance the oars of the Mediterranean warship were arranged on a single level. In Venice, both the light galley and the great galley were single-banked ships. Neither the latter nor the former were

Corner, and Giacomo Canale, two important politicians. The above citation is by Capello. The date of this manuscript has been variously reported; Nani Mocenigo (1930) dated it to 1540, Tenenti (1962) suggested 1553/54 and is more likely correct, and Zeno (1662) proposed an earlier date, 1538. See Hale 1980, 3: 281.

¹⁷⁴ Concina (1990, 53) asserts without documentations that the Venetian galley evolved from the Byzantine bireme, that is to say, the dromon. Presumably Concina is citing Sanuto the Elder discussed below. It should be pointed out, however, that the Byzantine dromon was a two-banked ship and that the Venetian galley is a single-banked vessel, with its oars running on an outrigger beam (*correnti*) unlike the dromon, which did not have an outrigger. Pryor (2006, 423) asserts that the Venetian galley evolved from the monoreme dromon. See also Pryor 1995, 101-16.

¹⁷⁵ Sanuto Torsello 1411, V.33-44: *In MCCXC anno Domini, quasi in omnibus galeis quae transfretabant per mare, duo in banco remiges remigabant: postmodum perspicaciores homines, cognoverunt quod tres possent remigare remiges superquodlibet praedictorum, quasi omnes ad praesens hoc utuntur. Ob quod nemini debet videri grave, ponere remiges quatuor vel quinque, pro banco quodlibet magnarum cuiuslibet galearum, postquam probatum est. Nam bene invenitur in scriptis, quoniam antiquo tempore Romanorum tres pro banco quolibet erant remiges remigantes. Reperitur etiam in Vegetio de re militari, ubi ipse tractat de navali bello, quod quaedam navigia quae Liburnas appellat, antiquo tempore remorum signulos ordines habuisse; paulo vero maiora binos; alia vero idoneae mensurae, ternos vel quaternos ac quinos etiam sortiebantur remigio gradus.* Vegetius's interpretation of the four or five levels of oars is incorrect, as the highest number of banks used on ancient galleys did not exceed three. Hence, four and five actually refer to the total numbers of rowers on either side on a vertical section.

rowed by more than three oars per bench. Thus, the project proposed by Vettor Fausto of building a quinquereme rowed by five rowers on a single bench, each pulling a separate oar, must have appeared revolutionary, if not visionary. For this reason, the Senators left any decisions concerning the construction of the quinquereme pending and resolved not to vote for an official decree.

In order to realize his “Greek dream,” however, Fausto did not resign and accept the Senate’s indecision. On 23 May 1526 Fausto again presented before the Senators of the Council of Ten. He read his request (*supplica*) for building his quinquereme reported as follows:

Most Serene Doge,

Since I, Vettor (*sic*) Fausto, see that your affairs are such that they do not permit you either to solve my case or to vote in my favor, as it has been promised to me, I believe it would not be inconvenient if I remind by this speech I wrote to Your Sublimity and to the most Excellent Lords [of this Council] my request. Consider, please, that it is almost seven years since I have returned to this city, and I was extremely pleased to be appointed professor of Greek, even though I received only half of the salary I could have received from the Lucchesi and from the Ragusans, as it is indicated in public documents. But I was willing to show to Your Sublimity all the knowledge I gained after many labors, perils, and hard work all over the world. Indeed, I became acquainted with several seamen of different countries, namely Catalans, Provencales, Normans, Biscaynes, Genoese, and others; and I have visited several maritime cities in Spain, France, Italy, and in other [countries], and I have spoken with many Sea Captains, among which were Piero Navarro, Pier Jam Bassà, the Gobbo from Dalmatia, and Doria; and I have spoken with the master shipbuilders of Naples, Genoa, and Pisa; and, therefore, I found out that the quinquereme, which was the great and fast galley that the Romans used in naval warfare, would be the mistress of the sea and it would defeat any other ship, since it is extremely seaworthy and could withstand any sort of weather. Thus, I myself designed the quinquereme according to the measurements I found in the most ancient Greek texts, and, successively, I came before this Council and presented my project to you, most Excellent Lords, and to the master shipbuilders of the Arsenal. I clearly stated that my quinquereme could have carried one cannon of more than 15 *miara*, in addition to the smaller ones, and that, at the bow, it could have hurled a 100 *libbre* iron [ball], which would be easily capable of sinking any armed ship. Furthermore, since my quinquereme would be quite huge, it could be laid at anchor offshore together with the other large ships. Moreover, my quinquereme would be a great advantage during naval warfare: thanks to its design and to the number of oars, it would sail as fast as the light galleys. I assert that my quinquereme will have all these features and will confirm this claim. Indeed, [also] the

master shipbuilders of the Arsenal of Your Sublimity, after they carefully evaluated the proportions of my quinquereme, said that the ship would confirm the above mentioned claims and it would be fast, when provided with the rowing system I have designed consisting of the [five] oars pulled together at the same time. However, [the master shipbuilders] said that they are unable to build and to set in motion [the rowing system] of my quinquereme. Therefore, I proposed to build it on my own, so that I could demonstrate how the fifth oar [on a quinquereme] would row better than the third [oar on a trireme] does at the present [on the other galleys], on condition that Your Sublimity would ask the Pope – since my quinquereme would be beneficial to all the Christian world – to provide me with a salary of 500 ducats from the Confraternity [of the Knights] of Rhodes, and, in the meantime, Your Sublimity would provide me with an income of 150 ducats per year. Although Your Sublimity and the most Excellent Lords appeared to promptly approve my project, nonetheless any judgment has not been pronounced so far. However, since I know that Your Sublimity has the intention to build new warships in order to defeat the Western corsairs, and has in mind to build a new fleet regardless of the expenses, I present again my quinquereme that will confirm all the above claims, which, neither light galleys (*galee sottili*), small galleys (*galeotte*), great galleys (*galee grosse*), nor large galleys (*galee bastarde*) can achieve, as they cannot sail with the wind. And I assert that I will demonstrate the rowing system, in which five men pulling the oars together at the same time would row better than the three men on light galleys. In the case my quinquereme will not be approved by the expert [master ship builders], and in case Your Sublimity will not experience the truth of what I am asserting, then, I will forego any reward. To set things straight, since the construction of the hull of my quinquereme involves great expenses, Your Sublimity should provide me with a great galley from his Arsenal, so that I may arrange on it the rowing system according to its cargo capacity based on the height of the depth in the hold. So, Your Sublimity will see the great advantage of my quinquereme, although not yet built, but still Your Sublimity will realize, either way, what the final result of one of my quinqueremes would be when completely realized with all its proportions. Then, Your Sublimity will decide, at his discretion, whether I deserve a reward or not, based on my innovations, which, I hope, will be wonderful and great. These are, Most Serene Doge and Excellent Lords, the things that a humble servant has been trying to acquaint himself with all over the world, thanks also to the ancient Greek and Roman texts. And now I offer to Your Sublimity my knowledge, which will confer to this rich city great prestige, benefit, and safety. It should not be that you, Excellent Lords, who are considered the wisest all over the world and the most expert in naval warfare, despise me, such a humble servant, and disregard my project, since very few quinqueremes would suffice to ruin any enemy's fleet. Therefore, with great deference, I request what I am asking will be fulfilled, and that one of my servants and I be allowed to carry arms, for the reasons that Your Sublimity well knows.¹⁷⁶

Fausto's proposal of testing the rowing system first on a great galley must have motivated the Lords of the Council to reexamine Fausto's project. With the official

¹⁷⁶ ASVe, Consiglio di Dieci, Parti segrete, fold. 1, folios not numbered. On the reverse: *Supplica del Fausto* ("Request by Fausto"). See APPENDIX I, doc. 2.

decree dated to 23 May 1526, the members of the Council of Ten decided “...that the request *dominus* Vettor Fausto has just read for building a quinquereme has to be examined by the Council of the *Pregadi* in order to vote on Fausto’s petition, excepting the request of carrying arms, which is not under our authority.”¹⁷⁷

On 30 July 1526 the Council again discussed Fausto’s request. A few weeks later on 22 September 1526 the proposal of building a quinquereme finally arrived in the hands of the Venetian senators.¹⁷⁸ A document from the Correr Museum from the end of the sixteenth century recorded that “many master shipbuilders were opposed to the proposal of the audacious shipbuilder, but the senator Bernardo Navagero spoke in favor of Fausto at the presence of the members of the Senate and supported him against his detractors.”¹⁷⁹ Finally, the Senate accepted and approved Fausto’s request:

The [members] of this Council have listened to the proposal of building a quinquereme by our humble servant Vettor Fausto. Our master shipbuilders have examined carefully the design [of the ship] and it has been approved. However, there is still some doubt concerning its rowing system which inevitably has to be tested prior to its construction. If the rowing system is successful, it would greatly increase both the good reputation and the safety of our city. Therefore, it has been decided that the above mentioned Vettor has to come before this Council and demonstrate the oar mechanics of his quinquereme in the presence of the Most Serene Doge and the experts to be selected by the members of the Council. In the event the rowing system is proven to work, the Patrons of our Arsenal will immediately have to provide him with a shipshed, which has to be locked up in order to permit entrance only to the shipwrights selected to build the quinquereme. Moreover, [it has been decided] to provide Fausto with all the necessities, such as workers, wood, and supplies he will need in order to build his quinquereme without further delay. Conversely, if the Council realizes that the [demonstration of the] rowing

¹⁷⁷ ASVe, Consiglio di Dieci, Parti segrete, reg. 1, fol. 62r. See APPENDIX I, doc. 3. The Council of the *Pregadi*, or Senate, which was established in 1229, consisted of Venetian Senators who were requested (*pregadi*) to deliberate on matters of foreign politics and everyday matters.

¹⁷⁸ ASVe, Consiglio di Dieci, Parti comuni, fold. 2, fol. 51v; Patroni e Provveditori all’Arsenal, fold. 7, fol. 64r; Collegio, Notatorio, reg. 7, fol. 93r.

¹⁷⁹ BCVe, Ms. Gradenigo 170, fol. 66r: *Alcuni protti dell’arsenale furono contrarii al valoroso fabbricatore, la il senatore Bernardo Navagero diffese il Fausto nel Senato e prese la protezione di lui a fronte degli avversari.*

system is not doable, then a great galley (*galia bastarda*) from our Arsenal should be allocated to Fausto, so that he can adapt the oars on this great galley and demonstrate the rowing system he invented. The Patrons [of the Arsenal] have to provide him, therefore, with all the necessities Fausto asks, in order to avoid any delay in the construction. Once the rowing system [on the great galley] is proven to work and to be effective, then, a ship-shed to build the quinquereme should be immediately assigned to Fausto. In order to properly reward his work, which is so important for the reputation of our State, it has been decided that [Fausto] will receive his reward.¹⁸⁰

A practical demonstration of how “...the five men pulling the oars together at the same time would row better than three men on the light galleys...”¹⁸¹ was the *conditio sine qua non* for the construction of the quinquereme. Unfortunately, records about the circumstances of the demonstration of the rowing system do not exist and it remains unknown whether Fausto ever adapted five oars to the hull of a great galley. Nevertheless, it seems that Fausto convinced the master shipbuilders of the Arsenal. Indeed, a few weeks later in October 1526 Fausto – the famous lecturer of Thucydides, Aristophanes, Pindar and Hesiod – started the construction of his quinquereme, working alongside shipwrights in the Arsenal.¹⁸² The construction of the quinquereme in the Venetian Arsenal lasted almost three years. Likely, the ship-shed assigned to Fausto was

¹⁸⁰ Sanuto, XLII, col. 765 and 766: *Questo Conseio ha inteso per la suplication hora lecta, quanto il fidelissimo nostro domino Vetor Fausto promette di far circa la galia quinquereme, il modello di la qual essendo stà visto per li protti nostri et aprobatò, resta in dubio solum la voga, et essendo omnino necessario de vederla, che reuscendo saria de grandissima reputation et securtà del Stato nostro, però: l'anderà parte che'l prefato domino Vetor debbi venir in Collegio presente il Serenissimo Principe et quelli pratici che parerà al ditto Collegio, et mostrar la voga de la ditta quinquereme; et essendo qualla aprobatò come reussibile, siano obligati li Patroni a l'Arsenal nostri deputadi a far la ditta quinquereme, et darli ogni possibile et celere expeditione, sì de maistranza, legname come de ogni altra cosa che li accaderà per il compir di la ditta galia, senza interposition de tempo. Quando veramente al Collegio nostro la voga monstrata non paresse reussibile, in questo caso li sia data una galia bastarda di l'Arsenal nostro sopra la qual ditto domino Vetor habbi a monstrar la voga, conzada la ditta galia a suo modo, et siano obligati li ditti Patroni darli similetr ogni possibile expeditione de quando el ditto li richiederà; et reuscendo la ditta voga, li sia consegnato il volto per far immediate la ditta galia ut supra.*

¹⁸¹ ASVe, Consiglio di Dieci, Parti secrete, reg. 1, folios not numbered (see APPENDIX I, doc. 2).

¹⁸² Sanuto, XXVI, col. 52, 107, 127; XXXVII, col. 195. See also: Degli Agostini 1754, 2: 448-72.

located in the *Arsenale Novissimo*, “the most recent area” added to the existing Arsenal in 1475.¹⁸³ The construction of the hull of the quinquereme and its upper structures was completed in the first days of 1529. On the morning of 11 January 1529,

The Most Serene Doge, wearing a garment of velvet and a coat on his shoulders, went to the Arsenal, together with all the members of the College, about ten Procurators, and ten other Senators who were in saint Mark’s square and had been invited, among whom were *sier* Andrea Mudazo and *sier* Piero Lando, who were the Superintends of the Arsenal. [The Most Serene Doge] made his entrance through the New Arsenal, and there he saw the ships (*barze*) that were being built, one of which was almost completed. He also saw the quinquereme built by Vettor Fausto, who was there and explained all the shipbuilding sequence, and stated that it was accomplished.¹⁸⁴

The construction of the quinquereme completely absorbed Vettor Fausto. Moreover, considering that Fausto was not a skilled shipwright, building a ship for the first time *ex novo* would have been a demanding task. In a long letter written to his friend Giovan Battista Ramusio, and dated to 13 September 1530, Fausto compared the days of his intense work at the Arsenal to Heracles’ descent into the Underworld:

I have arrived at the place where the Venetians build their ships, which is almost like Acheron. And I came there through a difficult and abysmal path, though a cave with huge and pointed stones hanging from the ceiling where there is constantly the thick darkness of Hades, as the poet said with slightly different words. When the past year, with hard work, I achieved the same fame that Hercules achieved – if I may compare myself to the ancients – at the moment when he arrived in Hades. Hercules, however, was at least accompanied by Theseus, who helped him to escape the jaws of the terrible Cerberus, and eventually [Hercules] succeeded in returning to world to see light again. I, instead, was completely left alone, and although I do not owe

¹⁸³ On the Arsenal of Venice, see the studies by Concina 1984; 1991a; and also Aymard 1987-407-18.

¹⁸⁴ Sanuto, XLIX, col. 357: *A dì 11, la mattina. El Serenissimo vestito di veludo cremesin et di sopra un manto aperto su le spalle, con il Collegio tutto, et procuratori zerca 10, et altri 10 senatori vicini a San Marco mandati a invidar, et tra li altri sier Andrea Mudazo et sier Piero Lando provedadori a l’Arsenal, anoe con li piati a l’Arsenal et intrò per l’Arsenal nuovo: vide le barze si fa, una de le qual è quasi compita; vete la galia quinqueremi qual ha fatto far Vettor Fausto, el qual era lì et diceva le opration sue et esser reussita.*

anything to anyone, no one helped me, and I had to fight alone against the ignorance and the ill will of Cerberus, so to speak.¹⁸⁵

Fausto's metaphor not only likens his hard work to that of the labors of Hercules but, most of all it is an explicit reference to "the ignorance and the ill will" of the conservative, Venetian master shipbuilders who employed traditional shipbuilding practices.

Remarkably, Fausto's quinquereme became famous even before it was launched. On 31 March 1526 Giovanni Contarini, known as *Cazadiavoli* ("Devil Chaser"), wrote a letter from the harbor of Trani to Lunardo Emo, the Superintendent of the Arsenal. In the letter, Contarini "asked to send [to Trani] the quinquereme that had been built by Vettor Fausto in the Arsenal, and said that, sailing onboard the quinquereme, he could achieve great deeds, and defeat four galleys of Andrea Doria."¹⁸⁶ However, the quinquereme remained unarmed and yet to be outfitted. Less than a month later, on 28 April 1526, "...in the Arsenal, it was launched. The quinquereme had been built by Vettor Fausto, who designed it and who is [also] a professor of Greek [...], however, most of the people believe that [the quinquereme] would be a failure. They said that on 6 May, on the day

¹⁸⁵ Fausto, 1530 (Letter to Giovan Battista Ramusio): *Adsum adque advenio Acheronte vix via alta atque ardua, per speluncas saxi structas asperis, pendentibus, maximis, ubi rigida constat crassa caligo inferum, ut ait poëta haec enim, paucis immutatis, Veneto navali convenient: ubi anno superiori, mango meo cum labore, talem sum denique visus gloriam assequi, qualem, si priscis licet nostra componere et Hercules olim ad inferis reportavit siquidem ille, non tamen Theseo, Cerberum, ab orchid faucibus abstractum, coelo atque huic luci ostendit, unus ego, nemine adiuvante, imo utinam non mulris eorum, qui minime debuissent, contra nitenti, tot ab invitis, ut ita dicam, Cerberis ignorationem quondam cum malignitate coniunctam avulse.* In: Weber 1894, 79-80.

¹⁸⁶ Sanuto, L, col. 147: *Fu letto una lettera di sier Zuan Contarini, Cazadiavoli sopraditto, proveditor di l'armata, di Trani, di ultimo, scritta a sier Lunardo Emo el consier. Supplica li sia mandà la galia quinqueremes fatta far per Vettor Fausto in l'Arsenal, con la qual promette far gran cose e prendere 4 galie di Andrea Doria.*

of the *Sensa* Feast, [the quinquereme] will take part in the parade on the Canal together with the Bucentaur.¹⁸⁷ Apparently, however, the quinquereme did not take part in this important Venetian festivity, for it was not yet ready.

The first official ceremony occurred on 21 May 1526. The historian Sanuto, who was present at the parade and saw the quinquereme from Saint Anthony, on the Lido di Jesolo, between Venice and Chioggia, recorded the following:

This morning, the quinquereme was launched in the Arsenal; [onboard] there were the rowers of the ferry-boats, and *sier* Alvise Sagredo, Patron of the Arsenal, was the captain. [The quinquereme] sailed up to Chioggia, as if it was vaulting [...] It was armed with its full load of artillery to make it steady on the water, and it had also a culverin weighting...on the bow, the captain was *sier* Alsive Sagredo, Patron of the Arsenal, and Vettor Fausto, who designed the ship, was the admiral...there was also the crew...the quinquereme was escorted by the galley of *sier* Agustin da Mula, who had been the Proveditor to the Fleet, and, together with the noblemen, [the quinquereme] sailed up to Saint Anthony, where I was standing and had the occasion to admire it. I saw that the rowers were rowing together in unison, and then the ship saluted Saint Anthony three times, as it was the custom, and then it turned and sailed back very fast, and arrived at Saint George Major, and, there, it also saluted, and then it arrived in front of Saint Mark.¹⁸⁸

Among the crew there were the professional rowers in the galley of Francesco Bondumier, "...who just arrived in Venice from Istria, and he wants a new galley, and

¹⁸⁷ Sanuto, L, col. 227: *in l'Arsenal, fo varato la galia quinqueremes, fata per Vettor Fausto, leze in greco, zoè datoli il sesto [...] ma per iudicio de la più parte non reuscirà. Se dice il Zuoba di la Sensa, che sarà a dì 6 Mazo, sarà vogata per canal insieme con il bucintoro.*

¹⁸⁸ Sanuto, L, col. 345 and 346: *A dì 21, la marina. In questa matina, la galia quinquereme trata di l'Arsenal con li homeni de trageti, capitano sier alvise Sagredo patron a l'Arsenal per condurla a Chioza, andò voltizando [...] la galia quinquereme ussita de l'Arsenal, carga de artellarie aziò l'habi el suo peso, con una colubrina de...a prova, capitano sier alvise Sagredo patron a l'Arsenal, armirao l'autor di essa Vettor Fausto, comito...et con la zurma,...si levò de dove l'era sorta, con la coperta di la galia de sier Agustin da Mula fo proveditor in armada, e con li nobeli, et vene vogando fino a Santo Antonio, dove io era et la vidi vogar tutti a un tempo et ben, per quanto si potè veder, et salutato tre volte Santo Antonio, justa el consueto, la voltò et ritornò a segonda de aqua et de vento molto velocemente, et andò a San Zorzi Mazor, et salutò etiam li et per mezo San Marco.*

his crew temporarily went aboard the quinquereme.”¹⁸⁹ Amid general skepticism, the quinquereme had been launched, but the Doge and the Superintendents and Patrons of the Arsenal were still concerned about its speed. Therefore, it was decided to test the quinquereme in a race with a light galley, and to determine whether the great size and heavy armament compromised the claimed qualities of the quinquereme. The race against the light galley *Cornera* was held on 23 May off of the island of Lido, just two days after the quinquereme’s launching in the Canal. Sanuto wrote an enthusiastic report celebrating Fausto for this revival of Greek science:

After lunch, since today was the day fixed for testing the rowing system of the quinquereme, the latter, together with the light galley under captain *sier* Marco Corner, son of *sier* Piero from Saint Marguerite, sailed toward Malamoco, the starting point [of the race] from where they would have begun the race, rowing against one another to see who would have been the faster. Therefore, after vespers His Serenity invited all the ambassadors, except those from Urbino and Mantua, and with their boats and accompanied by many nobles, among which was *sier* Vettor Morexini, they went to the castle called New Castle,¹⁹⁰ where seats had been prepared under a cover from the sun. And there were an infinite number of boats outside the two castles¹⁹¹ and throughout the Canal...and many people from Padua and from Chioggia aboard many ships, and today some gondolas have been paid eight or ten *lire* just to see such a thing. I saw many ladies in boats, and the Procurators, and finally the Most Reverend Cardinal Pisani with the Archbishop of Nicosia and with D. Lippomano from Padua. Now, at the fixed hour, when the signal was given, the said galleys came rowing, racing one against the other, and in front rowed the [light galley] *Cornera*, but when they had almost arrived at the castles, the quinquereme was on the outside, and the *Cornera* hugged the land so close that the quinquereme passed it in front of His Serenity and so came ahead, rowing as far as Saint Mark, with so many boats in the Canal, and sails of large barks and fishing boats that it seemed like an armada. It was most beautiful to see. This quinquereme has great power in its oars, but the benches are a little more angled compared to those of the other light galleys, so that Vettor Fausto, the author who designed it, will be immortal.¹⁹²

¹⁸⁹ Sanuto, L, col. 343: *Gionse la galia soracomito sier Francesco Bondimier in questa terra hozi, la qual era in Istria, venuto a cambiar la galia, et la zurma si adopererà sopra la galia quinquereme.*

¹⁹⁰ *Castel Nuovo* (New Castle) is also known as the Castle of Saint Andrew. It was built as part of the defenses on the Lido islands.

¹⁹¹ The second castle was the Castle of Saint Nicolas, which is also known as the Old Castle (*Castel Vecchio*).

¹⁹² Sanuto, L, col. 363: *Dapoi disnar, per esser zorno deputato a veder vogar la galia quinqueremes, la qual questa matina insieme con la galia soracomito sier Marco Corner, quondam sier Piero da Santa*

The race between the quinquereme and the galley *Cornera* is echoed in a letter dated 29 May 1529, which was written by Pietro Bembo (1470-1547) and addressed to Giovan Battista Ramusio (1485-1557):¹⁹³

I was extremely glad to read the good news you wrote me in your past exultant and joyful letter about the success and victory of our Fausto, and about his quinquereme that has been recovered from ancient times and that won the race against the trireme, at the presence of the Most Serene Prince of the Senate, and the entire city of Venice. I received this news last night [...] I first read [the letter in which you wrote] that the two ships were racing at the same height, sailing in front of the Doge, and that the trireme sometimes passed the quinquereme a little. Then I read your second letter in which you told how Fausto, standing in the middle of the quinquereme, encouraged his rowers to show their virtue, and that, in doing so, he passed the trireme that seemed [immobile] as a rock so quickly that it seemed to everybody a marvelous thing [to see]. I was exulted with happiness you gave me with this news. My happiness doubled in my soul when, slightly later, I read that the Doge, who was hoping that that Fausto would win, was not able to retain his tears from happiness when he saw that his wish came true [...] Oh, my dear Fausto, how happy you must have been when such a high personality [the Doge], so old and affected by infirmity, cried for he was deeply touched by your victory.¹⁹⁴

Margherita andò verso Malamoco, per venir poi a hore 19, con l'acqua a seconda, insieme vogando, per veder chi voga più presto. Et però poi vespero il Serenissimo, invitato gli oratori tutti, excepto Urbin et Mantoa, con li piati et zentilhomini molti, tra li qual sier Vetor Morexini, andoe al castel, chiamato Castel nuovo, dove fu preparato da sentar con tapezarie er coperto per il sol, et barche infinite poi fuora di do castelli et per canal; fo stimato da barche numero...et fino barche di Padoa con persone dentro, di Chioza una infinità di barche, et tal gondola è sta pagata per hozi lire 8 in 10, solum per veder tal cossa. Donne assai in barche, et procuratori, et fino con l'arziepiscopo di Nicosia Podacataro in barcheta con D. Lippomano primocerio di Padoa. Hor ditte galie e l'hora deputata, trato un signal, veneno vogando a regata una di l'altra, et prima vogava la Cornara, ma zonti quasi a li Castelli, la quinqueremes era di sora, et pense tanto la Cornera a terra che la passò davanti il Serenissimo, et cussì vene avanti vogando fino a San Marco, con tante barche per canal et velle di barche grosse state in pielago che pareva una armata. Fo bellissimo veder. Questa galia quinquereme ha la sua vuoga ma è poco avanti di le altre galie sotil; sichè Vetor Fausto, autor di darli il sesto, sarà immortal. Et dapoi, venuta la Signoria a San Marco, ditta galia cinqueremi vene vogando per canal grandando fino a la chà Foscari, dove la zirò, ma con grandissima faica per esser longa passa 28, è più che passa tre più di le sotil. Et era grandissimo numero di barche per canal grandando, tra le qual io vi fui, et durò la festa fino sera.

¹⁹³ Giovan Battista Ramusio is the father of Paolo Ramusio, who, in 1551, published Fausto's *Orationes quinque*.

¹⁹⁴ Bembo, letter n. 975: *M'avete rallegrato con le vostre lettere scritte mi dell'onorato successo e vittoria del nostro Fausto, e della sua a questo secolo nuova gaea cinquereme avuta in contesa pubblica con quella degli tre in presenza del Serenissimo Principe e del Senato, e in fine della città tutta, le quali io ieri a notte ricevevi [...] quando io, letta quella parte, dove dite le galee esser venute quasi per infino alla presenza del Principe di pari corso, ed alle volte a trireme aver passato la cinquereme d'alcun poco*

The Naval Career of Fausto's Quinquereme

After launching, Fausto's quinquereme was immediately sent to Greece to protect Venice's overseas dominions (*dominio da mar*). On 29 June 1529, the Proveditor to the Fleet Michiel Morosini spoke in front of the senators about the urgency of reorganizing the Venetian fleet since the Holy Roman Emperor was approaching with his navy to the coasts of France.¹⁹⁵ Morosini exhorted the Council to finance, to the sum of 15,000 ducats, the Venetian fleet that had just left sailing toward Greece.¹⁹⁶ The Sages of the Council, at first reluctant to devote such a huge amount of money to naval warfare, immediately agreed with Morosini's proposal when they received news that "the Emperor arrived in Monaco, which is dangerously close to Genoa. Thus, in accordance with the Council, yesterday, we have already sent the quinquereme to the Captain of Sea, and we have sent him a letter."¹⁹⁷

Gerolamo da Ca' Pesaro was elected Admiral of the Fleet on 10 June 1529. He was an experienced seafarer and had previously been Captain of the Flanders galleys. The Sages of the Council established that Gerolamo da Ca' Pesaro had to outfit five light galleys, whose commanders (*soracomiti*) would have been *sier* Zuan Francesco Donado,

spazio, lessi poi quell'altra che segue, dove narrate che il Fausto, messosi per lo mezzo della galea inanimava i suoi galeotti a mostrar la loro virtù, e che egli allora in un punto passò la trireme non altrimenti che se ella fosse stata uno scoglio con tanta velocità che parve a ciascuno cosa meravigliosa, io non potei tenere la voce dalla dolcezza che mi recò quella lettura. La qual dolcezza poi più abbondevolmente ancora mi si raddoppiò nell'animo, quando io poco dappoi lessi che il Principe, il quale dubitava che il Fausto perdesse vedendo quel fine non ritenne due lacrime dalla molta gioia che egli ne sentì. In: Travi, 1992, 3: 45.

¹⁹⁵ Sanuto, L, col. 568.

¹⁹⁶ ASVe, Senato mar, reg. 21, fol. 141v.

¹⁹⁷ Sanuto, LI, col. 286: *Fu posto, per i Savi tutti, una lettera al Capitano zeneral di mar. Come havendo hauto nova del zonzer di l'imperador a Monaco vicino Zenoa, però col Senato li scrivemo haver expedito heri la galia quinquereme.*

sier Almorò Barbaro, *sier* David Bembo, *sier* Zuan Battista Zorzi, and *sier* Bernardo Sagredo.¹⁹⁸ However, given the serious threat of Charles V stationing in France, the Great Council added seven more commanders to those already elected.¹⁹⁹

On 18 June 1529 the Senate urged Gerolamo da Ca' Pesaro to leave immediately with his fleet, "since we received the news that [Andrea] Doria, who is at the service of Caesar, sailed from Genoa to Barcelona with his galleys and ships. Therefore, we should expect that His Majesty will arrive in Italy soon, and we have to be prepared for this eventuality."²⁰⁰ The Venetian fleet's departure was fixed for the 27 of June. A few days before, on 24 June, the Senate elected Gerolamo da Canal, previously the Captain of the Gulf, as the Captain of the quinquereme.²⁰¹ The Senate, given the urgency of the situation, decreed at the very last moment, "without filing any formal request [to the Council], [...] that also Gerolamo da Canal, captain of the quinquereme, would have left soon."²⁰²

The historian Sanuto described the preparations of the expedition. On 26 June "the galley [of Gerolamo da Ca' Pesaro] was brought to Saint Mark in order to gild its poop, and during the previous night, by means of huge rollers, the galley was pulled up on shallow waters and put on land. The galley was adorned with flags, and had a

¹⁹⁸ Sanuto, LI, col. 462 and 464.

¹⁹⁹ Sanuto, LI, col. 464 and 483.

²⁰⁰ ASVe, Senato Mar, reg. 21, fol. 141v; Sanuto, LI, col. 506.

²⁰¹ Sanuto, L, col. 544 and 545.

²⁰² Sanuto, L, col. 560: *Et etiam, senza meter altra parte per il Collegio, fo terminà che sier Hironimo da Canal, governador de la quinqueremi, etiam lui mettesse banco.*

beautiful lantern and other [decorations], as was the custom.”²⁰³ Sanuto also described the departure ceremony. On the morning of 27 June the Admiral Gerolamo da Ca’ Pesaro accompanied by the Doge, the Senators, noblemen, the procurators, the foreign ambassadors living in Venice, and the commanders of the light galleys, gathered in the church of Saint Mark for the solemn mass and blessing of the banner depicting the lion of the patron of the Republic of Venice. However, “the captain of the quinquereme, while the mass continued, left the church and went to set the benches (*metter banco*) to his galley, accompanied by *sier* Michiel Morosini and *sier* Zuan Moro, Proveditors of the fleet, and by the other commanders, and then, he went back to the mass.”²⁰⁴ Evidently, Gerolamo da Canal wanted to leave with the Venetian fleet and “...he wanted to arm and outfit [the quinquereme] now, but the hemp to make the ropes had not yet arrived, and it should have on 20 July.”²⁰⁵

The quinquereme, however, was further delayed in its departure and left on 1 August 1529. That morning, the quinquereme slowly left the Arsenal and arrived at the Bridge of the Straw (*ponte de la Paia*), next to the Doge’s Palace, where the enlistment of the rowers would take place. The presence in Venice of a group of Spanish refugees from Istria was providential. The College immediately enlisted them among the rowers

²⁰³ Sanuto, L, col. 560: *La sua galia, del capitano, heri fu condotta a San Marco, non compito ancora di indorare la pope et, per il seco, tutta questa notte con burchiele fu cavato aziò la potesse arivar, etiam levarse, per li gran sechi fa la matina. La qual galia era adornata di bandiere, fanò bello et altro, justa il consueto.* It is noteworthy that the Admiral’s galley, in 1529, was carrying a single lantern, meaning that the use of three lanterns was a later practice.

²⁰⁴ Sanuto, L, col. 561: *Digandose la messa, sier Hironimo da Canal governador di la quinqueremi, in mezo di sier Michiel Morexini et sier Zuan Moro proveditori sora l’armar, acompagnato da procuratori, tutti li soracomiti, andò a meter banco, poi tornò in chixia.*

²⁰⁵ Sanuto, L, col. 566: *El qual Canal voria armar adesso [...] perchè non è li canevi zonti, nè saranno fino 20 lujo, da far corde.*

of the quinquereme.²⁰⁶ It seems that one of the main problems of the quinquereme was gathering 280 oarsmen needed to fill the 28 benches running on either side of the ship.²⁰⁷ Around mid-August, Gerolamo da Canal departed from Venice. On 10 September 1529, while sailing along the coast of Dalmatia, he wrote a letter to the Senate complaining that “he was not able to find enough rowers (*interzare*), he could not find available men, and that he had only one hundred men, and he needed [more].”²⁰⁸ On 19 November the quinquereme arrived in the harbor of Corfu, where it joined the Venetian fleet of the Admiral Gerolamo da Ca’ Pesaro.²⁰⁹ The Admiral in charge of faithfully reporting to the Venetian Senate all important matters pertaining to the naval expedition wrote a letter to the Senate saying that the quinquereme needed forty more rowers.²¹⁰

In the meantime, at the request of the Senate, Fausto had built two more quinqueremes in the Arsenal of Venice. The two new ships, named *Zorzi* and *Bemba*, were sent to join the fleet of Gerolamo da Ca’ Pesaro. They were assigned to Zuan Battista Zorzi and to David Bembo, respectively.²¹¹ Both arrived in Corfu towards the end of November, slightly after the quinquereme of Gerolamo da Canal. The Admiral recorded in his letter to the Senate that *Bemba* was missing ten rowers.²¹²

²⁰⁶ Sanuto, LI, col. 222.

²⁰⁷ As recorded in the manuscript *Misure di vascelli* (fol. , the quinquereme consisted of 29 benches on either side; however, one bench was removed on the portside in order to accommodate the ship’s boats, and one bench was removed on the starboard in order to accommodate the ship’s galley (or kitchen).

²⁰⁸ Sanuto, LI, col. 516: *Come non pol interzar la galia, non trova homini, ha solum 100, et ne bisogna...*

²⁰⁹ Sanuto, LII, col. 346.

²¹⁰ Sanuto, LII, col. 346.

²¹¹ Sanuto, LI, col. 286. In Venice, ships were referred to by the last name of their captains in the feminine form.

²¹² Sanuto, LII, col. 346.

Soon afterwards the Senate ordered Admiral Gerolamo da Ca' Pesaro to return to Venice and disarm the galleys, "except those that were in Cyprus, that is to say [the quinquereme] of the Captain Gerolamo da Canal, and ten galleys."²¹³ At the same time, the Senate allowed the Captain to transfer to his quinquereme the rowers from the ten light galleys that were also in Cyprus. The Senate's decision to recall and disarm the fleet resulted from the peace concluded on 14 October 1529 by Suleiman I and the Holy Roman Empire.²¹⁴

News of the peace arrived in Venice on 29 December, when the Ottoman ambassador docked his ship in front of Saint Mark's square and was welcomed by Venetian noblemen and former *bailo* to the Sublime Porte. On the same day, the Senate ratified the peace treaty and ordered the Venetian fleet to return to Venice, leaving the quinquereme behind in Cyprus.²¹⁵ This decision flamed discussion amongst the senators and did not meet the approval of a group of patricians, who wanted to keep in Cyprus "the new and well-designed galleys" that had been recently armed at the Arsenal.²¹⁶ Therefore, the Senate decreed that ten light galleys had to remain in service in Cyprus in order to better protect the Republic's *Stato da mar*.²¹⁷

From the senatorial decree, we learn that the oarsmen of the ten light galleys, if needed, could have served on board the quinquereme. However, during the first days of January 1530, Captain Gerolamo da Canal sailed to Cephalonia where he enlisted 60

²¹³ Sanuto, LII, col. 393: *Exceto do sono in Cipro, il governor di la quinquereme, con 10 galie.*

²¹⁴ ASVe, Senato Mar, reg. 21, fol. 161v.

²¹⁵ Sanuto (LII, col. 100-102) provides a list of all the Venetian galleys, with their corresponding captains who came back to Venice, or were about to, in order to be disarmed.

²¹⁶ Sanuto, LII, col. 393.

²¹⁷ Sanuto, LII, col. 393.

fresh rowers to address the shortage of man power aboard the quinquereme. On 17 January 1530, from the islet of Hydra (Saronic Islands), Gerolamo wrote a long letter to the Signory, praising the technical features of his quinquereme:

Most Serene Prince,

I did not write earlier to you about the excellent quality of the quinquereme both because you had no doubt about it, and also because I recently joined the Venetian fleet [in Greece]. I assert that the quinquereme is different from the light galley; however, I experienced that the quinquereme has perfect sails, both at the stern and toward the bow, it is seaworthy and, as far as its speed, very few galleys could race with it. When I armed and outfitted the quinquereme, as Your Serenity knows, since there were 49 galleys that were operative on the sea, I thought it would have been better if I enlisted Greek rowers, and recently, I have hired 60 Greeks. Of course, Most Serene Prince, if the quinquereme had a crew of expert and professional rowers, very few galleys or none would be faster than the quinquereme. Moreover, I suggest to Your Serenity with reverence that vessels like the quinquereme should not be operating all the time, but only in case of challenging naval warfare. Moreover, Your Serenity, although I am not an expert on naval warfare, I acknowledge that the quinquereme is the best vessel ever built that is able to defeat any fleet of light galleys. Assuming that you arm ten quinqueremes and place them in front of your fleet of light galleys, I am sure that the quinqueremes would stop any enemy attack and would not permit them to damage the galleys. As I told you, Your Serenity, I am not an expert on naval warfare; however, few captains who are in service of the Venetian fleet fought in as many naval battles as I did. I would like to recommend to You that it would be extremely convenient to build 10 quinqueremes, and you must make sure that these vessels will be ready for use in the future. Surely, this type of vessels cannot be afforded all the time, given both its reputation and its expense. Nonetheless, I wanted to write to You these few words about the quinquereme, as good servants who are in charge of important matters of the Republic are required to do. Your Serenity, then, who is very wise, will decide as he pleases.²¹⁸

²¹⁸ Sanuto, LII, col. 594-595: *Serenissimo Principe, se fin hora non li ho significato particolarmente di quanta bontà sia questa quinquereme, la causa è stata ei non esser inquietato, nè manco havermi trovato fra galie. Non li dico che la quinquereme sempre si pol metter nel numero de galie sottil, et sappia certo Vostra Serenità che la vela è perfettissima, sì in puppa come de l'asta, bonissima marinera, et del remo poche galie li anderano avanti. Ancora che io l'habbia armata, come è noto a Vostra Serenità, da poi che era fora 49 galie da Venetia che ho convenuto tuor homeni grezi et ultimamente ho tolto a Cephalonia homini 60 grezissimi, certo, Serenissimo Principe, se questa galia havesse una zurma pratica, over che questa fusse assuefata, certo o poche o niuna galia de l'armata li andaria davanti. Et, parlando cum ogni reverentia, i navili de questa sorte non sono da tenir fuora salvo che in tempo de gran fatione; et sapia certo Vostra Serenità, per quel poco giudicio che io ho di le cose naval, io non cognosco legni che più facile sia a fermar una armata de galie sotil che la quinquereme; che havendone, ne le teste de una armata de galie sotil, 10 quinquereme, io non credo che navili da remo li potesse offender. Et ben confesso a Vostra Serenità io saper poco; ma quella sia certa che pochi nostri pur si hanno trovato in tanti lochi dove le armate di Vostra Serenità hanno fatto fation, quanto io vostro servitor. Ben li aricordo cum ogni reverentia, che 'l non saria se non a proposito che Vostra Sublimità ne facesse far 10; et la sia certa che a qualche bisogno de importantia le torneriano a gran comodo de le cose de Vostra Sublimità. Ben è vero che non sono navili da tenir de continuo, sì per la reputation che etiam per la spesa. Io ho*

A few months later, Gerolamo da Canal renewed to the Doge his suggestion of providing the Venetian fleet with ten more quinqueremes. In a letter addressed to the Council on 9 March 1530, Gerolamo da Canal reaffirmed the superiority of quinqueremes over light galleys. As confirmation for this, he asserted that he had defeated some galleys of French privateers.²¹⁹ Indeed, Cristoforo da Canal, the nephew of Gerolamo, in his *Della milizia marittima*, recalled that Gerolamo da Canal had engaged in a naval battle with the Barbary corsair Bessaguli in waters around *Cao Ducato* (also known in archival sources as Santa Maura, or modern Lefkada, Albania). Gerolamo had won a crushing victory: "...[Gerolamo da Canal], when he was the Captain of the quinquereme, by means of that galley alone, fought for five hours against three galleys of the corsair Bassaguli from Barbary, who had captured two Venetian galleys off Cape Ducato and was about to run away. But he [Gerolamo da Canal], not only defeated him [Bassaguli], but also killed everybody on board and, without reporting any damage for his part, saved the two Venetian galleys."²²⁰

Ten days later, Gerolamo da Canal incurred a misfortune, "...while sailing in the direction of Crete, there was such a terrible weather for 14 consecutive days that it was impossible to even cover the ship with its awning, and, as a result, many of the crew almost lost their feet from the cold. *Sier* Piero da Canal, son of *sier* Jacoino, a relative of

voluto cum ogni reverentia dir queste poche parole a quella, come fanno li boni servitori che hanno cargo de le cose de Vostra Sublimità, la qual è sapientissima et farà quanto li parerà a proposito.

²¹⁹ Sanuto, LIII, col. 18.

²²⁰ Cristoforo da Canal, book 1: *Essendo egli Governatore della galera di cinque remi, con quella sola galera per spatio di cinque hore combatté con tre galere di Bassaguli corsale di Barbaria, il quale aveva preso sopra cao Ducato due delle nostre galere et via se le menava. Egli non solamente lo vinse, ma tagliò a pezzi quanti erano sopra quelle e con niuno o poco danno dei suoi, le due perse recuperò.* In: Tenenti 1962, 58, n. 86.

Gerolamo da Canal who was onboard [of the quinquereme], died.”²²¹ On 9 May 1530, while still in Crete, Gerolamo da Canal suffered more losses, and wrote to the Signory that “...many men aboard the quinquereme had died, and others...could not be paid. He asked for more to be sent to pay the members of the crew, so that those miserable persons can sustain themselves, since they have no means of financing themselves, etc.”²²² This pitiful image recalls what Baldissera Quintio Drachio wrote about Fausto’s quinquereme in his *Visione* at the end of the 16th century, “...it was not order, but confusion; it was a hospital and a lazaret, or better, it was a spectacle of death.”²²³

Despite this misfortune the quinquereme continued to succeed against the enemy. On 9 July 1530, the quinquereme sunk two fustas belonging to Maltese corsairs, and Gerolamo da Canal wrote to the Senate indicating that he had captured a privateer’s ship.²²⁴ A week later, the quinquereme arrived at the harbor of *Capo Malio* (modern Malea promontory, Laconia), to await new instructions from Venice, since the Proveditor of the fleet, Alessandro da Ca’ Pesaro, had just died.²²⁵ In Venice, the Senators were discussing the issue of the vacant Admiralty position, mostly because “...it is not proper to leave galleys that are at sea without a commander.”²²⁶ Therefore, the Sage of the Council proposed to elect *ad interim* either Gerolamo da Canal or

²²¹ Sanuto, LIII, col. 118: *Adeo 14 zorni continui mai havia potuto butar la tenda per galia, sichè le povere zurme haveano quasi perso li piedi da fredo. Item, è morto sier Piero da Canal quondam sier Jacoino, era suo nobile.*

²²² Sanuto, LIII, col. 194: *È morti assà homeni di la galia, et altri...per non esser pagati, et si mandi danari per dar sovenzion, aziò quei meschini possano viver; lui non ha el modo de sovenirli, etc.*

²²³ Baldissera Quintio Drachio, *Visione*, in ASVe, Archivio Proprio Contarini, env. 25, fol. 13r: *Non fu ordene, ma confusione, et fu un hospital, et uno lazareto, anzi uno spettacolo di morte.* The lazaret was a hospital for those affected with contagious diseases, especially leprosy.

²²⁴ Sanuto, LIII, col. 337.

²²⁵ Sanuto, LIII, col. 349.

²²⁶ Sanuto, LIII, col. 352: *Non è da lassar le galie, sono fuora, senza governo.*

Vincenzo Giustinian, who was the Captain of the *bastarde* or grand galley.²²⁷ The Senators approved and appointed Gerolamo da Canal to the position, and the greatly disappointed Vincenzo Giustinian filed his complaints about the Council's decision.²²⁸

Thus, Gerolamo da Canal advanced in his career after having fought and defeated many enemy ships and proved himself an expert and qualified captain of the quinquereme. However, the Senate ordered that he had to serve aboard the galley of Alessandro da Ca' Pesaro. Thus, the senators decreed that the quinquereme, after eleven months of honorable service in the Venetian fleet, had to return to Venice.²²⁹

In the long letter that Gerolamo da Canal wrote to the Signory on 17 January 1530, he had greatly praised the quinquereme and approved the technical innovations and the work of Vettor Fausto. It was not by chance that on 8 October 1530, a few months after the return of the quinquereme to Venice, the Council passed a decree to establish a chair of mathematics at the School of Saint Mark: "...the [Venetian] youth should learn [...] both the liberal arts, which are those that are most useful to men, and those arts that are called mathematical, which have yet to be studied because we do not yet have a lecturer. Therefore, it is established that we should appoint a lecturer in mathematics who will teach the public."²³⁰ Just three years after the return of the

²²⁷ Sanuto, LIII, col. 352.

²²⁸ Sanuto, LIII, col. 382, and 396.

²²⁹ Sanuto, LIII, col. 353.

²³⁰ ASVe, Senato terra, reg. 26, fol. 55r: *La gioventù se instruisce [...] delle arte liberal quelle sopra tutte deveno esser cercate che sono più certe esser maggior commodo al viver humano, come sono quelle che se chiameno le mathematiche, delle qual non vedendosi frutto altro perchè in tal necessaria arte non si legge, si deve convenientemente dar modo che sia publice letto in ditta arte.* The lecturer appointed to the newly established chair of mathematics was Giovanbattista Memo, with a salary of one hundred ducats (ASVe, Senato terra, reg. 26, fol. 103r).

quinquereme to Venice and the establishment of the first chair of mathematics, Jacopo Sadoletto published in Venice *De pueris recte instruendis* (“On the good education of children”). Sadoletto stated that “arithmetic and geometry afford wonderful pleasure to the mind,” and he related mathematics to Greek *paideia*:

These liberal arts are parts of that one great body, Philosophy. The mathematical sciences, whether because they train the mind to solitary speculation, or because they, in themselves, are parts of philosophy, must be learned, at any rate in some measure by those who aim at gaining knowledge of philosophy [...] And the student should draw his information on geometry and astronomy from Greek writers, for the Latin treatises are confusing.²³¹

After the restoration of Greek science in Venetian naval architecture by Vettor Fausto, mathematical sciences became part of *the* humanist culture. Thus, Fausto was not simply a scholar who wasted his knowledge on “vile mechanical arts,” but rather the champion of Venetian *virtus*. Most of all, for the master shipbuilders of the Arsenal, he was *el gran Fausto*, “the great Fausto.”²³² Vettor Fausto had triumphed!

²³¹ Sadoletto 1737-1738, 3. 117, and 124; in: Rose, 1976, 12. On Sadoletto, see: Douglas 1959. On Venetian humanists devoted to the study of mathematics, see Rose 1969, 191-242.

²³² Baldissera Quintio Drachio, *Visione*, in ASVe, Archivio Proprio Contarini, env. 25, fol. 14v.

CHAPTER III

THE *MARINA ARCHITECTURA*

Introduction

According to Fausto, his *marina architectura*—naval architecture based on theoretical knowledge applied to shipbuilding practice—aimed to restore in the shipyard the ancient principles, just as they had been restored in terrestrial architecture.¹ In a letter to his friend, the humanist Giovan Battista Ramusio, Fausto claimed that naval architecture had to be based on *litterae et disciplinae*, the “knowledge” which came from the study of ancient works, the “erudite letters.”² Indeed, Fausto stated:

Architecture, above all, needs to be based on knowledge. Vitruvius said that architecture relies very little on craftsman’s practice; Archimedes said that it requires such a deep knowledge that it is impossible to write an exhaustive essay about it. If learning terrestrial architecture is truly very difficult, what might we say about naval architecture in which each part (of the ship) is defined not by straight lines—which can be easily calculated—but by constantly varying curved lines?³

¹ The phrase *marina architectura* is used by Vettor Fausto in his letter of 13 September 1530 addressed to Giovan Battista Ramusio (Weber 1894, 128-33). For a general view of the concept of architecture during the Renaissance, see Kristeller 1951, 166-89; Mandosio 1998, 643-704; and Schiavone (2003, 117-72), who discusses the negative attitude of Classical theorists towards mechanical arts. In this regard, see the brilliant article by Altieri Biagi 1965, 1-12, who discusses the evolution of the terms “mechanical” and “mechanics” from antiquity to modern times.

² Weber 1894, 130. The letter is dated to 13 September 1530. For a discussion of the letter, see below, and also Concina 1987a, 23-8.

³ Letter to G. B. Ramusio (13 September 1530): *Imo vero nihil usquam est, quod maiorem literarum pene omnium cognitionem requirat quam architecturae profession, quipped cuius rurimam partem, que fabrili peritia continentur, Vitruvius esse contendat: Archimedes autem, tam multiplicis esse solertiae, ut ne scribe quidem de ea ad plenam posse existimet. Ac, si terrestrium aedificiarum difficilis admodum est architectura cognitio: quid de marina illa dicam, ubi non rectis lineis, qua facilis sere ratio est, set curvis, atque iis subinde variantibus, extruenda sunt omnia?* See also Weber 1894, 130. In his letter, Fausto also recalls Demetrius Poliorcetes, who not only armed and fitted his fleet, but also built it by his own hand, Plut. *Demetrius*, 20. For a discussion of the letter, see Concina 1987a, 23-8.

According to Fausto, “naval architecture” does not require mere *fabrilis peritia*, “craftsman’s practice,” but rather *architecturae professio*, “the science of architecture,” based on a shipbuilding principle that emanates from knowledge of Greek and Latin texts.⁴

During the Italian Renaissance, humanists like Fausto rediscovered the value of the Classical tradition and of Greek and Latin writers such as Vitruvius, Livy, Plato, and Cicero, who had previously fallen into obscurity.⁵ The rebirth, or renaissance, of the Classical world and its ideas produced a cultural and scientific revolution *ante litteram* that led medieval man into the Renaissance, which reached its highest achievement with the scientist Galileo Galilei.⁶ In Venice, interest in Greek and Roman tradition stimulated a radical advancement in many fields, from art and literature to philosophy and architecture. Due to Fausto’s work in the Arsenal, the influence of Classical culture effected great changes even in the traditional, empirical practices employed in shipbuilding.⁷ The significance of Fausto’s role lies precisely in that he was the *first* naval architect who had ever worked in the Arsenal, all the more remarkable considering he had no previous shipbuilding experience. As a result, Fausto marked the distinction between the shipwright who built ships empirically by means of his expertise and keen eye, and the naval architect, who based his design on defined principles and methods.

⁴ Weber 1894, 131.

⁵ Starthern 2003, 81-90 and 172-97. For the revival of Latin and Greek literature in Venice, see Branca 1983; Pertusi 1980; Reynolds and Wilson 1975, 137-42; Weiss 1969 and 1977, 36-72; Wilson 1992, 124-57.

⁶ For a general overview of the Venetian Renaissance, see Butterfield 1962, 103-17; Ergang 1967, 45-56 and 111-14; Branca 1983; Tafuri 1985; Shapin 1996, 10-23 and 82-96; Grendler 1999, 176.

⁷ For Classical influence in urban planning and political structures (*renovatio urbis et imperii*), see Valeri 1958; Tafuri 1984 and 1985; Calabi and Morachiello 1987; Concina 1988a and 1989.

The *Navium Ratio*

Vettor Fausto thought that naval architecture, just like terrestrial architecture, may similarly be improved through imitating ancient architects. His purpose was to obtain from the Latin and Greek texts a new source of knowledge that would replace the obsolete and Biblical triad of *numerus*, *pondus*, and *mensura*, the heritage of medieval times.⁸ During the Renaissance, the art of shipbuilding was based on empirical procedures, which relied on shipwrights' skills and practice.⁹ Fausto's proposal to the Venetian Arsenal of a "naval architecture" purported to establish the *navium ratio*, the shipbuilding principle.¹⁰

The two most important sources that influenced Fausto's *marina architectura* were *De architectura* by the Roman Marcus Vitruvius Pollio (80/70-15 B.C.E.) and *De re aedificatoria* (1450) by the Renaissance architect Leon Battista Alberti (1404-1472). In *De architectura*, Fausto discovered the new concepts of *proportio*, *eurythmia*, and *symmetria*. Vitruvius stated that "architecture consists of order, [...] harmony, and symmetry."¹¹ The Roman architect explained that "...order is the proper balance of each part of the work separately, and, as to the whole, the relation between proportions and

⁸ In the *Book of Wisdom* of the Bible (11.21) it is written that God had ordered all things in "measure, and number, and weight." See also *Isaiah* (40.12) and *Job* (28.25). The same concept is expressed by Saint Augustine (*Conf.* 5.4.7; *De civ. D.* 5.11). See Crombie 1959, 1: 22-47; Kristeller 1974, 12-22; Lindberg 1992, 11-76; Katz 1993, 45-51; Eco 2004, 61-97. The lines from the *Book of Wisdom* are cited by Fra' Luca Pacioli in his *De divina proportione* ("On Divine Proportions," 1509). In Bruschi et al. 1978, 61 and 77.

⁹ Chiggiato 1987; Versi 1991.

¹⁰ Letter written by Fausto to Ramusio dated to 13 September 1530. In: Weber 1894, 129.

¹¹ Vitruvius, *De arch.* 1.2.1: *Architectura autem constat ex ordinatione [...] eurythmia et symmetria*. Scranton (1974) discusses the passage; Scaglia (1979) analyses Vitruvius' influence on early Renaissance architects.

symmetry.”¹² Vitruvius specified that the arrangement of proportions to obtain a symmetrical result relies on dimension, *quantitas*, which consists of taking a *modulus*, a basic unit of measure, from the work itself.¹³ The *modulus* is the foundation of Vitruvian theory of proportions and symmetry, and establishes the building method, which each architect must diligently practice.¹⁴ Vitruvius wrote that *proportio* is the balanced arrangement (*commodulatio*) of a fixed module (*ratae partis*) that has to be applied to each separate part and also to the whole.¹⁵ The *symmetria* is “...the appropriate harmony arising from the parts of the building itself and from the correspondence (*responsus*) of the fixed module (*ratae partis*),” which comes from each separate part compared with the form of the whole design (*partibusque separatim ad universae figurare speciem*).¹⁶ Therefore, the *rationis proportio* (*De arch.* 1.1.1) is the proportion, which arises from the calculation of the fixed module (*rata pars*) and could be applied to each field.

Vitruvius cited the human body as an example:

Nature indeed has so planned the human body that the face, from the chin to the top of the forehead and the roots of the hair is a tenth part; also the palm of the hand from the wrist to the top of the middle fingerbreadth is as much; the head, from the chin to the crown, is an eight part; from the top of the breast with the bottom of the neck to the roots of the hair, a sixth part [...]

¹² Vitr. *De arch.* 1.2.2: *dinatio est modica membrorum operis commoditas separatim univarseque proportionis ad symmetriam comparatio*. See also *ordo*, *positura* and *figura* in Lucr. I 685.

¹³ Vitr. *De arch.* 1.2.2: *Haec componitur ex quantitate [...] Quantitas autem est modulorum ex ipsius operis sumptio*.

¹⁴ Vitr. *De arch.* 3.1.1: *Aedium composition constat ex symmetriam, cuius rationem diligentissime architecti tenere debent*. For the Vitruvian theory of proportion and symmetry, see Di Pasquale 1996, 499.

¹⁵ Vitr. *De arch.* 3.1.1: *Proportio est ratae partis membrorum in omni opera totiusque commodulatio*.

¹⁶ Vitr. *De arch.* 1.2.4: *Item symmetria est ex ipsius operas membris conveniens consensus ex partibusque separatim ad universae figurae speciem ratae partis responsus*.

The foot is the sixth part of the height of the body, the elbow is the fourth part, likewise the breast.¹⁷

So, "...as in the human body the symmetric quality of eurhythmy comes from elbow, foot, palm, fingerbreadth and the other small parts [...] in ships (it comes from) the space between the tholes, which is called *dipechyaia*."¹⁸ Vitruvius discussed ships in the tenth book of *De architectura*, where he refers to the *symmetriarum ratiocinatio* (or "the calculation of the symmetries") applied to ship construction."¹⁹ Vitruvius stimulated Fausto's interest in studying a shipbuilding principle based on proportions that could be employed in the design of ships.

Leon Battista Alberti (1401-1472), the author of *De re aedificatoria* (ca. 1450) and initiator of the earliest excavation of Emperor Caligula's (37-41 C.E.) Nemi barges, wrote a *libellus* titled *Liber navis* (ca. 1440).²⁰ Only a few Renaissance writers knew of

¹⁷ Vitr. *De arch.* 3.1.2: *Corpus enim hominis ita natura composuit uti os capitis a mento ad frontem summa et radices imas capilli esset decimae partis. Item manus palma ab articulo ad extremum medium digitum tantudem. Caput a mento ad summum verticem, octavae. Tantundem ab cervicibus imis. Ab summo pectore ad imans radices capillorum, sextae [...]. Pes vero altitudinis corporis sextae, cubitus quartae, pectus item quartae.*

¹⁸ Vitr. *De arch.* 1.2.4. *Uti in hominis corpore e cubito, pede, palmo, digito ceterisque particulis symmetros est eurythmiae qualitas [...] navibus interscalmio, quae dipechyaia dicitur.* Lazaire de Baïf (1537, 60) noted that "...in a ship, the fixed distance between two tholes is called *interscalmium*, as Vitruvius wrote in his first book" (*A scalmo interscalmium dictum, quod est spatium inter duos scalmos designatum in ipsa navi. Qua dictione usus est Vitruvius libro primo*).

¹⁹ Vitr. *De arch.* 1. 2.4.

²⁰ Alberti 1485, *De re aed.* 5.12: *Ex navi Traiani per hos dies, dum quae scripsimus commentarer, ex lacu Nemorensi eruta, quo loci annos plus mille CCC demersa et destituta iacuerat, adverti pinum materiam et cupressum egregie durasse.* Alberti believed the Nemi ships belonged to Trajan (98-117 C.E.) and attempted raising the barges for Cardinal Prospero Colonna by roping them to floating barrels. While ingenious, this method proved unsuccessful because of extensive rotting of the ships. The instruments and machines Alberti used for the failed recovery of Caligula's ships are the same as those depicted in the *Hypnerotomachia Poliphili* (1499), whose author has now been identified as Alberti by Lefavre (1997). Alberti's interest in ships is also documented by the many drawings depicting an anchor and a dolphin symbolizing the Roman motto *festina lente*, "hasten slowly." This depiction first appeared in 1499, in the *editio princeps* of the *Hypnerotomachia Poliphili*, and, again in 1501; two years later, the Venetian printer Aldo Manuzio adopted it as his printing emblem. See Lefavre 1997, 8-43; Godwin, 1999, 69.

this now-lost naval treatise. Leonardo da Vinci (1452-1519) left a brief note on his personal sketchbook that reads, “See *de navi* by Battista [Leon Battista Alberti] and Frontino *de acquadotto*.”²¹ In his *De re nautica libellus* (“Book on Nautical Matters”), Lilio Gregorio Giraldi (1479-1552), a nobleman from Ferrara, cited the “booklet by the Florentine Leon Battista that is titled *Navis*.”²²

The most informative source about the *Liber navis* is Leon Battista Alberti himself.²³ In the fifth book of *De re aedificatoria*, he wrote: “I have already at length discussed the proportions of a ship in another work, the booklet that deals with ships.”²⁴ In the twelfth chapter of *De aedificatoria*, which is entirely devoted to ships, however, Alberti provided proportions for ships: “In a merchant ship the length has to be three times the breadth, in a light galley at least nine times.”²⁵ He also provided proportions for masts: “The length of the (main) mast has to be equal to the ship’s length over all.”²⁶

The loss of *Liber navis* is all the more deplorable as it was the first Renaissance study on proportions applied to ship design. Alberti stated that “in ship design, ancient architects were inspired by shapes of fish, so that the body corresponded to the hull, the

²¹ Richter and Pedretti 1977, 256; Mancini 1882, 280-1. Richard Barker (2007, 41), however, argued that Leonardo might not have seen the original *Liber navis*, but rather derived his knowledge of the manuscript from Alberti’s *De re aedificatoria*.

²² Giraldi 1540, 3. 15: *Libello Leonis Alberti Florentini, qui Navis inscribitur*.

²³ Such as Leonardo da Vinci, Gregorio Giraldi, Jacopo Frisio, and Bernardino Baldi. See Mariani 1941, 12, and Pedretti 2007, 125.

²⁴ Alberti 1485, *De re aed.* 5.12: *Alibi de navium rationibus in eo libello, qui navis inscribitur, profusius prosecute sumus*.

²⁵ Alberti 1485, *De re aed.* 5.12: *Onerariae longitudo velim ad latitudinem sit ne minus tripla, fugacis ne plus nonupla*.

²⁶ Alberti 1485, *De re aed.* 5.12: *Arbori atque navi aequa dabitur longitudo*.

head to the bow, the tail to the stern-rudder, the gills and the fins to the oars.”²⁷ This zoomorphic principle was a great intuition that affected naval architecture even in the following centuries. This concept can be seen in Matthew Baker’s *Fragments of Ancient English Shipwrihty* (1570s), where Baker depicted the hull of a ship mirrored as that of a fish, and in the naval treatise *Nautica mediterranea* (1601) by Bartolomeo Crescenzo.²⁸ The zoomorphic principle underlying the shape of a ship’s hull derived from the mythical *Argo*: in ancient Greek culture, *Argo* represented the first ship ever built and was modeled according to the shape of the fish *pristis*.²⁹

The significance of Alberti’s *Liber navis* and its influence on Fausto’s work can be fully appreciated in a passage from *De re aedificatoria*, where Alberti wrote that *haec nostra ratio*, the principle employed in naval architecture, “can be decisive in the victory and safety of the crew.”³⁰ He stated that the construction of a ship had to be based on *lineamenta*, the ship’s design.³¹ According to Alberti, the dangers of navigation come not only from the force of winds and waves but, most of all, from faults in the design of the ship itself (*vitia liniamenta*).³²

²⁷ Alberti 1485, *De re aed.* 5.12: *Fabricandis navibus lineamenta veteres arhitecti sumpere a piscibus, ut quod in illo dorsum, in hac fit carina, quod illi caput, huic prora; tum et pro cauda temon, etpro remis brancae et aliculae.*

²⁸ Crescenzo 1601, 9; Gibbs Smith 1978, 34. Also, Cristoforo da Canal, in his *Della milizia marittima*, compares the frames fastened to the keel to fish spines; Nani Mocenigo 1930, 64.

²⁹ Baif 1537, 32. For a description of the fish *pristis*, see Plin. *HN* 9.8; for *Pristis*, one of Aeneas’s ships, see Verg. *Aen.* 5.116; for the type of ship called *pristis*, see Nonius Marcellus 13.134.

³⁰ Alberti 1485, *De re aed.* 5.12: *Haec nostra ratio et ars aedificatoria classariis ducibus et turmis salutem pariat.*

³¹ Alberti 1485, *De re aed.* 5.12.

³² Supra n. 31.

The Vitruvian concepts of *ratio* and *modulus*—from which the English word “mold” derives—are fundamental in ship design. Both Marcus Vitruvius Pollio and Leon Battista Alberti paved the way for the field of *marina architectura*.

From *Fabrilis Peritia* to *Architecturae Professio*

The establishment of a new shipbuilding principle based on fixed proportions led to a complete separation between the shipwright, who built the ships with his hands, and the naval architect, who designed ships and supervised their construction.³³ When the Venetian Senate saw Fausto’s quinquereme design that he had drawn according to ancient proportions, they asked the *provi*, the Venetian shipwrights, to evaluate Fausto’s project. After examining the design, raising many questions, and expressing doubts, the *provi* finally admitted that they were unable to build a galley with such a complicated arrangement of oars.³⁴ Consequently, Vettor Fausto himself had to build his quinquereme in the Arsenal, and thus, a new type of shipbuilder was born: the *architectus navalis*.

Fausto was so influenced by the revival of Latin and Greek texts that he joined the *Filellenes*. The *Filellenes*, as the word itself suggests, were scholars devoted to spreading Classical culture by exchanging Greek and Latin written sources with each

³³ Concina 1990, 71-99; Basch 1998, 34; Hocker and McManamon 2006: 16.

³⁴ Sanuto, XLII, col. 765 and 766.

other.³⁵ It was in this lively cultural atmosphere that Fausto conceived his *marina architectura* based on the expertise and knowledge of the *architectus navalis*.

Vitruvius in his *De architectura* wrote that the architect's service depends upon *fabrica et ratiocinatio*, that is to say, upon craftsmanship and principles based on calculations.³⁶ Isidore of Seville (560-636 C.E.), in the nineteenth book of his *Etymologiarum liber*, combined naval architecture with terrestrial architecture. He made a distinction between the *architectus* who supervised the project (*dispositio*) and the *faber* who was responsible for its construction (*constructio*).³⁷ In the *Politicus* of Plato, the Younger Socrates said that the ἀρχιτέκτων, “the architect,” is not αὐτὸς ἐργατικός, “a workman himself,” but rather a director of workmen, ἐργατῶν ἄρχων. “Παρεχόμενος γέ που γνῶσιν ἀλλ’οὐ χειρουργίαν”—noted the Eleatic Stranger—“Because [the architect] supplies knowledge, not manual labour.”³⁸ Centuries after Plato, Alberti stated that “...the hand of the carpenter is a tool to the architect.”³⁹ In the *prohemium* of the *De re aedificatoria*, Alberti was the first during the Renaissance to assign ship design to the skill and knowledge of a naval architect.⁴⁰

Fausto spent many years visiting various Mediterranean shipyards in search of shipbuilding experience, and he talked with shipwrights of many nations, including

³⁵ Ross 1976, 521-44; Lepori 1980; Logan 1980, 104-5.

³⁶ Vitr. *De arch.* 1.1.1 : *Opera ea nascitur et fabrica et ratiocinatione.*

³⁷ Isid. *Etym.* 19.9 and 19.8: *Fabros autem sive artifices Graeci vocant, id est instructores. Architecti autem cementarii sunt, qui disponunt in fundamenta.* See also Forcellini 1833, 1: 367 *sub vocem* “Architectus”: *Architectus differt a fabro, quod faber solam partem in construendo operam manuariam, architectus praeterea consilium et dispositionem totius operas.*

³⁸ Pl. *Plt.* 259e. See also Arist. *Metaph.*, 981b 30. For ἀρχιτέκτων in shipbuilding, see Arist. *Ath. Pol.* 46.1.

³⁹ Alberti 1485, *De re aed.*, *prohemium* (introduction): *fabri enim manus architecto instrumento est.*

⁴⁰ Alberti also recalls the *veteres architecti*, the ancient Roman architects.

Catalans, Normans, Basques, and Genoese. In 1540 he stated, “I developed my method by myself with great effort, traveling all around the world wherever I heard there was a skilled shipwright able to teach me good techniques, apart from the knowledge of the ancient written sources, which I have interpreted as none have before [me].”⁴¹ Fausto combined *ars* and *scientia*, ἔπιστήμη πρακτική and ἔπιστήμη γνωστική, the practical art and the intellectual science, as noted by Plato.⁴² Indeed, “naval architecture” was a *scientia*, since it originated from a theoretical knowledge based on *litterae et disciplinae*, but the outsider Fausto also applied his shipbuilding knowledge to building his *quinqueremis* in the Venetian Arsenal.

Vitruvius noted that the science (*scientia*) of the architect depends on many disciplines (*disciplinae*) and various knowledges that are performed in other arts (*artes*).⁴³ In describing the perfect architect, Vitruvius wrote, “he should be a man of letters, a skilful draughtsman, should have some knowledge of geometry, should be familiar with historical studies, and should listen diligently to philosophers, [should be] acquainted with music, [and] not ignorant of medicine.”⁴⁴

In order to better understand the Classical atmosphere surrounding Fausto, it has to be said that Lazaire de Baïf, the French ambassador in Venice and a *Filellene*, wrote a compendium entitled *De re navali* (1537), in which he gathered all the Latin and Greek

⁴¹ ASVe, Consiglio di Dieci, Parti secrete, reg. 1, fol. 62r.

⁴² Pl. *Plt.* 258d.

⁴³ Vitr. *De arch.* 1.1.1. *Architecti est scientia pluribus disciplinis et variis eruditionibus ornata quae ab ceteris artibus perficiuntur.* For a discussion, see Granger 1925.

⁴⁴ Vitr. *De arch.* 1.1.3: *Et litteratus sit, peritos graphidos, eruditus geometria, historias complures noverit, philosophos diligenter audierit, musicam scierit, medicinae non sit ignarus.* For the architecture profession in antiquity, see Clarke 1963.

written sources available at that time concerning naval architecture.⁴⁵ In the chapter entitled *Verba navibus propria*, “Words referring to ships,” he recorded certain Latin passages in which the verbs *aedificare*, *construere*, *facere*, *fundare*, and *fabricare* are mentioned in relation to ships. In addition to the passages from Ovid,⁴⁶ Cicero,⁴⁷ and Columella,⁴⁸ the most significant source mentioned by Baïf is a passage from Plautus’ *Miles gloriosus*. The courtesan Acroteleutium compared the planning of the intrigue against the braggart warrior to the building of a ship. She said to the old gentleman Periplectomenus:

When the architect is skilful, if he has once laid down the keel exact to its lines, [then] building a ship is easy, once [the keel] is laid and placed. Now, this keel of ours has been skillfully laid and firmly placed, and the carpenters helping the architect are not unskilled in this business. If we are not delayed by the raw material [*i.e.*, the timbers] that is needed – I know the adroitness of our ingenuity, soon [our] ship will be ready.⁴⁹

In *De re navali* there are many other passages dealing with ancient ships and, in particular, with *quinqueremes*. In his chapter devoted to the *naves longae*, “long galleys,” Baïf mentioned Aristophanes,⁵⁰ Thucydides,⁵¹ Diodorus Siculus,⁵² Herodotus,⁵³

⁴⁵ Lazaire de Baïf (1537), *De re navali libellus in adolescentulorum bonarum literarum studiorum favore*. Parisiis: Apud Franciscum Stephanum.

⁴⁶ Ov. *Her.* 16.107-18.

⁴⁷ Cic. *Leg. Man.*, 4.9, *Sen.* 20.72, *Verr.* 1.3.

⁴⁸ Colum. *Rust.* 1.4.

⁴⁹ Plaut. *Mil.* 915-21: *Ubi probus est architectus, bene lineatam si semel carinam conlocavit, facile essere navem facere, ubi fundata, constitutast, nunc haec carina satis probe fundata, bene statutast, atque architecto adsunt fabri ad eam rem haud non imperiti. Si non nos materiarius remoratur, quod opus det (novi indolem nostri ingeni), cito erit parata navis.* See Pomey (1973, 483-515) who discussed the passage along with Ov. *Her.* 16.107-18.

⁵⁰ Ar. *Ra.* 1074.

⁵¹ Thuc. 2.93.2.

⁵² D. S. 14.44.6.

⁵³ Hdt. 3.39.3; 3.44.2; 6.8.

Pollux,⁵⁴ and Vegetius,⁵⁵ all ancient authors that Fausto read and knew extremely well. Yet, is it possible to identify more specifically the Greek and Latin texts Fausto referred to in deducting his *ratio*, the system of proportions applied in building his galley?

The passage from Vitruvius's *De architectura* describing a ship's *modulus*, that is the space between the tholes, should have been the starting point in Fausto's design. Obviously, this fundamental prescription, although stated by a most influential architect such as Vitruvius, was not sufficient for building an entire ship. Another ancient source on which Fausto based his galley's design may have been the *Historiae* by Polybius. In describing the Battle of Ecnomus (256 B.C.E.) between Romans and Carthaginians, the Greek historian recorded that 300 Romans were on board each πεντήρης (pentērēs), that is to say, a quinquereme. The exact configuration of the Roman quinquereme is not known, although scholars argue that the quinquereme or "five" evolved from the ancient trireme and was a three-banked vessel with two rowers per oar on the two upper levels and one rower with his oar on the lower level.⁵⁶ The figure of 300 Romans, including officers and sailors, indicates there must have been less than 30 benches per level on either side, or less than 90 benches total on either side.⁵⁷

Fausto built his galley with 28 benches per side. The Venetian historian Sanuto, who was present at the launching of Fausto's quinquereme, recorded in his *I Diari* that

⁵⁴ Poll. *Onom.* 1.87 and 1.120.

⁵⁵ Veg. *Mil.* 4.34.

⁵⁶ Casson 1971, 101-2. Casson's assumption is based on the fact that the quinquereme and the trireme had roughly the same maximum breadth and were stored in the same shipsheds. See also Morrison 1996, 296.

⁵⁷ Walbank, 86.

he saw the oarsmen “rowing together in harmony.”⁵⁸ Yet, Fausto stated that he built his galley according to the proportions found “in the most ancient Greek manuscripts,” most of which have yet to be identified.

The only source known thus far that Fausto likely used in building his *quinqueremis* is the Pseudo-Aristotelian “Mechanics,” because in 1517 Fausto published a Latin version of the original Greek work.⁵⁹ Fausto’s interest in the Greek philosopher Aristotle led him to join the *Studio Padovano*, the University of Padua, which was one of the most important centers of learning in Italy—perhaps the most important in Europe—in terms of scholarly study for the Latin tradition of interpreting Aristotle.⁶⁰ Applying Aristotle’s Fifth Question about the movement of bodies to ship design, Fausto was able to calculate the steering performance of the stern axial rudder. The application of Aristotle’s Fifth Question involves the principle of levers.⁶¹

To determine the arrangement of the oars, Fausto might have studied *The Conics* by Apollonius of Perga (ca. 262-190 B.C.E.), a Greek mathematician who studied Euclidean geometry.⁶² A document from the Archive of Venice (Archivio Proprio Contarini) throws light on ancient sources that he may have used, since it reported that “Fausto was a very eminent scholar, and whenever he shaped a timber, he always used

⁵⁸ Sanuto, L, col. 343.

⁵⁹ Drachmann 1963, 13-8; Tarn 1985,137-40.

⁶⁰ Maccagni, 1980, 3: 135-7; Schmitt 1984, 104-23.

⁶¹ Page 1939, 430.

⁶² Heath 1896, 11. For a brief discussion of the theorem, see Archibald 1916. Clagett (1964) discusses how the works of Apollonius and Euclid are related to each other.

the compass. [...] He drew his (shipbuilding) principle from Euclid, who is the guide to each mechanical operation.”⁶³

Therefore, one of the “ancient Greek manuscripts” consulted by Fausto must have been Euclid’s *Data*, which was the fundamental study of geometry in establishing the basis of Greek mathematics.⁶⁴ The manuscript depicts graphically the proportions employed by Fausto in building a great galley (*galea grossa*). The circumference of the large circle corresponds to the length of the galley (fig. 1). The diameter of the inscribed circle, which is equal to the radius of the larger circle, corresponds to the *bocca*, or the ship’s maximum breadth. Thus, the ship’s length-to-beam ratio is 1:6.

No one in the Arsenal, after Fausto, was able to build a galley according to Greek and Roman geometric proportions; the *marina architettura* was born, lived, and died with Fausto. Remarkably, the quinquereme survived its creator. Fausto stimulated later studies on naval architecture, such as those of Alessandro Picheroni della Mirandola, whose “Drawings of Biremes, Triremes, and Quadriremes” can be regarded as the first technical naval drawings *strictu sensu* of the European Renaissance.⁶⁵ The Italian architect Antonio da Sangallo the Younger (1484-1546) was also interested in Fausto’s

⁶³ ASVe, Archivio Proprio Contarini, env. 25, folio not numbered (former ASVe, Provveditori all’Arsenale, env. 1, fol. 11r). This manuscript was first mentioned by Tucci (1964, 281), who also provided a transcription of it with some errors. Euclidean geometry was revived through the work of Fra’ Luca Pacioli, who, in 1494, published in Venice the *Summa de arithmetica, geometria, proportioni et proportionalità* (On Arithmetic, Geometry, Proportions and Proportionality). It should be noted, however, that in Venice there were many *abbaco* schools that taught basic mathematics and geometry, see Gamba and Montebelli 1987. That Euclid became the authority in Renaissance mathematics is also stated by Giuseppe Moletto (the first professor of mathematics in Venice, 1531-1538) in his *Rudimenta quaedam pro mathematicis disciplinis* (“Elementary Mathematics”), which was published in Venice in 1578. Two years earlier, Moletto published the “Dialogue on Mechanics,” mostly based on the Latin translations of the “Mechanics” by Fausto (1517) and Leonico (1525); in Carugo 1984, 183; Lierd 1987.

⁶⁴ Taisbak 2003. For the transmission of Euclid’s *Data* during the Medieval Age, see Ito 1980.

⁶⁵ Venice, BNM, Ms. It., cod. 379 (=7588).

quinnereme and in particular in its rowing arrangement, for he left a drawing of it.⁶⁶ The humanist Francesco Robortello (1516-1567), in his edition of Aelianus, published two illustrations depicting a side and a breadth plan of the quinnereme. The fame of the quinnereme quickly spread to the East, and during the sixteenth century, this type of vessel was incorporated into the Ottoman fleet.

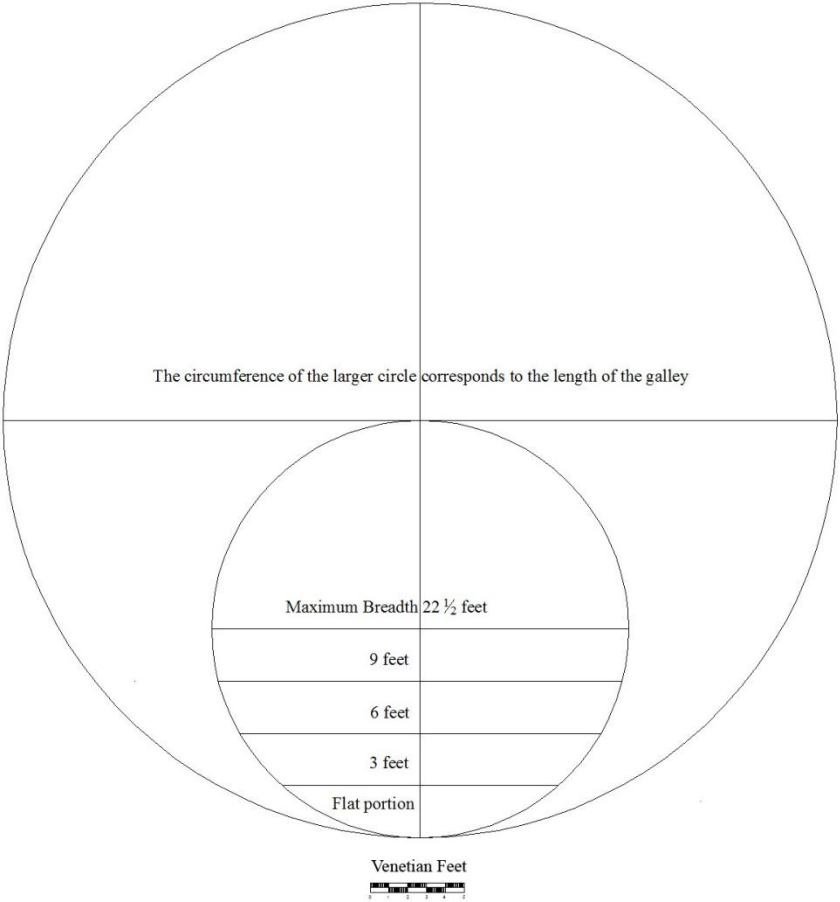


Fig. 1. Geometrical drawing illustrating the proportions of Fausto's great galley.

Drawing: L. Campana.

⁶⁶ Frommel 1994, 391.

A dispatch sent from Constantinople to the Venetian Senate by the *bailo* Giacomo Soranzo, on 22 May 1568, recorded “the Captain’s galley is a quinquereme with 29 benches, manned by five men pulling a single oar, and Paili Bassà [Piyale Pasha, ca. 1515-1578] gave to the Captain three lanterns as gifts, as well as banners, and all the necessities that were prepared for the Captain, for he had armed and outfitted his ship in an excellent way, decorated the stern, and embellished the sides with gold-embroidered cloth.”⁶⁷ Just three years later, at the eve of the Battle of Lepanto (7 October 1571), the Pope requested that Venice build a quinquereme to serve as the flagship of the Papal fleet. Marco Antonio Colonna was chosen as Sea Captain and Admiral of the quinquereme.⁶⁸ The Ottoman Navy, however, never faced the Venetian quinquereme, for while heading toward Lepanto, it was struck by lightning in a fierce storm and sank off the coast of Ragusa.⁶⁹

⁶⁷ ASVe, Senato, Dispacci, Costantinopoli, string 3, folio not numbered, dispatch dated to 22 May 1568: *La galea Capitana è quinquereme de banchi 29, et li cinque homini per banco vogano un remo solo, et Piali Bassà ha donato al Capitano li soi tre fanò, le bandiere e tutte le altre provisioni che li havevano preparato per sè, et del resto egli l’ha messa benissimo ad ordine et fra le altre cose ha fatto coprir la pupa et le bande di pano d’oro.* It has to be pointed out, however, that the Ottoman quinquereme was rowed by five rowers pulling one long sweep, whereas Fausto’s quinquereme was rowed by five rowers, each pulling his own oar. In addition, also Fausto’s quinquereme had 29 benches, but one bench was removed on either side in order to accomodate the ship’s galley (kitchen) and the ship’s boat.

⁶⁸ Guglielmotti 1862, 25.

⁶⁹ *Supra* n. 68.

CHAPTER IV

THE QUINQUEREME

Introduction

This chapter discusses passages from Classical works mentioning the quinquereme and investigates the theoretical knowledge involved in its construction. The technical design aspects of the quinquereme's hull will be examined in the following chapter.

Particular emphasis is given to the passages from the "Mechanics" by Aristotle containing observations on the oars and steering mechanism. The "Mechanics" by Aristotle was a formative text for Fausto in the conception of his quinquereme. Aristotelianism was widely spread in Venice as a result of the firm opposition against Averroism, whose medieval interpretations of Aristotle did not conform to that of the Renaissance world.¹ In Venice, the philosophical theories of Aristotle circulated among the humanist circle of Ermolao Barbaro (1453-1493) and were largely studied at the University of Padua.² However, both the University of Padua and the humanists gathered around Barbaro focused primarily on the Aristotelian writings concerning natural philosophy and the natural sciences, whereas minor works, such as the "Mechanics," were disregarded. In Barbaro's ambitious project to publish the *opera*

¹ Russell 1945, 57-61.

² Nardi 1958; Branca 1980.

omnia of Aristotle with the Aldine press, the “Mechanics” was not included.³ Thus, Fausto’s *Aristotelis mechanica*, published in Paris in 1517, was the first Latin translation produced in the Western world.⁴

As discussed previously, a copy of this Greek text may have been acquired by Fausto during his visit to the University of Alcalà, which was the major center in Spain for the study of Aristotelian works. Fausto dedicated his *Aristotelis mechanica* to his friend and patron Giovanni Badoer, with whom he went to France as a member of the Venetian delegation when Badoer was elected ambassador.⁵ Fausto, upon his return to Venice, applied the knowledge and the mechanical principles of Aristotle’s “Mechanics” to the building of the quinquereme. As discussed in the previous chapter, however, Fausto based the construction of his vessel also on other ancient authors, among whom Euclid held a prominent role. Other than the relationships that Fausto established with Spanish and French scholars, and the friendship with Giovanni Badoer, another person who may have played an important role in the project of building the quinquereme was the Venetian Pietro Bembo.

Bembo studied at Messina in 1492-1494, and his interest in mathematics was documented through his friendships with many mathematicians and scientists with

³ Branca 1980, 3: 156.

⁴ BNM, 2983: *Aristotelis Mechanica Victoris Fausti industria in pristinum habitum restituta ac latinitate donata, in aedibus Iodoci Badii* (1517).

⁵ Giovanni Badoer had also been the patron of Giorgio Valla, a professor of humanities at the School of Saint Mark (1492-1500). In 1498 Valla dedicated to Badoer a translation of several mathematical Greek texts; see Rose 1976, 299-310.

whom he had frequent correspondence.⁶ Among them was Niccolò Leonico Tomeo, professor of philosophy at the University of Padua, who, right after Fausto's translation, published another Latin translation of the "Mechanics" in 1525. Others included Giambattista Memmo, the first public professor of mathematics in Venice, and the Sicilian mathematician Maurolico.⁷

When Pietro Bembo became librarian of the Marciana Library in 1530, he spent all his energy and time in the recovery of Euclid's "Elements." It was part of the splendid collection of mathematical manuscripts left in legacy to Venice, as a "second Byzantium," in 1468 by Cardinal Bessarion.⁸ A Latin translation of the Greek text of the "Elements" had circulated since 1505, when the Venetian humanist Benedetto Zamberti published it in Venice with the printer Tacuino.⁹

Also included in my discussion here are accounts and naval treatises written by sixteenth- and seventeenth-century humanists and sea captains describing Fausto's quinquereme. These literary sources provide a rare insight into the features of this new type of vessel.

⁶ See Bembo's letters addressed to the most famous Italian and European humanists published by Ernesto Travi (1992). See also Cian 1885, 139-154; Spezi 1862, 79-94; Mazzacurati 1980.

⁷ Rose 1976, 11. Niccolò Leonico Tomeo gave courses on Aristotle at Padua (Balsamo 2002, 179).

⁸ Castellani 1895, 891. Bembo worked as a librarian in the Marciana Library until 1543.

⁹ Zamberti 1505: *Euclidis Megaresis philosophi platonici mathematicarum disciplinarum janitoris. Venetiis: in aedibus Ioannis Tacuino*. It is not known which Greek manuscript Zamberti used for his Latin translation. A revised version of Zamberti's translation was made by Fra' Luca Pacioli in Venice in 1509. A Latin translation of the "Elements" from the Greek text, however, was available since the twelfth century in Southern Italy, but it had minimal circulation and little recognition. On Euclidean study during the Renaissance and various Latin translations that followed after that of Zamberti, see Folkerts 2003 and 2006. Also in the twelfth century, Abelard of Bath made a translation of the "Elements" from the Arabic version, which soon became widespread; see Clagett 1955, 16-42; Drake et al. 1999, 3: 65-70; and especially, the recent article published by Sonja Brentjes (2008) who discusses the circulation of the Arabic version of Euclid in Renaissance Europe.

Rowing Arrangement, Rowing System, and Steering Mechanism

In his encyclopedic work titled *Naturalis historia* (“Natural History”), Pliny the Elder (23-79 C.E.) asserted that “according to Mnesigiton, the quinquereme was invented by the Salaminians.”¹⁰ In this regard, Mnesigiton, or Nasichtone, is not the inventor of the quinquereme, but “a quite unknown writer” who provided the information about the inventors (the Salaminians) of the quinquereme, as noted by the eminent classicist Tarn.¹¹ The admiral Pantero Pantera and even the celebrated humanist Pietro Bembo ascribed the invention of the quinquereme to Mnesigiton, but the original Latin text proves this information to be incorrect.¹² Aside from this clarification, it is important to note that Pietro Bembo praised “the recovering of the quinquereme that has been invented by Fausto, who is like Nasichtone of Salamis in ancient times.”¹³

Fausto claimed before the Venetian Senators that he wanted to recreate the quinquereme “that was used by the Romans during their wars.”¹⁴ This is quite an audacious statement when one considers that there were, obviously, substantial differences between the ancient quinquereme and the ship proposed by Fausto. The quinquereme was the warship most extensively used by the Romans, Carthaginians, and

¹⁰ Plin. *HN* 7.57: *Quinqueremem Mnesigiton Salaminios*.

¹¹ Tarn 1939, 128. Mnesigiton probably lived in the fourth century B.C.E.

¹² This error had been reiterated also by Concina (1990, 74).

¹³ Bembo, letter n. 975, addressed to Giovan Battista Ramusio (29 May 1529); in Travi 1992, 47.

¹⁴ Coates (1995, 138) suggested that the quinquereme of the Romans was 45 meters long overall, slightly shorter than the quinquereme designed by Fausto. For the Roman quinquereme, see Tarn 1930, 130-1; Morrison 1995, 68-9 and 1996, 270-1.

Hellenistic naval forces that were contesting for dominion over the Mediterranean, a struggle which was eventually decided in Rome's favor.

According to the Greek historian Diodorus Siculus (first century B.C.E.), the *πεντήρης*, or quinquereme, was invented by Dionysus I of Syracuse around 399 B.C.E., when the Carthaginians threatened his kingdom in Sicily, and Dionysus planned to wage war against the Carthaginians. Therefore, he “accordingly began at once to assemble by decree craftsmen from the cities under his control and attracted them with high wages from Italy, and even from the territory controlled by the Carthaginians. He had in mind to manufacture a great quantity of arms and missiles of all kinds, and, moreover, also triremes and quinqueremes, although a ship of the latter oar system had at that time not yet been built.”¹⁵ That Dionysus was the inventor of the quinquereme is asserted a second time by Diodorus, when he recalled that the tyrant “began constructing the quadriremes and quinqueremes, being the first to think about the construction of such ships.”¹⁶

According to the Greek historian Polybius (200-118 B.C.E.), in 261 B.C.E., during the First Punic War (264-241 B.C.E.), the Romans modeled their quinquereme on one of the Carthaginian quinqueremes that they had captured off the coast of Messene (Messina, Sicily). Polybius thus narrated the episode:

When they saw that the war was dragging on, the Romans undertook for the first time to build ships, a hundred quinqueremes and twenty triremes. As their shipwrights were absolutely inexperienced in building quinqueremes, such ships never having been in use in Italy, the

¹⁵ D. S. 14.41.3.

¹⁶ D. S. 14.42.2. Based on the authority of Aristotle, Pliny wrote that the quadrireme was invented by Carthaginians.

matter caused them much difficulty. [...] It was not that they had fairly good resources for it, but they had none whatsoever, nor had they ever given a thought to the sea; yet when they once had conceived the project, they took it in hand so boldly, that before gaining any experience in the matter they at once engaged the Carthaginians, who had held for generations undisputed command of the sea. [...] When the Romans first undertook to send their forces across to Messene, not only did they not have any decked ships, but no long warships at all, not even a single vessel, and borrowing fifty-oared boats and triremes from the Tarantines and Locrians, and also from the people of Elea and Naples, they took troops across the sea in these at great hazard. On this occasion the Carthaginians put to sea to attack them, as they were crossing the straits, and one of their decked ships advanced too far in its eagerness to overtake them and running aground fell into the hands of the Romans. This ship they now used as a model, and built their whole fleet on its pattern; so it is evident that if this had not occurred, they would have been entirely prevented from carrying out their design by lack of practical knowledge.¹⁷

The sea captain Pantero Pantera in his *L'armata navale* ("The Navy") echoed the words of Polybius and recalled the success of the Roman quinquereme against the enemy fleet:

This type of vessel (i.e., the quinquereme), as asserted by Polybius, formed the core of the first fleet that was built by the Romans. They built one hundred quinqueremes, and these were the first ever built in Italy. The model of the quinquereme came from a Carthaginian quinquereme that was captured by the Romans after it foundered in the Strait of Messina. During the First Punic War, which lasted twenty-four consecutive years, one time [the Roman and the Carthaginians] engaged in naval battle with more than five hundred quinqueremes on both sides. Another time, they fought with about seven hundred. During the Second Punic War, the Romans used the quinquereme extensively, more than any other type of vessel they used it also against Philip, Antiochus, and Perseus. Caesar used it during the Civil Wars, as did Pompeius and Mark Anthony.¹⁸

¹⁷ Plb. 1.20.8-16.

¹⁸ Pantera, 1614, 19: *Di questa sorte di vascelli (come dice Polibio) fu la prima armata che facessero i Romani, havendo fatto fabricare cento quinqueremi, le quali furono le prime che si mettessero in mare in Italia, et ne fu preso il modello da una quinquereme de i Cartaginesi, la quale, essendosi rotta nel Faro di Messina, venne in poter dei Romani. Della quinquereme, più che d'ogn'altra sorte di vani lunghe, si servirono sempre i Romani contra i Cartaginesi, et i Cartaginesi contra i Romani. Et nella prima guerra Punica, che durò ventiquattr'anni continui, fu combattuto una volta tra le altre con più di cinquecento quinqueremi dall'una, et dall'altra parte, et un'altra volta con poco meno di settecento. Le usarono anco i Romani più dell'altre sorti di navi bella seconda guerra Punica, et contra Filippo, et contra Antioco, et contra Perseo, et nelle guerre civili se ne servirono Cesare, et Pompeo, et Marco Antonio.*

Polybius recounted that during the Battle of Ecnomus (256 B.C.E.), the crew of the Roman quinquereme that fought against the Carthaginians totaled “three hundred rowers and a hundred and twenty marines.”¹⁹ The ancient quinquereme could have developed either from the trireme or from the bireme. In the rowing arrangement based on the trireme, the quinquereme would have had two rowers sitting on the upper two levels, and one rower on the lowest level, whereas in the rowing arrangement based on the bireme there would have been three rowers on the upper level and two on the lower. Morrison and Casson, however, tend to believe that the rowing arrangement of the quinquereme developed from the trireme and therefore, the three hundred rowers mentioned by Polybius would have been positioned with two rowers on the upper two levels, and one at the lowest level, thus having 30 benches per level, and a total of 90 benches per side.²⁰ However, the Ragusan Benedetto Cotrugli (1416-1469), in his *De navigatione* written in 1464/65, asserted that multi-oared vessels like the *hexeres* (six-er) and the *hepteres* (seven-er) “have six and seven oars respectively, but they are arranged in superimposed levels, one above and the other below, and thus they are three and three, and four and three.”²¹ Cotrugli, citing a passage from “The Life of Demetrius” by Plutarch, said that the forty-er that Demetrius built could not have been with forty levels, but arranged on five different levels.

¹⁹ Plb. 1.26.7.

²⁰ Morrison 1995, 69; Casson 1971, 101-2. See also Polybius 1.21.1-2 about the training of rowers.

²¹ Cotrugli 1464/65, fol. 25b: *Et quisti sei remi per banco o vero VII devite intendere cge li uni vogavano per ordine desopra, gli altri desotto, tri e tri o vero quarto e tri*. The transcription of the *De navigatione* has been recently published by Salopek (2005). The passage is from page 100.

During the Renaissance, it was not clear how multi-oared vessels would have appeared, and some incredible rower configurations and vessel shapes have been proposed. Thus, the illustration of the Roman quinquereme that accompanied Scheffer's *De militia navali veterum* ("On the Ancient Navy," 1654), showing five superimposed levels of rowers (fig. 2), could never have been realized. The nearly contemporaneous *De fabrica triremium liber* ("On the Construction of Triremes") by Heinrich Meibom (1671) depicts the same configuration, with five superimposed levels of rowers (fig. 3). In the words of Pantera Pantero, "The quinquereme was a long ship, longer than the above mentioned [triremes, that is, light galleys]. It has been called 'quinquereme' because it was rowed by five men on each bench."²²

Judging from the available literary sources, the construction of Fausto's quinquereme fueled the debate generated around the rowing system of this vessel in ancient times. The French humanist Lazaire de Baïf (1496-1547), who lived in Venice as ambassador to France and who was a friend of Fausto, wrote in his *De re navali* (1537) that "the quinquereme, in ancient times, had forty benches on either side, and it had a total of four hundred rowers."²³ Pantera Pantera, who investigated the number of

²² Pantera, 1614, 19: *Di questa sorte di vascelli (come dice Polibio) fu la prima armata che facessero i Romani, havendo fatto fabricare cento quinqueremi, le quali furono le prime che si mettersero in mare in Italia, et ne fu preso il modello da una quinquereme de i Cartaginesi, la quale, essendosi rotta nel Faro di Messina, venne in poter dei Romani. Della quinquereme, più che d'ogn'altra sorte di navi lunghe, si servirono sempre i Romani contra i Cartaginesi, et i Cartaginesi contra i Romani. Et nella prima guerra Punica, che durò ventiquattr'anni continui, fu combattuto una volta tra le altre con più di cinquecento quinqueremi dall'una, et dall'altra parte, et un'altra volta con poco meno di settecento. Le usarono anco i Romani più dell'altre sorti di navi bella seconda guerra Punica, et contra Filippo, et contra Antioco, et contra Perseo, et nelle guerre civili se ne servirono Cesare, et Pompeo, et Marco Antonio.*

²³ Baïf 1537, 34: *Quadráginta fuisse sedilia in tabulato alterius lateris quinqueremis, quae quidem quadringentis remigibus agebatur.*

benches of the Roman quinquereme, disagreed with Baïf and provided much information about Fausto's ship:

Since [the quinquereme] has been extensively used and highly praised by both the Carthaginians, who had been the lords of the sea, and by Romans, who had been the emperors of the world, I would like to investigate its original shape and what they had in common with [our] galleys used today. Lazair de Baïf, in his *De re navali*, disagreed with those who said that the twenty-eight-benched galley built by the Venetians [i.e. by Vettor Fausto] was similar to the ancient quinquereme, and he based his opinion on the authority of Pliny,²⁴ who wrote that the quinquereme had four hundred rowers. He also added this valuable information: while Caius Caligula was sailing from Astura to Antium, the quinquereme he was on board became immobilized and could not proceed – as did the other quinqueremes that were with him – although it was manned by four hundred rowers. Thus, Caligula, wishing to know the reason for this delay, ordered the vessel be checked, and it was found that a small fish remained attached to the rudder and was obstructing its movement. However, if we assume that the quinquereme had four hundred rowers, five men on each bench (as Baïf said), the quinquereme would have had forty benches on either side, and it would have been almost one third longer than the quinquereme built by the Venetians that had twenty-eight benches. Some other writers asserted that the quinquereme had three hundred men,²⁵ who, calculated at a number of five on each bench, result in a quinquereme of thirty benches, which is slightly longer than the Venetian quinquereme, which had twenty-eight benches. This is more plausible to me, because a quinquereme with forty benches would have an exaggeratedly long hull, both lengthwise and beamwise, and it would be imperfectly built and useless due to its heaviness.²⁶

²⁴ Pantera is referring to: Plin. *HN* 32.1.

²⁵ Pantera is referring to the passage by Polybius (1.26.7) previously discussed.

²⁶ Pantera 1614, 19-20: *Onde, essendo state tanto stimate, et usate, sì da i Cartaginesi, che tennero un gran tempo il principato del mare, come da i Romani, che ebbero l'imperio del mondo, mi si porge occasione di andar per congettture, investigando di che forma potessero essere, et che simiglianza havessero con le galee, che a questi tempi usano. Lazaro Baifio nel libro che ha fatto De re navali, si oppose a quelli che dicevano che una galea di ventiotto banchi fabricata da i Venetiani fosse simile di forma all'antica quinquereme, et fondava le sue ragioni con l'auttorità di Plinio (libr. 32, cap. 1), dove dice che la quinquereme haveva quattrocento huomini da remo; soggiungendo questa stupenda cosa, che, mentre Caio Caligula Imperatore navigava da Astura ad Antio, gli fu trattenuta la quinquereme, sopra la quale egli era di maniera, che non poteva caminar, quanto le altre, che erano seco con gran meraviglia sua, benchè fosse vogata da quattrocento huomini, però, desiderando saper la causa di questo impedimento, ordinò che si rivedesse il vascello con ogni diligenza, et si trovò che si era attaccato un pesciolino al timone che non lo lasciava scorrere. Però, portando le quinqueremi sino a quattrocento huomini da remo a cinque per banco (dice il Baifio), bisognava che la quinquereme avesse havuto quaranta banchi per ciascun lato, onde veniva ad essere quasi per la terza parte maggiore della galea fabricata da i Venetiani di vento'otto banchi. Hanno detto alcuni altri che la quinquereme portava trecento huomini da remo, i quali, computati a ragione di cinque per banco, vorrebbero a far la quinquereme di trenta banchi, che sarebbe poco maggiore della galea venetiana di vent'otto: et quella opinione mi pare più verismile perchè, se la quinquereme avesse havuto quaranta banchi, sarebbe stata un vaso di sterminata lunghezza, et non essendo proportionato anco per la lanrghezza, sarebbe senza dubbio riuscito imperfetto, et inetto per la gravezza.*

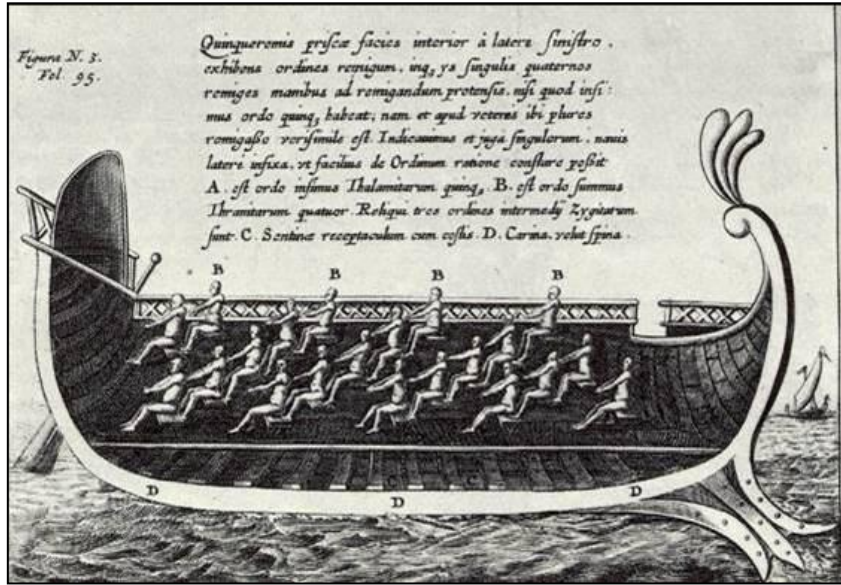


Fig. 2. Quinquereme from Scheffer's *De militia navali veterum*, 1654.

After: Concina 1990, fig. 106 (page not numbered).



Fig. 3. Quinquereme from Meibom's *De fabrica triremium liber*, 1671.

After: Concina 1990, fig. 108 (page not numbered).

Fausto purported to investigate “the principle for the oar [arrangement] that was used in ancient times and that has been long forgotten,” the *antiqui remigii rationem tota annos iam sepultam*.²⁷ In order to assess the oar mechanics of his quinquereme, Fausto followed the most ancient tradition on mechanical inquiry, which was based on the authority of Aristotle (384-322 B.C.E.). The study of the “Mechanics” by Aristotle reveals how significant was Aristotle’s contribution to both ancient and Renaissance naval architecture.²⁸

In his “Fourth Question,” Aristotle’s main concern was to investigate the propulsion of a ship: “Why do the rowers in the middle of the ship contribute most to its movement?”²⁹ Aristotle solved this problem by comparing the oar to a lever:

The oar acts like a *lever*, for the thole is the fulcrum (as it is fixed), and the sea is the weight, which the oar presses against; the sailor is the force which moves the bar. In proportion as the moving force is further away from the fulcrum, so it always moves the weight more; for the circle described from the centre is greater, and the thole, which is the fulcrum, is the centre. The largest part of the oar is within in the centre of the ship. For the ship is broadest at this point, so that it is possible for the greater part of the oar to be within the sides of the ship on either side. Therefore, the movement of the ship is caused, because the end of the oar, which is within the ship, travels forward when the oar is supported against the sea, and the ship, being fastened to the thole, travels forward in the same directions as the end of the oar. The ship must be thrust forward most at the point at which the oar displaces the most sea, where the distance between the handle and the thole is greatest. This is the reason why those in the middle of the ship contribute the most to the movement of the ship, for that part of the oar which stretches inside from the thole is greatest in the middle of the ship.³⁰

However, the work by Aristotle does not provide the necessary information for the mechanism of the oaring, the length of the oars, and how to avoid interference with

²⁷ Letter written by Fausto to Ramusio, dated 13 September 1530; in Weber 1894, 129.

²⁸ Regrettably, a study focusing on Aristotle and mechanical problems as applied to naval architecture has yet to be undertaken.

²⁹ Arist. *Mech.* 4.850b.10.

³⁰ Arist. *Mech.* 4.850b.10-29. Translation by Hett 1936, 355 (italics mine).

one another. From a theoretical point of view, Apollonius of Perga (262-190 B.C.E.), in his “Conics,” discusses at length the mechanism of levers, but Fausto must have conducted some trials of his own. Fausto’s quinquereme was rowed *alla sensile* (in the simple way), with five rowers on a bench, each pulling a single oar. In the words of Drachio, this rowing system with five rowers caused many problems, “for the fifth oar interfered with the fourth, the fourth interfered with the third, the third with the second, and the second with the first, and, one could see that often – if not always – during the stroke, the second hit the water in the furrow made by the first with its blade, the third by the second, the fourth by the third, and the fifth by the fourth.”³¹

At some point, Fausto discontinued the *alla sensile* rowing system and adapted in his quinquereme the *alla scaloccio* system of rowing (“in the ladder way”), with five men pulling the same oar. The oar for the *alla scaloccio* rowing system was bigger and heavier than the one required for the *alla sensile* system, and the former required the same number of rowers as the latter. The “Drawing of the Galleass built in the Fausto’s way” (*Disegno di galeazza alla Faustina*) from the *Architettura navale* by Steffano de Zuanne (1686) clearly depicts a galleass rowed *alla scaloccio* (fig. 4).

³¹ ASVe, Archivio Proprio Contarini, env. 25 (*Visione di Baldissera Quintio Drachio*), fols. 13v-14r: *Il quinto impediva il quarto, et il quarto il terzo, et il terzo il secondo, et il secondo il primo, di modo che si vedea che nel vogar spesse volte se non sempre feriva il secondo nel solco formato del primo con la pala, et il terzo nel secondo, et il quarto nel terzo, et il quinto nel quarto.*

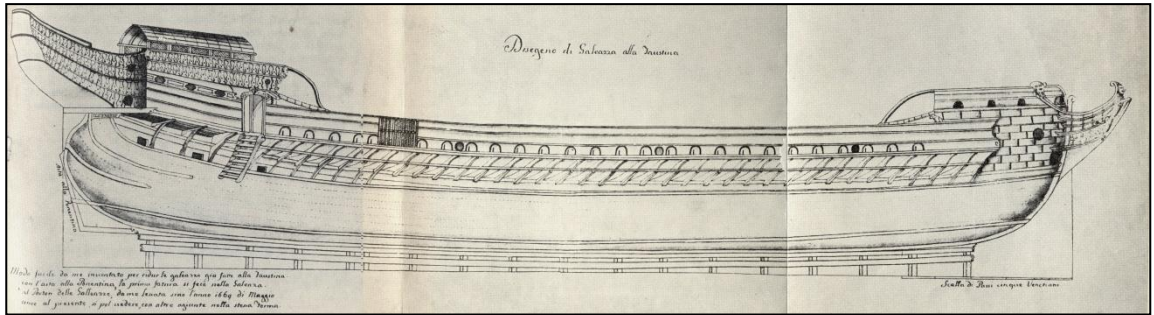


Fig. 4. Galleass “in the Fausto’s way” (*alla Faustina*).

Steffano de Zuanne, *Architettura navale*, 1686.

After: Anderson 1962, pl. 13B.

The earliest evidence for the introduction of long *alla scaloccio* oars is a document dated 30 July 1534, which discusses the dispatch of sixty long oars for the sea captain.³² At that time, the *alla scaloccio* rowing system was already in use in the Western Mediterranean by the Genoese, Spaniards, and French. A document dated to 25 June 1521 seems, however, to attribute to the French the invention of the new rowing system *à la galoche* (in Venetian *alla galozza*, and later *alla scaloccio*). It consisted of four men on a bench pulling the same oar. A senatorial decree of 19 January 1542 asserted that “*Dominus Vettor Faustp* has always been faithful and helpful, and always purported to provide us with the benefit of his clever inventions that he made in the past and that are worthy of praise, since he improved our galleys. In this present day, he devised a new system to arrange the crew of the galleys, so that

³² ASVe, Patroni e Provveditori all’Arsenale, reg. 8, fol. 37v; in Bondioli 1995, 178, n. 43.

both the rowers hired from the mainland and those from the Levant (i.e., convicts from Dalmatia) would be able to row easily.”³³

It has been suggested that the *alla scaloccio* rowing system was introduced when the shortage of trained and professional rowers, which are essential for *alla sensile* rowing, compelled the Venetian navy to impress slaves and convicts (*forzati*) for rowing aboard galleys. The above document is cited also by Tenenti, who explains that “rowers from the Levant” actually denotes convicts and slaves from Dalmatia.³⁴ Fausto also referred to *le zurme di terra ferma*, “rowers from the mainland,” meaning that they were not trained rowers.³⁵ Thus, this document might suggest that, in 1542, Fausto proposed to the Venetian Senate to change the rowing system of galleys from *alla sensile* to *alla scaloccio*, a system which he probably employed on his *quinnereme* shortly thereafter.

The praise for Fausto’s “clever inventions,” which opens the document, might indicate that Fausto himself was the one who introduced the new rowing system to the Venetian fleet, which was a novelty for the Republic. Moreover, in *Della milizia marittima* by Cristoforo da Canal, we learn that Fausto presented a second proposal to

³³ ASVe, Senato mar, reg. 26, fols. 160v-161r: *Invigilando Domino Vettor Fausto con ogni studio, et diligentia al beneficio delle cose nostre per la molta affitione, et fidelità soa verso de noi, oltra le altre cose ingeniose, et degne di laude dallui fatte per il passato di utilità grande nelle nostre galee, al presente ha escogitato un modo di acconciar talmente esse galee, che le zurme di terra ferma le potranno vogare commodamente come fanno quelle di levante.*

³⁴ Tenenti 1962, 91, n. 19.

³⁵ Bondioli (1995, 178, n. 43) notes that “It certainly seems curious that at this time (1534), the records do not attribute this invention to Vettor Fausto (who launched his *quinnereme* two years earlier and did not neglect his studies of rowing after that date because in 1542 he presented a plan on this subject for mainland galleys.” Actually Fausto launched his *quinnereme* in 1526 and not in 1532, and the phrase “mainland galleys” refers not to a certain type of galley, but to galleys that were rowed by unskilled men recruited from the mainland.

the Senate regarding the oars. The main problem was to reduce the weight of the oars to make the activity of rowing lighter and less tiring. Cristoforo da Canal wrote that “the oars should be made of beech rather than maple wood [...] because beech is much stronger and less permeable to water than maple wood, which, although it is more flexible, as it is not so hard, upon becoming impregnated with water, it swells, and, thus becomes much heavier.”³⁶ Thus—continues Cristoforo da Canal—“Fausto accordingly suggested that an oar should be made of fir or larch: either one section of the oar of (fir) and the other of (larch), or the entire oar made of a single type of wood.”³⁷ Fausto’s proposal of wood choices for oars was not accepted, whereas that of Cristoforo da Canal, which advocated the use of beech for oars, was approved by the Senate. In 1550 the Venetian Republic acquired the beech forest of the Cansiglio, close to Treviso, whose wood was specifically used for making oars.³⁸

Fausto also studied the steering mechanism of the stern-hung rudder. In doing so, he again turned his attention to Aristotle, who investigated the steering mechanism of ships in his Fifth Question. Aristotle the Stagiritic lived in the fourth century B.C.E. and, thus, he referred to the quarter rudder, the *πηδάλιον* (or the Latin *gubernacula*,

³⁶ Cristoforo da Canal, *Della milizia marittima*, book 1: *i remi più tosto di fò che di aere [...] perchè il fò è di gran lunga più forte tanto che meno condannabile al mare dell’aere, il quale sebbene è più pieghevole, essendo, nondimeno men forte riceve in sè l’acqua et gonfiandosi in processo di tempo diviene molto più greve*; in Nani Mocenigo 1930, 79.

³⁷ Cristoforo da Canal, *Della milizia marittima*, book 1: *Fausto, il quale ha prudentemente anco pensato che i remi si possono fare anco di abete et di larice, o una parte di uno et l’altra dell’altro, o vero tutti d’un solo*; in Nani Mocenigo 1930, 70. In this passage, the admiral Cristoforo da Canal is referring to the outboard and inboard portion (*zironi*) of the oar, the latter being one third of the length of the oar. The division on the oar was marked by the socket for the thole, the vertical pivot on which the oar rested that served as a fulcrum.

³⁸ Agnoletti 2007, 115.

which became the medieval *temones*), and not to the stern-hung rudder, which came into use much later.³⁹ However, the mechanical principle was the same. In the Fifth Question, Aristotle's main question is:

Why does the rudder, which is small and at the end of the vessel, have so great power that it is able to move the huge mass of the ship, though it is moved by a smaller tiller and by the strength of but one man, and then without violent exertion? Is that because the rudder is a bar, and the helmsman works a lever? The point at which it is attached to the ship is the fulcrum, the whole rudder is the lever, the sea is the weight, and the helmsman is the motive force. The rudder does not strike the sea at right angles to its lengths, as an oar does. For it does not drive the ship forward, but turns it while it moves, receiving the sea at an angle. Since the sea is the weight, it turns the ship by pushing in a contrary direction. Indeed the lever and the sea turn in opposite directions, the sea to the inside and the lever to the outside. The ship follows because it is attached to the rudder. The oar pushes the weight against its breadth, and, being pushed by it, the oar in return drives the ship straight forward. On the contrary, the rudder, being placed aslant, causes movement also to be at an angle, either in one direction or the other. It is placed at the stern, and not in the middle of the ship, because the part moved can move most easily when the moving agent acts from the end. For the first part moves most rapidly because as in other travelling bodies, the travel ceases at the end, so in a continuous body the travel is weakest at the end.⁴⁰ If, then, it is weakest there, it is at that point easiest to shift it from its position. This is why the rudder is at the stern and also because, as there is very little movement at that point, the displacement is much greater at the end, because the same angle stands on a large base, and also because the enclosing lines are greater. From this, it is obvious why the ship moves further in an opposite direction than the oar-blade: for the same mass, when moved by the same force, will travel further in air than in water.⁴¹

³⁹ In Northern Europe, the earliest archaeological evidence for a stern-hung rudder connected to the straight post is seen on the Kollerup cog, in southern Denmark, dated to ca. 1150; see Hocker and Dokkedal 2001. The Tournai baptismal font of the Cathedral of Winchester, dated to ca. 1150, suggests that the pintle-and-gudgeon rudder came into use in this period; see Sleeswyk and Lehmann 1982; Mott 1997, 106. In the Mediterranean, the earliest archaeological evidence for a single rudder is seen in the Venetian galley found in San Marco in Boccalama (condemned in 1328 C.E.). This galley – probably a great galley (*galea grossa*) – also provides the earliest iconographical evidence for the stern rudder. A graffito depicting a light galley with a stern rudder was found on an inaccessible portion of a ceiling plank, suggesting that the engraving was made during the construction of the galley (Fozzati 2002, 75; D'Agostino 2003, 25).

⁴⁰ As already noted by Leon Battista Alberti in his *De re aedificatoria* (5.13), “the number of rudders increases the stability of the ship, but it diminishes its speed” (*Temonum numerus navi auget firmitatem, minuit velocitatem*).

⁴¹ Arist. *Mech.* 5. 850b.30-851a.18.

Fausto, in his *Aristotelis mechanica*, graphically represented the Fifth Question of Aristotle—known as the parallelogram of velocity—and he adapted it to the stern rudder (fig. 5)

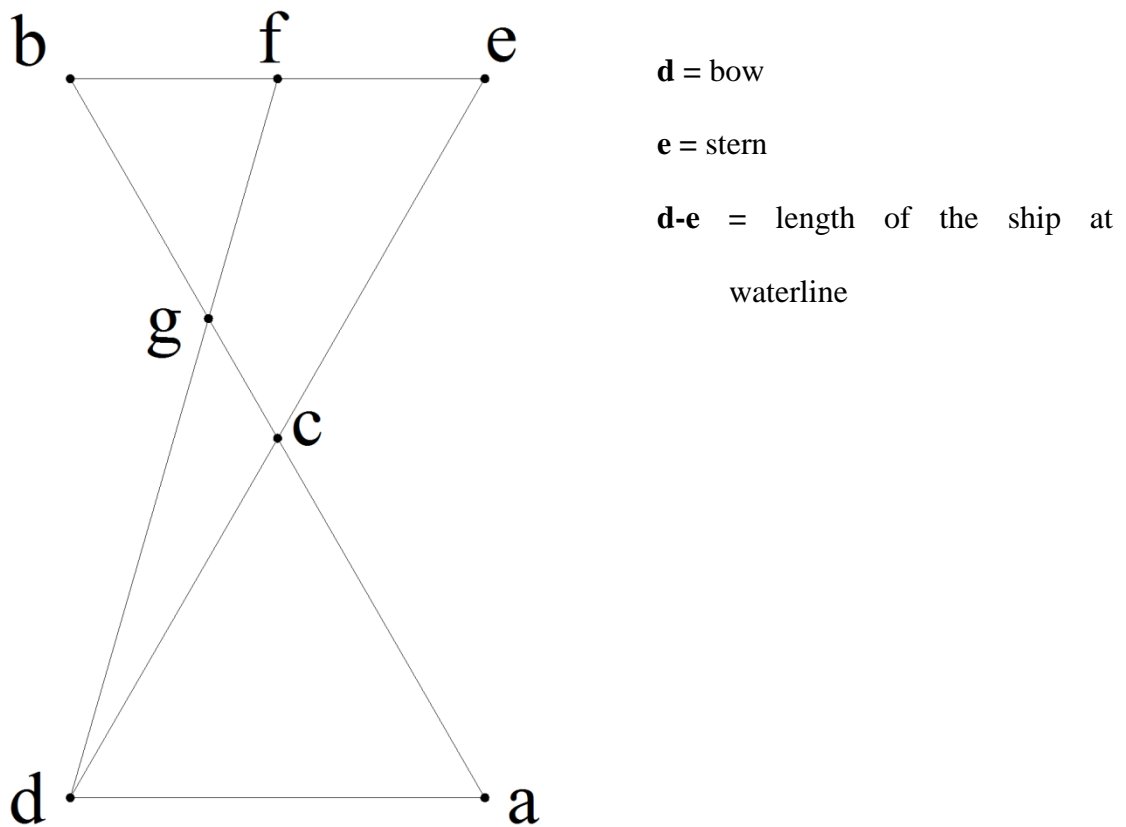


Fig. 5. The “Fifth Question” from Fausto’s

Aristotelis mechanica, fol. 10r.

Drawing: L. Campana.

Maneuvering the sternrudder and covering the distance $e-b$, the force of the rudder moves the ship so much that the stern (e) is now at b and the bow (d) is now at a and the position of the ship is now defined by $b-a$ (length of the ship at waterline). Note that the stern covered the distance $e-b$ and the bow covered the distance $d-a$, which describes the base of an equilateral triangle. Therefore, if the distance covered by the stern is known, say $e-f$, it is then possible to know the distance covered by the bow $d-g$.

In 1686, the Venetian Steffano de Zuanne, in his *Architectura navale* (“Naval Architecture”), compared the stern rudder “in the Western way” (*alla Ponentina*) with the stern rudder built “in Fausto’s way” (fig. 6), noting that the latter is

not perpendicular; it is too wide and, for this reason, it causes many problems. When the ship sails with light wind, the stern rudder shifts toward the sides because it is not perpendicular, and, being so, there forms a gap between the stern rudder and the sternpost, where the water passes and makes the steering of the stern rudder ineffective. If the blade is positioned perpendicularly, the end portion of the stern rudder moves towards to the left [port], as can be seen from the drawing and, for this reason, the galley is slow, and this might cause the loss of the rudder at any time. Conversely, the stern rudder in the Western way is always perpendicular to the sternpost with no gaps and the galley sails perfectly and speedily, and there is no concern that it could break; it can be managed more easily and safely, as has been experienced several times.⁴²

The drawing made by Steffano de Zuanne of the stern rudder *alla Faustina* shows a curved sternpost—inherited from late medieval ships and galleys—on which is

⁴² London, BL, Add. Ms. 38655, fol. 27r: [*quello alla Faustina*] *così storto con quella larghezza che si sente, non poco tormenta, oltre che, andando a vella con vento scarso la galia, il timon si tien tutto alla banda, onde per esser così storto, per necessità forma un vacco tra l’asta et il timon che passano di la l’acqua non sente il governo, e così intressata la palla alla dritta manda la punta di sotto alla sinistra, come si vede, e causa che la galia perde non poco di camino, e sempre con pericolo di perdere il timon. Ma quello alla ponentina, che sta sempre unito all’asta, la galia non sente tormento, non perde il camino, non vi è pericolo di rompersi, si governa con più facilità e sicurezza, come da molte esperienze si è veduto.*

mounted a rudder with a curved blade. A similar arrangement can be found, for example, on the Venetian *galea grossa* depicted in the *Libro di appunti di Zorzi Trombetta da Modon* (“The Notebook of Zorzi Trombetta from Modon,” ca. 1441-49), with the only exception being in the extremity of the curved blade of the rudder *alla Faustina*, whereas the extremity of the blade of Zorzi Trombetta’s *galea grossa* is straight.⁴³

On the “Drawing of the galleass built in Fausto’s way” (*Disegno di galeazza alla Faustina*) (fig. 4), Stefano de Zuanne wrote: “[This drawing] illustrates an easy way – invented by me – to reduce the [proportions] of the galleasses built in Fausto’s way. There is a [stern] post built in the Western way, the first improvement that was made to the galleass. [The galleass] was built by me, in the *Porton* of the Galleasses,⁴⁴ in May 1669, and [I am still today building this type of vessel], and all the modifications to its shape are visible [in this drawing].”⁴⁵

⁴³ London, BL, Cotton ms., Titus A XXVI, fol. 48v.

⁴⁴ It was an area of the Arsenal.

⁴⁵ Venice, BNM, Add. Ms. 38655, fol. 67v: *Modo facile da me inventato per ridur le galeazze alla Faustina, con l’asta alla Ponentina, la prima fatura si fece alla galeaza. Al Porton delle Galleazze, da me levata sino l’anno 1669 di Maggio come al presente, si pol vedere, con altrea giunte nella stesa forma.*

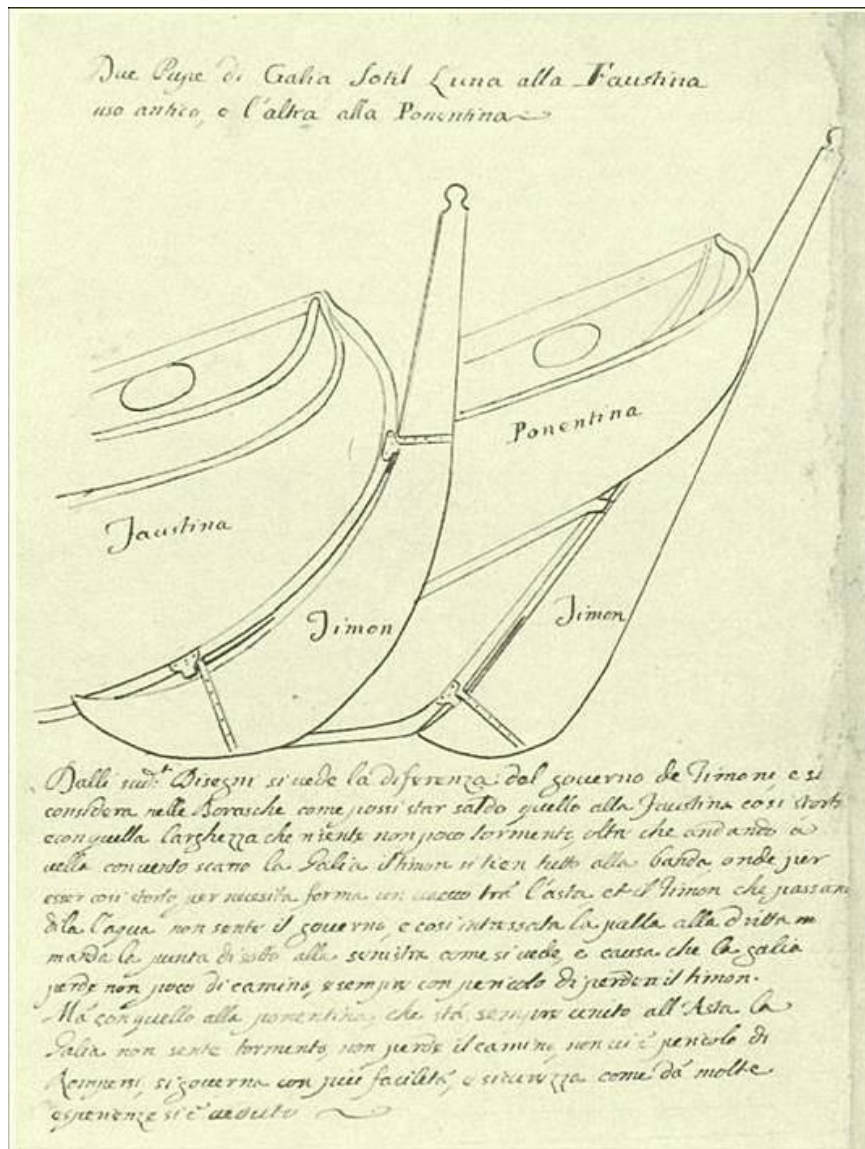


Fig. 6. Stern rudder “in Fausto’s way” (left) and “in the Western way” (right).

Steffano de Zuanne, *Architettura navale*, 1686. After: Concina 1990, fig. 59 (page not numbered).

Fausto's contribution to the study of mechanics is acknowledged in the *Liber mechanicorum* ("Book on Mechanics") published in 1577 in Venice by Guidobaldo dal Monte (1545-1607).⁴⁶ The Italian mathematician Filippo Pigafetta (1533-1604), in 1581, made an Italian translation of Guidobaldo's work. In the dedication he wrote:

With the fall of the Roman Empire and the appearance of the barbarians in Italy, Greece and Egypt and those places where arts and letters had prevailed, nearly all the sciences declined miserably and were lost. Mechanics in particular were for a long time neglected [...] But it seems that after a certain time the noblest arts and teachings, such as letters, philosophy, medicine, astrology, arithmetic, music, geometry, architecture, sculpture, painting and, above all, mechanics, were revived back to light from dark shadows in which they had lain buried.⁴⁷

Among the contributors to the science of mechanics, Pigafetta also mentioned Vettor Fausto.

⁴⁶ Bertoloni Meli 1992, 27; Henninger-Voos 2000.

⁴⁷ Pigafetta 1581, dedication (page not numbered).

CHAPTER V

MISURE DI VASCELLI ETC. DI...PROTO DELL'ARSENALE DI VENETIA

Introduction

The fifteenth and sixteenth century was a period of significant changes in ship design and can be regarded as an experimental transition in naval architecture.¹ The *galia sottile* (light galley), the warship *par excellence* of the Venetian fleet, was progressively modified in its design and adapted to the new requirements of warfare. Since the invention of gunpowder and the subsequent use of cannons aboard ships, galleys carried light chaser guns (*bombarde*) mounted on the bow, in the area called *palmetta*.² The relatively light weight of the early guns placed in this area between the *giogo* (yoke) of the bow and the *sperone* (spur) did not alter the overall shape of the hull. Between the fifteenth and the sixteenth centuries, major changes were introduced in the structure of the hull, whose balance was compromised by the increase of guns aboard ship. In order to solve the problem of trimming, Venetian shipwrights experimented and adopted different strategies in construction. Significant changes included an increase in hull volume, consequently, moving the midship frame forward toward the bow. In addition, Venetian shipwrights used the *calcagnol*, a gripe inserted between the baseline (*carena*) and the keel, whose purpose was to increase the height

¹ Barker 1988, 540-1; Hocquet 1991a, 403-12.

² For a glossary of naval architecture terminology, see APPENDIX II.

of both the posts and to improve the stability of the keel.³ In traditional shipbuilding practices employed by the Venetian *proti*, these innovations were the result of continuous empirical research.

The quinquereme built by Fausto can be regarded as the highest point of experimentation and innovation ever reached in Venetian naval architecture in the Arsenal. The quinquereme was the largest ship ever designed and built in the *squeri* (shipsheds) of the Serene Republic, and we can recognize a subtle connection that links Fausto's quinquereme to the later robust galleasses that were built until the second half of the 18th century.⁴

However, as was already discussed in the previous chapter, Fausto claimed that the design of the quinquereme was not based on an empirical method, but rather on a *navium ratio*, a shipbuilding principle. If on the one hand, the *marina architectura* was based on theoretical knowledge acquired from recovered Classical texts, on the other, it implied a deep acquaintance with the rules of mathematics and geometry. In 1838, in his article titled "The Venetian Multiple-oared Vessels," in the section devoted to Fausto's galley, Casoni stated that "the design, the armament, and the rowing system and its mechanisms of the quinquereme are still unknown."⁵ Richard Barker, in a brilliant, enlightening contribution on naval architecture, stated that "little is known about Fausto's *real* contribution to shipbuilding (other than rowing arrangements),

³ Bondioli 1995, 173.

⁴ Lane 1992, 71; Tucci 2002, 139.

⁵ Casoni 1838, 337.

except that they were not all successful, or lasting.”⁶ The technical innovations introduced by Fausto have still to be fully understood and appreciated, and the rowing arrangement is a topic that has not yet been fully exploited.⁷

The manuscript *Misure di vascelli etc. di...proto dell’Arsenale di Venetia* (“Measurements of [Various] Ships...by [a] Master Shipbuilder of the Arsenal of Venice”) has been known since 1881, when Fincati briefly mentioned it in his discussion about light galleys in his book “Le triremi.”⁸ In 1964, the Venetian historian Ugo Tucci published the transcription, albeit with some errors.⁹

The *Misure di vascelli etc. di...proto dell’Arsenale di Venetia* is a sixteenth-century shipbuilding manuscript that records “measurements of [various] ships...by [a] master shipbuilder of the Arsenal of Venice.”¹⁰ The manuscript belonged to the intellectual and man-of-letters Gian Vincenzo Pinelli (1535-1601), of noble Genoese origin, patron and avid collector of books and manuscripts. He possessed one of the best private libraries in Italy during the second half of the sixteenth century.¹¹ Pinelli gathered his valuable collection while living in Padua, where he founded a humanist circle of erudite scholars. Although his correspondence with the most famous Italian and European intellectuals, such as the collector Fulvio Orsini (1529-1600), the

⁶ Barker 2007, 42.

⁷ The only biographic study devoted to Fausto and his work in the Arsenal is that by Ennio Concina (1990). However, Concina does not discuss any of the technical aspects of the quinquereme. See also Eliav 2012.

⁸ Fincati 1881, 80-1.

⁹ Tucci 1964. See discussion below.

¹⁰ It is conserved in the State Archive of Venice, in the envelop 2 of the folder titled Archivio Proprio Pinelli (ASVe, Archivio Proprio Contarini, env. 2).

¹¹ Grendler M. 1980, 386-416. For the life and library of Gian Vincenzo Pinelli, see Gualdo 1607; Rivolta 1914 and 1993, xvii-lxxx; Raugei 1988; Dupuy and Raugei 2001.

humanist Torquato Tasso (1544-1595), and the traveler Filippo Pigafetta (1533-1604), has been partially studied,¹² Pinelli included among his friends the scientist Galileo Galilei (1564-1642).¹³

Over the centuries, the magnificent collection of Gian Vincenzo Pinelli was dispersed, and it suffered from several serious misfortunes. Pinelli, at his death, left the library to his nephew Cosmo Pinelli, who had planned to establish a library in honor of his uncle, but he died shortly afterwards. Part of the collection was later stolen and plundered by a servant; next, the Venetian Senate confiscated all the material concerning sensitive affairs relating to the Venetian State. Upon the death of Cosmo (31 October 1602), the Pinelli collection passed to his son. While he was sailing aboard a ship bound for Naples, Turkish corsairs attacked the ship off the coast of Fermo (Adriatic coast) and threw overboard thirty-three chests containing manuscripts and other valuable items, such as mathematical instruments. Of these, twenty-two chests of books were recovered, but the others all perished.¹⁴ The remaining portion of the Pinelli collection found its way to Naples, where Cosmo's widow sold it at an auction in 1608. The collection was bought by agents of Cardinal Federico Borromeo (1564-1631) for 3,050 *scudi*, who later sold in Naples some books judged to be less valuable. Only one-

¹² Dupuy and Raugéi 2001, 10-15.

¹³ Galilei became involved with Pinelli toward the end of the sixteenth century, when he started teaching at the University of Padua. Pinelli owned unpublished manuscripts and various notes on optics by Ettore Ausonio and Giuseppe Moletto, the latter a professor of mathematics at the University of Padua and the former a mathematician and physician from Venice. Pinelli's interest in optics is shown by his collection of optical instruments. On Galileo and Pinelli, see Grendler 1981, 145-8; Dupré 2002, 111-47, and 2003, 73-84; Nuovo 2007a, 133, and 2007b, 55.

¹⁴ Gualdo 1607, 110-13; Rivolta 1933, lxxi.

third of the original core of the Pinelli collection survives today and is housed in the Ambrosiana Library of Milan.

The Archivio Proprio Pinelli (Pinelli's personal collection) in the State archive of Venice comprises documents that range in date from 1380 to 1594, with later additions dating to 1670-1674.¹⁵ The content of these documents pertains mostly to Venetian political and military affairs, such as the many reports and manuscripts about the wars against the Ottomans.

Description of the Manuscript

The manuscript *Misure di vascelli etc. di...proto dell'Arsenale di Venezia* totals 42 folios, including the title page (fol. 4v left blank). The folios are numbered consecutively from 1r to 21r on the upper right corner, except the title page. The foliation, which was added later by a different hand, follows the manuscript's original pagination, as proven by the catchwords. The author of the foliation is the same person who wrote the title and added the writing "FF-25" on the upper margin of the title page. The writing "FF-25" indicates the manuscript's previous location, which was always the State Archive of Venice, but among "miscellaneous manuscripts" rather than among the documents belonging to Pinelli.¹⁶

The *scriptor* wrote in a mercantile cursive hand employing an indelible dark brown ink. The *ductus* remains uniform and regular throughout the manuscript. The

¹⁵ Rivolta 1933, 25.

¹⁶ ASVe, Miscellanea Codici , n. 125, FF 25.

handwriting suggests that the manuscript was composed (or copied) by a single person. The writing area (19.5 x 11 cm) of each folio is composed of fourteen to eighteen lines.

Misure di vascelli etc. di...proto dell'Arsenale di Venetia is a later copy of an earlier manuscript. The latest date when the original manuscript could have been written is provided in folio 17r, which records the instructions to build a galleon (*galion*) of 1500 *botte*.¹⁷ The date reported for the galleon's construction is 1 April 1546. The earliest date for when the manuscript could have been written is given in folio 15r, which records instructions for a great galley (*galia grossa*) said to have been built on 25 April 1530.

The content of the manuscript can be summarized as follows:

fol. 1r

Full-load draft of the following ships:

- light galley (*galia da 3*)
- galley with 4 oars per bench (*galia da 4*)
- galley with 5 oar per bench (*galia da 5*)
- great galley or galleass (*galia grossa over galiaza*)
- *fusta*
- ship (*nave*) of 500 *botte*
- ship (*nave*) of 1000 *botte*

¹⁷ One *botte* equals approximately 0.6 deadweight tons, see Lane 1964, 222-3; Tucci 1967, 215-17; Lane 1973, 479-80; Hocquet 1991b, 313-8; Lane 1992, 247.

	- ship (<i>nave</i>) of 1500 <i>botte</i>
fol. 1r	List of two-decked ships: <ul style="list-style-type: none"> - galleons - <i>barza</i>¹⁸ - ship (<i>nave</i>)
fol. 1v	Number of benches on the following ships: <ul style="list-style-type: none"> - great galley (<i>galia grossa</i>), 25 benches per side - <i>bastardella</i>, 26 benches per side - light galley (<i>galia sottil</i>), 25 benches per side, 24 benches per side on the other side - <i>fusta</i>, 20 benches per side - <i>bregantin</i>, 14 benches per side - <i>fregata</i>, 8 benches per side
fols. 2v-3r	Description of the deck of a galley
fols. 3r-3v	Description of the stern area of a galley
fol. 4r	Artillery on board a galley
fol. 4r	Length (<i>lunghezze</i>) of a galley (length overall, maximum breadth, depth in hold)
fol. 4v	Blank

¹⁸ In Venetian archival documents, the *barza* is also referred to as *nave piccola* (small ship); see ASVe, Senato mar, reg. 14, fol. 196r.

fol. 5r-5v	Measurements of a galley with five oars per bench (<i>galia da 5</i>)
fol. 6r-6v	Molds (<i>sesti</i> , or templates) for the galley with five oars
fol. 7r-8v	Measurements of a galley for the Admiral of the Sea (<i>Provveditor</i>), either with four oars per bench or with three oars per bench
fol. 9r-10r	Measurements of a galley with four oars per bench (<i>galia da 4</i>)
fol. 10r-11r	Measurements of the Captain's galley (<i>galia da zeneral</i>) with four oars per bench
fol. 11r-11v	Measurements of a galley for the Admiral of the Sea (<i>Provveditor</i>), continued
fol. 11v	Measurements of a light galley (<i>galia da 3</i>)
fol. 12r	Measurements of a galley for the Admiral of the Sea (<i>Provveditor</i>), continued
fol. 12r-12v	Measurements of a galley with four oars per bench (<i>galia da 4</i>), continued
fol. 12v-13r	Measurements of a light galley (<i>galia da 3</i>), continued
fol. 13r-13v	Measurements of a galley for the Admiral of the Sea (<i>Provveditor</i>), continued
fol. 13v-14v	Measurements of a light galley (<i>galia da 3</i>), continued
fol. 15r-16r	Measurements of a great galley (<i>galia grossa</i>)

fols. 16v-17r	Measurements of a light galley (<i>galia da 3</i>), continued
fols. 17r-19r	Measurements of a galleon (<i>galion</i>) of 1500 <i>botti</i>
fols. 19v-20r	Description of the deck of a galley (copy of fols. 2v-3r)
fols. 20r-20v	Description of the stern area of a galley (copy of fols. 3r-3v)
fol. 21r	Artillery on board a galley (copy of fol. 4r)

Ugo Tucci suggests that the manuscript is:

...one of those personal notebooks that the master shipbuilders of the Arsenal of Venice usually compiled, either for their own use or for the use of their pupils, to whom they secretly communicated their expertise; often times the personal knowledge was transmitted from father to son. [These manuscripts] have no literary value, and they were, with all probability, addressed to people who already possessed some specific, technical background. Indeed, they record basic measurements of the ship's hull, and, sometimes, the recorded measurements are accompanied by suggestions about the recording procedure or comments about technical features that are noteworthy for their difficulty and novelty.¹⁹

The *Misure di vascelli etc. di...proto dell'Arsenale di Venezia* is unique for several reasons. First, the content of the manuscript presents a desultory character and does not have a linear, organized exposition. For example, the measurements of the various ships are not in consecutive order, but are randomly presented. It is likely that

¹⁹ Tucci 1964, 277: *Si tratta di uno di quei d'appunti del mestiere che i protti dell'Arsenale di Venezia tenevano per memoria propria ovvero ad uso di una cerchia ristretta d'allievi ai quali li confidavano segretamente; spesso venivano trasmessi di padre in figlio. Privi d'intenti letterari e destinati a pesone che già possedevano un certo grado di preparazione specifica, si limitano di solito all'annotazione di misure delle strutture essenziali dei vascelli, talvolta integrate da brevi suggerimenti sul modo di codurle e su particolari tecnici meritevoli di rilievo per una qualche loro difficoltà o anche per innovazioni costruttive.*

the copyist was transcribing some loose, unorganized folios and did not have the patience, or perhaps the knowledge, to put them in proper order.

The suggestion that the copyist did not belong to the maritime milieu of Venice and that he lacked the specific, technical background mentioned by Tucci is evident from the first folios.²⁰ Indeed, on the folios 1r-4r, the copyist listed ship components in a descriptive manner, as if it was a glossary of naval architecture terms. Although the meanings of many of the terms recorded by the copyist have now mostly been explained by modern scholarship,²¹ the list contained in the first folios is of particular interest. It can be considered the first Venetian systematic glossary of nautical terms. In confirmation that the copyist was not a master shipbuilder of the Arsenal of Venice, folios 2v-4r are repeated at the end of the manuscript in folios 19v-21r, respectively. In addition, in folio 6r, the copyist confused the word sixth (*sesto*) with the word mold (*sesto*), both of which are spelled in the same way.

For their clear didactic intent, the first and last folios (1-4r, 19v-21r) stand apart from the rest of the manuscript. It is likely that they did not belong to the original core of the manuscript. Folio 4v, which is left blank, further proves this view, since it emphasizes the break between the two parts.

²⁰ *Supra* n. 66.

²¹ The following scholars have greatly contributed to the study of Venetian naval architecture: Anderson 1925, Lane 1934; Anderson 1945; Bellabarba 1993; Bondioli 1996 and 2003; Bondioli and Penzo 1999.

The Quinquereme

In 1881, the Admiral Luigi Fincati, after briefly presenting the *Misure di vascelli*, observed that “the study and the publication of this manuscript, illustrated by drawings, as well as other similar texts, would be beneficial and would greatly advance the history of naval architecture and ship construction.”²²

The discussion here will focus on the quinquereme, that is to say the galley with five oars per bench (*galia da 5*). As a premise, the theoretical reconstruction of the quinquereme given here is based on the technical features and measurements recorded in Vettor Fausto’s manuscript. For this reason, it should only be regarded as an educated interpretation and a working hypothesis, rather than a final reconstruction.²³ This preliminary work on the quinquereme will hopefully set the framework for studying all the other ship types recorded in Fausto’s manuscript.

The folios containing the shipbuilding instructions for *galia da 5* are: 1r, 5r-v, and 6r-v. Folio 1r provides only the full-load draft of the *galia da 5*, which is 5 Venetian feet (*5 pie*).²⁴ The remaining folios provide a series of offset measurements that were taken at key points directly from the vessel, by at least two persons, after the *galia da 5* had been built in the shipyard.²⁵ In order to record each measurement

²² Fincati 1881, 82: *La pubblicazione annotate e illustrate di talune di codeste memorie, coi loro disegni, sarebbe di una grande importanza per la storia della costruzione navale.*

²³ The proposed reconstruction of the quinquereme greatly benefitted from discussions with Cemal Pulak who provided me with great insight and suggestions everytime I requested it.

²⁴ See Table 1.

²⁵ It is very common to read in Venetian documents that master shipbuilders (*proiti*) utilized the help of young apprentices.

exactly, the following instruments were used: a plumb line (*archipendolo*), strings, ropes, and a rod calibrated in feet and fingerbreadths.

In the Venetian system of linear measurements, the unit consisted of fingerbreadths (*dita/deda*), feet (*pie'di/pie'*), and paces (*passa/passi*). Venetians used two different fingerbreadths, the *dito grosso* (large fingerbreadth), corresponding to 1/14 of a foot, and the *dito sottile* (small fingerbreadth), corresponding to 1/16 of a foot. The basic unit was the foot, from which fingerbreadths and paces were derived (Table 1). Since the Venetian foot is equal to 34.7735 cm, which includes four digits after the decimal point, all the other measurements (paces and fingerbreadths) are also expressed up to four digits after the decimal for the purpose of consistency.²⁶

Table 1. Venetian linear system of measurement.

Unit	Metric Equivalent	
1 <i>pie'</i>	1 foot = 34.7735 cm	
1 <i>dito grosso</i>	1 large fingerbreadth = 1/14 foot	34.7735 ÷ 14 = 2.4838 cm
1 <i>dito piccolo</i>	1 small fingerbreadth = 1/16 foot	34.7735 ÷ 16 = 2.1733 cm
1 <i>passo</i>	1 pace = 5 feet 34.7735 × 5 = 173.8675 cm	

²⁶ On the Venetian system of linear measurements, see Martini 1883, 817.

Folios 5r-v and 6r-v contain a series of offset measurements that, if plotted in a Cartesian plane (x and y coordinates), render the sheer plan, the sternpost, the stem, and the midship frame, respectively, of the *galia da 5*. A glossary of naval terminology is provided in APPENDIX II. It is of interest to note that the folios recording the measurements of the quinquereme also included some information about a *galea da 5* that had been built previously. For example, the stations in the *partison* of the galley built “in the former way” (*alla prima via*) were 100, whereas in the galley that is being recorded there are 85 stations.²⁷ This is a clear indication that Fausto’s quinquereme was modified in its proportions and, therefore, different from standard galleys. The transcription of folios 1r, 5r-v, and 6r-v, followed by an English translation, is presented here.

Transcription

fol. 1r *Una galia da 5 remi armada pesca pie 5.*

fol. 5r *Galie da 5*

*Longa passa 28 deda 4 ½ dentro dalla
haste. Hanno campi 160 a deda 14 per campo.*

Mo’ a deda 16 ½ ha campi 136 con do mezzi.

Et quasi la vene ad haver in ferir a prova

²⁷ The *partison* is the portion of the hull comprising the frames that are narrowed and/or raised by means of geometrical methods.

*pie 19 deda 4 alla prima via. Mo' per instarsi
con el ferir da poppe l'ha deda 1 manco, che
sono pie 19 deda 3, et più si par fina deda 8.
In sesto alla prima via fu campi 100 che fanno
passa 17 ½, ma a questa sono 85 che fanno
passa 17 deda 42 ½, che fanno deda 1 ½ manco
ferir a poppe. Poi in ferir a poppe pie 33 deda
4 et deda 4 ½ in codama, resta nome in
tutto ferir da poppe pie 33 deda 7.
Sono adonque pie 19 deda 11 a prova in ferir. In
partison da prova deda campi 30, sono pie 30
deda 15, in mezzo campi 5, pie 5 deda 2 ½, in
partison da poppe de campi 50 pie 51 deda 9.
in ferir da poppe pie 33 deda 8 ½.
Sono in tutto pie 140 deda 14 ½, che fanno
li passa 20 deda 11.²⁸
Con late 60 resta in palmete a prova pie 8
deda 5 ½. Palmetta a poppe pie 10 deda
13 ½. Dall'oro dentro dell'hasta fina alla
fazza verso poppe della timonera, pie 3 deda
8. Larga la timoniera deda 8 per prova*

fol. 5v

²⁸ This is an error by the copyist. It should be 28 paces and not 20.

del forcame da poppe.

[...]

Le late dal cao de sesto al zovo de prova

campi 11 et a poppe 22.

fol. 6r *Per la galia da 5 li sestì*

Prima l'hasta da poppe in squara alta pie 10

deda 10. Slanzo pie 7 deda 4. Alza al poselese

del calcagnol deda 10. Dal poselese fina agno²⁹

pie 2 ½, alza la hasta luntano dal poselese

in cao de pie 2 ½ deda 1 per la sua altezza.

In altezza de pie 3 dalla lingua al sesto

pie 1 dede 12. In altezza de pie 6 dalla

ligna fina al-~~6~~-sesto³⁰ deda 2. Pie 6 deda 6

l'accorda l'hasta con la ligna. Poi pie 1

deda 4 scomenza a tornar dentro. Poi

pie 2 dalla ligna al sesto torna dentro

l'hasta de' 9 ½. Poi altezza deda 8 torna

dentro de' 13. In altezza in cima l'hasta

²⁹ The vernacular word *agno* corresponds to the Italian *anco/ancho/anche*, whose translation varies depending on context but it generally means “also.” The vernacular *agno* becomes in Italian *anche* for the phonological phenomenon called consonant shift. The voiced velar plosive *g* shifts into the voiceless velar plosive *c*. In addition, the consonantic group *gn* becomes *nc* in chiasitic position. The Italian *anche* derives from the Latin demonstrative pronoun *hanc* (singular feminine accusative form of *haec* meaning “this”).

³⁰ The number 6 is striken out and replaced by the copyst as *sesto* (in this context meaning “mold”).

dalla ligna alata³¹ pie 1 deda 2.

Slanzo dell'hasta da prova pie 9 deda 2. Alta
pie 7 deda 2. Alza al poselese del cal-
cagnol deda 10. Agno pie 3 dal poselese
alza l'hasta pie uno deda 4. In cao
fol. 6v de pie 6 alza l'hasta pie 1 deda 12. In al-
teza de pie 3 ½ dalla ligna all'hasta
pie do de' 5. Per la zovela dea 7. Larghe
le haste deda 9. Nebelo de' 3. Avanzano
fuora l'hasta di maggiori de' 6 buoni.
El suo costado in squara³² la mita del
sesto. In pontal pie 6 deda 1. In bocca
pie 8 dea 9. Int'el 3 pie dalla ligna
al sesto dea 5. Int'el 6 pie dalla ligna
al sesto dea 5. Dalla mezzaria al poselese
pie 4 ½ boni. Alza el sesto al poselese
dea 5 buoni. Alto el sesto in la corba
dea 5 ½. Partison longa pie 3 dea 2 ½
da poppe, da prova pie 3.

³¹ The word *alata* is a vernacular form for the Latin *ad latum* meaning “on the side.”

³² The term *in squara*, literally meaning “in square,” refers to the rectangle that encompasses one half of the midship frame and basically corresponds to the Cartesian coordinates within which the offset measurements are taken. See, for example, figure 11 showing the *squara* (rectangle) ACDF corresponding to the one half of the midship frame of Fausto's quinquereme.

Translation

fol. 1r The full-load draft of a galley with five oars is 5 feet.

fol. 5r Galleys with 5 oars

The length overall, taken from the outermost edge of the posts, is 28 paces and 4 ½ fingerbreadths.

There are 160 stations [*i.e.*, frame locations] in total, each measuring 14 fingerbreadths [from center to center].

However, if you make each station of 16 ½ fingerbreadths [from center to center],

then you have in total 136 stations and two halves.

Formerly, the distance between the last molded frame at the bow and the stem was 19 feet and 4 fingerbreadths, which was effectively reduced by 1 fingerbreadth in relation to its corresponding part toward the stern.³³

However, if you prefer the portion of the hull toward the bow to be more slender, then add [to it] 8 fingerbreadths.³⁴

Formerly, the molded-frame portion [of the hull] consisted of 100 stations, which measure 17 ½ paces. In this [galley], however, the stations total 85, which measure 17 paces and 42 ½ fingerbreadths. You

³³ The *ferir da poppe*, that is, the distance between the last molded frame at the stern and sternpost.

³⁴ Thus, the *ferir da prova* (the distance between the last molded frame at the bow and the stem) is 19 feet and 11 fingerbreadths.

have to subtract 1 ½ fingerbreadth from the total distance between the last molded frame at the stern and the sternpost.

The distance between the last molded frame at the stern and the sternpost measures 33 feet and 4 fingerbreadths, plus 4 ½ fingerbreadths for the width [of the sternpost]. Therefore, the distance between the last molded frame at the stern and the sternpost measures [effectively] 33 feet and 7 fingerbreadths.³⁵

So, the distance between the last molded frame at the bow and the stem is 19 feet and 11 fingerbreadths.³⁶ [The portion of the hull comprising the molded frames at the bow has 30 stations, equal to 30 feet and 15 fingerbreadths [in total length]. The midship [portion at the bow that is not subjected to narrowing and rising of the frames] consists of 5 stations, equal to 5 feet and 2 ½ fingerbreadths. [The portion of the hull comprising] the molded frames toward the stern has 50 stations, [equal to] 51 feet and 9 fingerbreadths.

fol. 5v The distance between the last molded frame at the stern and the sternpost is 33 feet and 8 ½ fingerbreadths.

The total [length] is 140 feet and 14 ½ fingerbreadths, which is equal to 20³⁷ paces and 11 fingerbreadths.

³⁵ Indeed, 33 feet and 8 ½ fingerbreadths, minus 33 feet and 7 fingerbreadths is 1 ½ fingerbreadth, which corresponds to the length that the manuscript says to subtract.

³⁶ This is obtained by summing 19 feet, 3 fingerbreadths, and 8 fingerbreadths, which is the length the manuscript suggests adding in order to obtain a more slender profile toward the bow.

³⁷ The copyist mistakenly wrote 20 instead of 28. This is clear from the calculations.

With 60 deck beams, the distance between the forward yoke and the stem is 8 feet and 5 ½ fingerbreadths.

The distance between the after yoke and the sternpost is 10 feet and 13 ½ fingerbreadths.

From the inner edge of the [stern] post to the mounting beam of the rudder there are 3 feet and 8 fingerbreadths. The mounting beam of the rudder is 8 fingerbreadths.

[...]

The distance between the last molded frame and the after yoke is 22 stations.

The distance between the last molded frame and the forward transverse outrigger beam is 11 stations.

fol. 6r

Galley of 5: the molds

First of all, the height of the sternpost is 10 feet and 10 fingerbreadths.

The rake [of the sternpost] is 7 feet and 4 fingerbreadths.

At the point where the keel rises, the gripe is 10 fingerbreadths high.

From the point [reference, origin], [measure] 2 ½ feet [along the baseline],

measure 2 ½ feet in height [from the origin along the perpendicular]

measure 3 feet in height. From the perpendicular, measure 1 foot and 12 fingerbreadths. Measure 6 feet in height. After the sixth [foot], add 2 fingerbreadths.

At 6 feet and 6 fingerbreadths, the sternpost coincides with the perpendicular.

At 1 foot and 4 fingerbreadths, the sternpost curves inward.

Then measure 2 feet. From the perpendicular the sternpost curves inward by 9 ½ fingerbreadths. Then measure 8 fingerbreadths. [The sternpost] curves inward by 13 fingerbreadths.

The extremity of the perpendicular. From the perpendicular toward its [right] side measure 1 foot and 2 fingerbreadths.

The rake of the stem is 9 feet and 2 fingerbreadths.

The height [of the stem] is 7 feet and 2 fingerbreadths.

At the point where the keel begins to rise, the gripe is 10 fingerbreadths high.

At 3 feet from the point [of the gripe] measure 1 foot and 4 fingerbreadths in height. Measure

fol. 6v

6 feet [along the baseline]. Measure 1 foot and 12 fingerbreadths in height. Measure 3 ½ feet in height. From the perpendicular to the stem is 2 feet and 5 fingerbreadths.

The yoke is 7 fingerbreadths wide.

The [stem and the stern]post are 9 fingerbreadths wide and 3 fingerbreadths deep.

The frames extend beyond the post a good 6 fingerbreadths.

[The measurements] of one half of a frame in square.

The depth in the hold is 6 feet and 1 fingerbreadth.

The maximum beam [of the ship] is 8 feet and 9 fingerbreadths.

At 3 feet, [measure] 5 fingerbreadths from the base line to the mold.

At 6 feet, [measure] 5 fingerbreadths from the base line to the mold.

[Measure] 4 ½ feet from the center line to the turn of the bilge.

Move the mold up from this point a good 5 fingerbreadths.

The mold is 5 fingerbreadths high on the floor frame.

The narrowing at the stern is 3 feet and 2 ½ fingerbreadths.

The narrowing at the bow is 3 feet.

Reconstructing the Quinquereme

For clarity, the shipbuilding instructions of the *galia da 5* have been rendered by computer graphics using AUTOCAD and represented here. For the stem and the sternpost, the offsets are plotted in the Cartesian coordinates and distances are indicated by capital letters (A, B, C...) along the x and y axes; the resulting points are labeled numerically (1, 2, 3...). In addition, the original text is arranged in tables, showing each phrase and its corresponding offset point.

Sternpost

We propose the following reconstruction of the sternpost based on the offset measurements provided in folio 6r. The original text is tabulated in Table 2, showing each measurement in the original text and its corresponding translation. In addition,

Table 2 shows each measurement plotted in the Cartesian system with its corresponding points represented graphically in Figure 7.

Table 2. Offset measurements of the sternpost (fol. 6r).

	Transcription	Translation	Offset Distances		Point
			Vertical (y)	Horizontal	
HEIGHT OF STERN POST	Prima l'hasta da poppe alta pie 10 deda 10	The height of the sternpost is 10 feet and 10 fingerbreadths	A-B	---	---
RAKE OF STERN POST	Slanzo pie 7 deda 4	The rake [of the sternpost] is 7 feet and 10 fingerbreadths	---	A-C	1
HIGH OF THE GRIPE	Alza al poselese del calcagnol deda 10	At the point where the keel rises, the gripe is 10 fingerbreadths high	A-C'	---	
	Dal poselese fina agno pie 2 ½	From the point [reference, origin], [measure] 2 ½ feet [along the baseline]	---	A-F	2
	Alza la hasta luntano dal poselese in cao de pie 2 ½ deda 1 per la sua altezza	Measure 2 ½ feet in height [from the origin along the perpendicular]	A-F'	---	
	In altezza de pie 3	Measure 3 feet in height	A-G'	---	3
	Dalla lingua al sesto pie 1 dede 12	From the perpendicular, measure 1 foot and 12	---	A-G	

Table 2. Continued.

	Transcription	Translation	Offset Distances		Point
			Vertical (y)	Horizontal	
		fingerbreadths			
	In altezza de pie 6	Measure 6 feet in height	A-H	---	---
	Dalla ligna fina al-6 sesto deda 2	After the sixth [foot], add 2 fingerbreadths	H-I	---	
	Pie 6 deda 6 l'accorda l'hasta con la ligna	At 6 feet and 6 fingerbreadths, the sternpost coincides with the perpendicular	A-4	---	4
	Poi pie 1 deda 4 scomenza a tornar dentro	At 1 foot and 4 fingerbreadths, the sternpost curves inward	4-5	---	5
	Poi pie 2	Then measure 2 feet	5-L'	---	6
	Dalla ligna al sesto torna dentro l'hasta de' 9 ½	From the perpendicular the sternpost curves inward by 9 ½ fingerbreadths	---	A-L	
	Poi altezza deda 8	Then measure 8 fingerbreadths	L'-M'	---	7
	Torna dentro de' 13	[The sternpost] curves inward by 13 fingerbreadths	---	A-M	
	In altezza in cima l'hasta	The extremity of the perpendicular line	A-B	---	8

Table 2. Continued.

	Transcription	Translation	Offset Distances		Point
			Vertical (y)	Horizontal	
	Dalla ligna alata pie 1 deda 2	From the perpendicular towards its [right] side measure 1 foot and 2 fingerbreadths	---	A-B'	

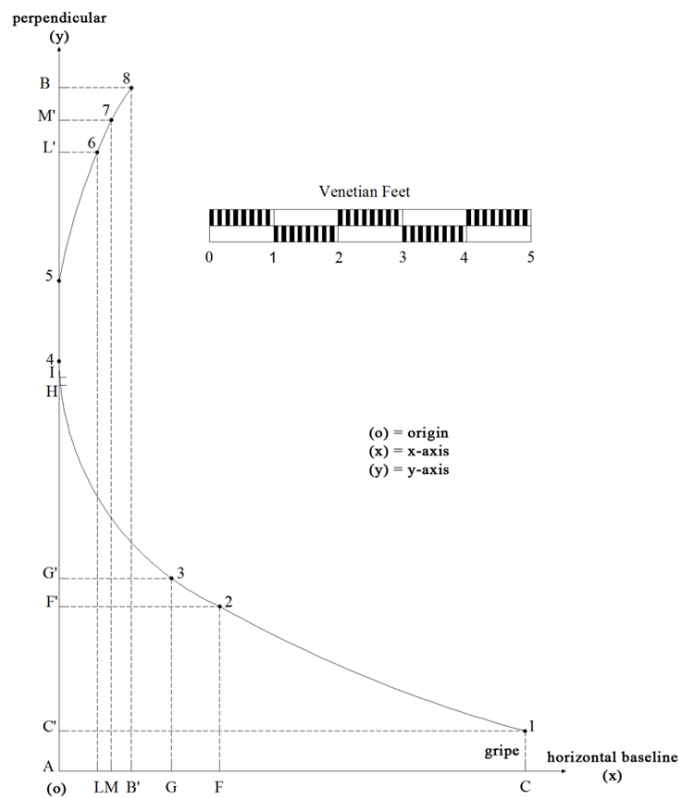


Fig. 7. Reconstruction of the sternpost based on folio 6r of *Misure di vascelli etc. di...proto dell'Arsenale di Venetia*. Drawing: L. Campana.

Stem

Following the same procedure mentioned for the sternpost, a reconstruction of the stem for the *galea da 5* is proposed below. The text of folios 6r-v recording the measurements of the stem is shown on Table 3.

Based on the measurements provided for the stem, however, the location of point 3 obtained by the intersection of lines A-E and A-E' is clearly incorrect (fig. 8).

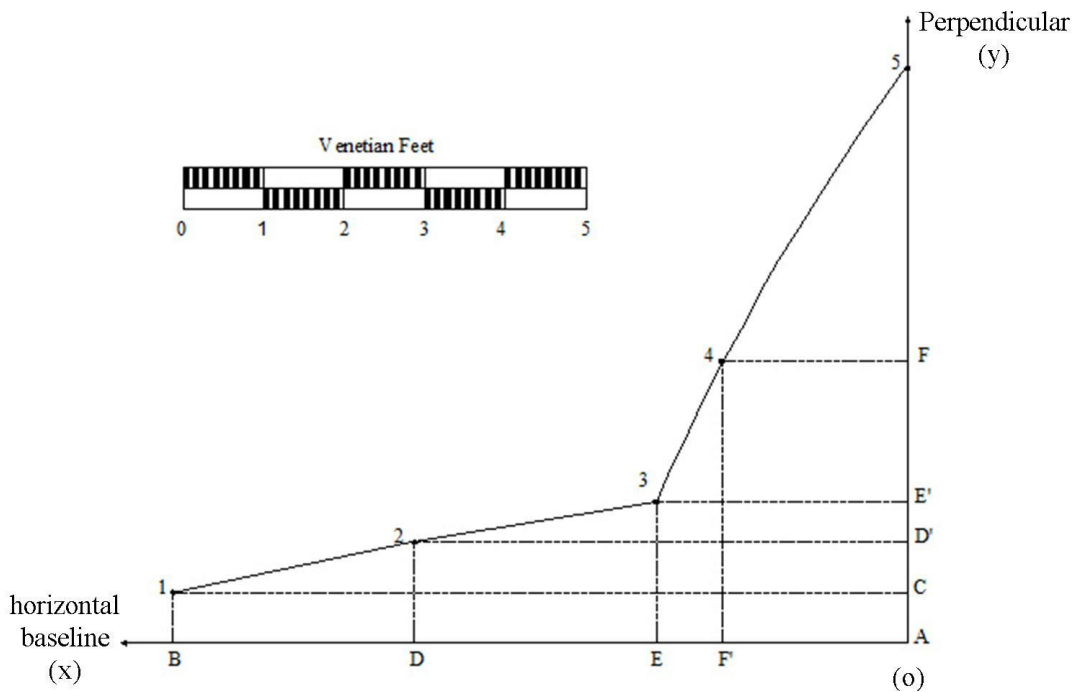


Fig. 8. Reconstruction of the stem of the *galea da 5* based on folio 6r-v of *Misure di vascelli etc. di...proto dell'Arsenale di Venetia*. Drawing: L. Campana.

The irregular profile of the stem suggests a copying error in the measurement of point 3. This is most likely due to an error by the copyist. After several trials, it became apparent that A-E' was incorrect and could not have measured only 1 feet and 12 fingerbreadths, as recorded by the copyist. By simply adding 1 foot to the previous measurement, a more plausible and smooth profile for the stem is obtained (fig. 9)

Table 3. Offset measurements of the stem (fols. 6r-v).

	Transcription	Translation	Offset Distances		Point
			Vertical (y)	Horizontal (x)	
RAKE OF STEM	Slanzo dell'hasta da prova pie 9 deda 2	The rake of the stem is 9 feet and 2 fingerbreadths	---	A-B	---
HEIGHT OF STEM	Alta pie 7 deda 2	The height [of the stem] is 7 feet and 2 fingerbreadths	A-5	---	5
	Alza al poselese del calcagnol deda 10	At the point where the keel begins to rise, the gripe is 10 fingerbreadths high	A-C	---	1
	Agno pie 3 dal poselese	At 3 feet from the point [of the gripe]	---	B-D	2

Table 3. Continued.

	Transcription	Translation	Offset Distances		Point
			Vertical (y)	Horizontal (x)	
	Alza l'hasta pie uno deda 4	Measure 1 foot and 4 fingerbreadths in height	A-D'	---	2
	In cao de pie 6	Measure 6 feet [along the baseline]	---	B-E	3
	Alza l'hasta pie 1 deda 12	Measure 1 foot and 12 fingerbreadths in height	A-E'	---	
	In alteza de pie 3	Measure 3 ½ in height	A-F	---	4
	Dalla ligna all'hasta pie do de' 5	From the perpendicular to the stem is 2 feet and 5 fingerbreadths	---	A-F'	

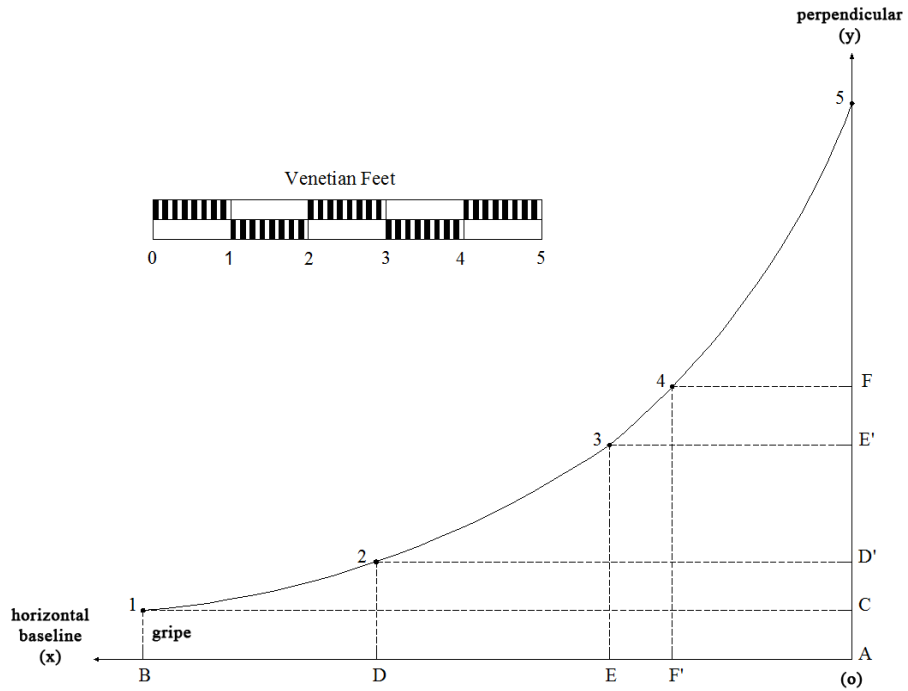


Fig. 9. Modified reconstruction of the stem of the *galea da 5* based on folios 6r-v of *Misure di vascelli etc. di...proto dell'Arsenale di Venetia*. Drawing: L. Campana.

Midship Frame

A reconstruction of the midship frame of the *galea da 5* is shown in figure 10. The original text is tabulated in Table 4 showing each measurement in the original text and its corresponding translation. This section also suggests a step-by-step procedure used in designing the midship frame of the ship (figs. 11-19).

Table 4. Offset measurements of the midship frame (fol. 6v).

Transcription	Translation	Calculations	Offset	Points
El suo costado in squares la mita del sesto	[The measurements] of one half of a frame in square	---	---	---
In pontal pie 6 deda 1	The depth in the hold is 6 feet and 1 fingerbreadth	6 feet \times 34.7735 cm = 208.6410 cm 1 fingerbreadth \times 2.1733 cm = 2.1733 cm 208.6410 + 2.1733 = 210.8143 cm	F-4	---
In bocca pie 8 dea 9	The maximum bream [of the ship] is 8 feet and 9 fingerbreadths	8 feet \times 34.7735 cm = 278.1880 cm 9 fingerbreadths \times 2.1733 cm = 19.5597 cm 278.1880 + 19.5597 = 297.7477 cm	4-C	---
Dalla mezzaria al poselese pie 4 1/2 bon	[Measure] 4 1/2 feet from the center line to the turn of the bilge	4 1/2 feet \times 34.7735 cm = 156.4771 cm	F-M	3

Table 4. Continued.

Transcription	Translation	Calculations	Offset	Points
Alza el sesto al poselese dea 5 buoni	Move the mold up from this point a good 5 fingerbreadths	5 fingerbreadths \times 2.1733 cm = 10.8665 cm	F-N	3
Partison longa pie 3 dea 2 ½ da poppe	The narrowing at the stern is 3 feet and 2 ½ fingerbreadths	3 feet \times 34.7735 cm = 104.3205 cm 2 ½ fingerbreadths \times 2.1733 cm = 5.4332 cm 104.3205 + 5.4332 = 109.7538 cm	F-L	---
da prova pie 3	The narrowing at the bow is 3 feet	3 feet \times 34.7735 cm = 104.3205 cm	F-O	---

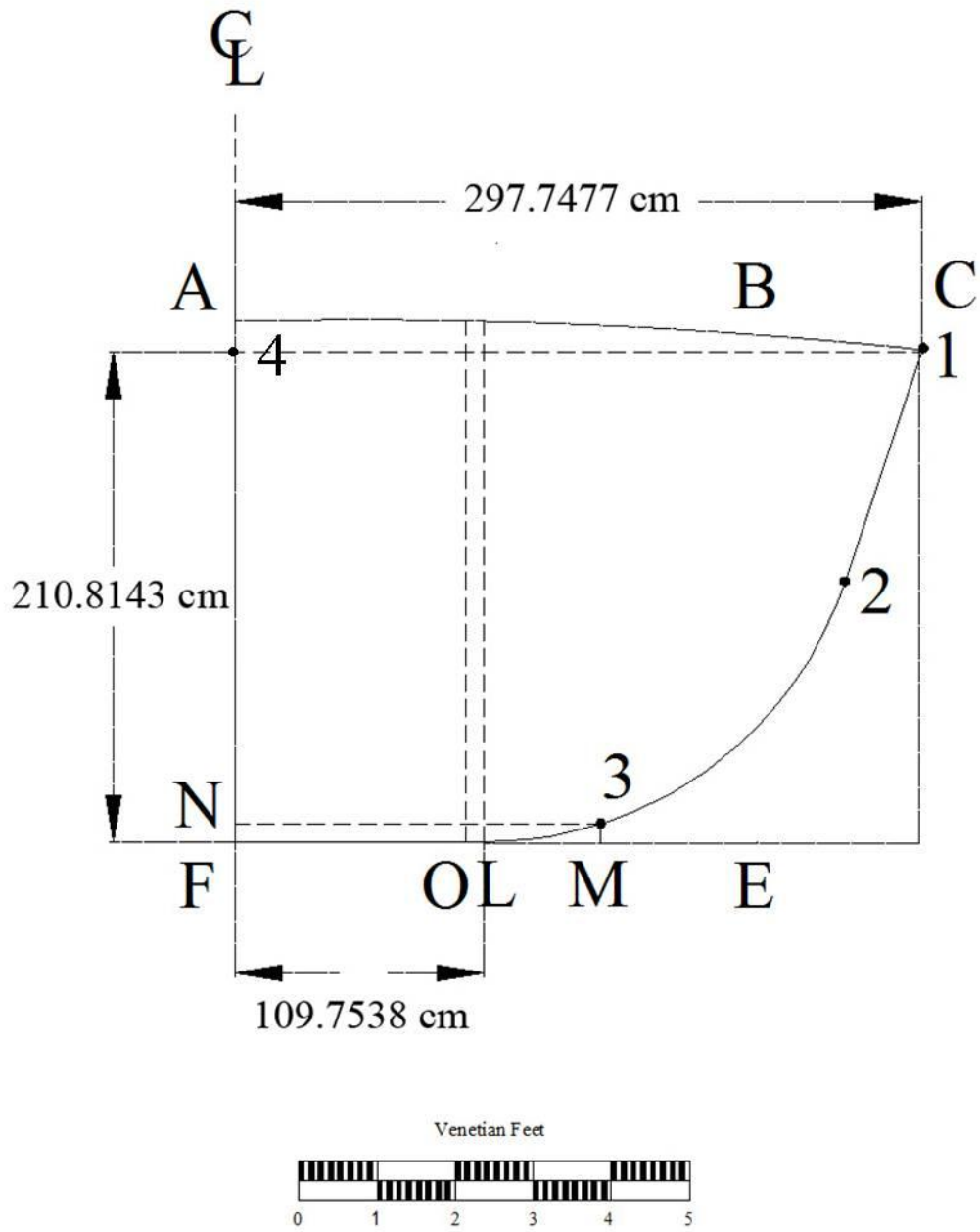


Fig. 10. Reconstruction of the midship frame based on folio 6v of *Misure di vascelli etc. di...proto dell'Arsenale di Venetia*. Drawing: L. Campana

Below, the suggested sequence for designing the midship frame is illustrated.

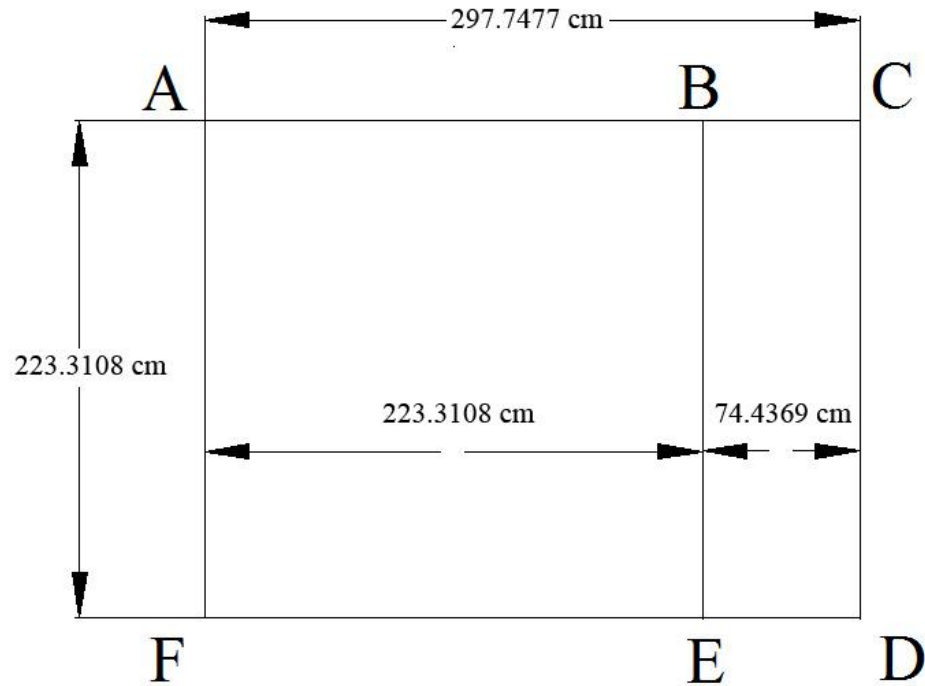


Fig. 11. Suggested sequence for designing the midship frame, step 1.

- 1) Construct a rectangle representing the maximum half-breadth (A-C and F-D) of the hull, and the height at half-breadth (C-D and A-F) equal to $\frac{3}{4}$ of the maximum half-breadth (fig. 11).

$$\begin{aligned}
 A-C = F-D &= 8 \text{ feet and } 9 \text{ fingerbreadths} \\
 &= (34.7735 \text{ cm/feet} \times 8 \text{ feet}) + (2.1733 \text{ cm/fingerbreadths} \times 9 \\
 &\text{fingerbreadths}) \\
 &= 278.1880 \text{ cm} + 19.5597 \text{ cm} = 297.7477 \text{ cm}
 \end{aligned}$$

and

$$A-F = C-D = \frac{3}{4} \times 297.7477 \text{ cm} = 223.3108 \text{ cm}$$

- 2) Divide the rectangle by perpendicular line B-E so that B-C (= E-D) is equal to $\frac{1}{4}$ of the maximum beam A-C (= F-D)

$$\frac{1}{4} \times 297.7477 \text{ cm} = 74.4369 \text{ cm}$$

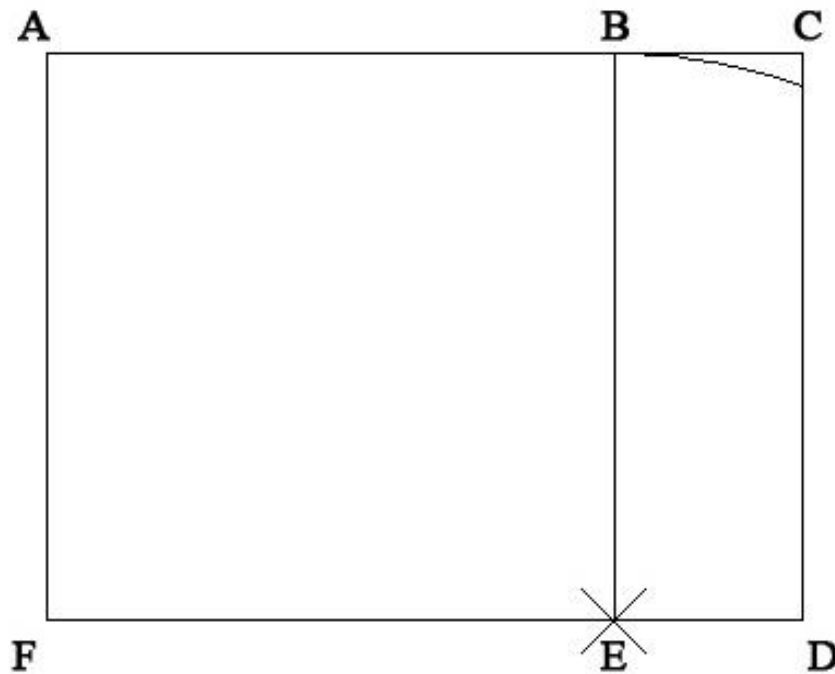


Fig. 12. Suggested sequence for designing the midship frame, step 2.

- 3) Draw an arc of a circle with its center at E and its radius equal to B-E (= E-F), so that it intersects line C-D (fig. 12).

- 4) Draw a diagonal from E to C to obtain point 1 at the intersection of diagonal E-C with circle arc (fig. 13).
- 5) Note that angle $\widehat{F\hat{E}C}$ is 108° (fig. 13).

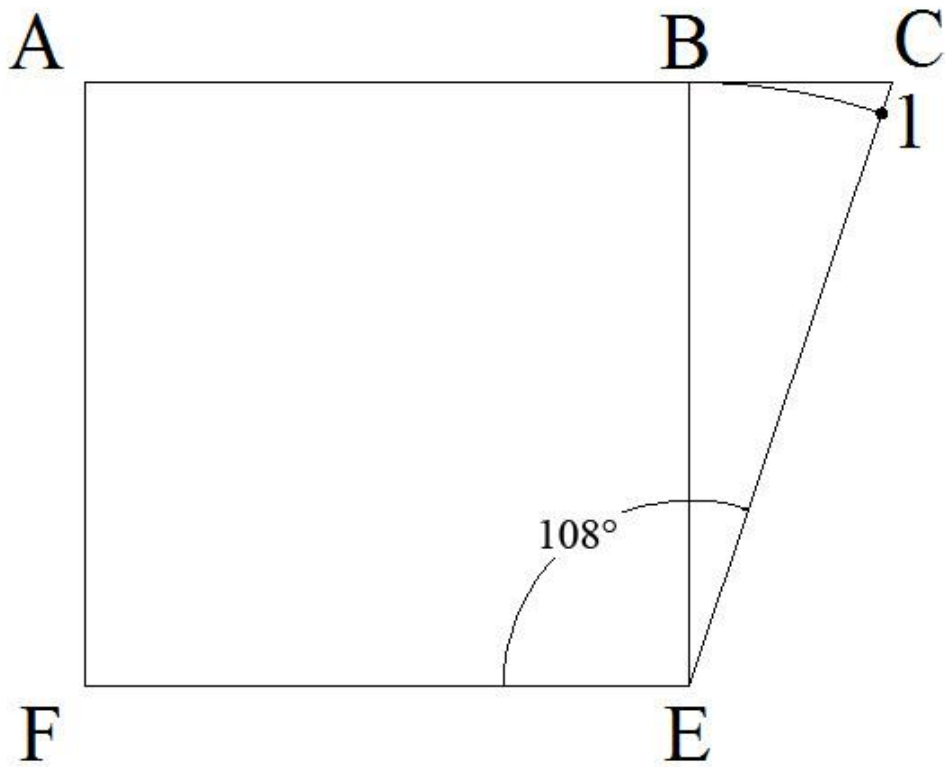


Fig. 13. Suggested sequence for designing the midship frame, step 3.

6) Bisect angle $F\hat{E}C$ (180°) with line E-G to obtain angle $F\hat{E}G$ (54°) (fig. 14).

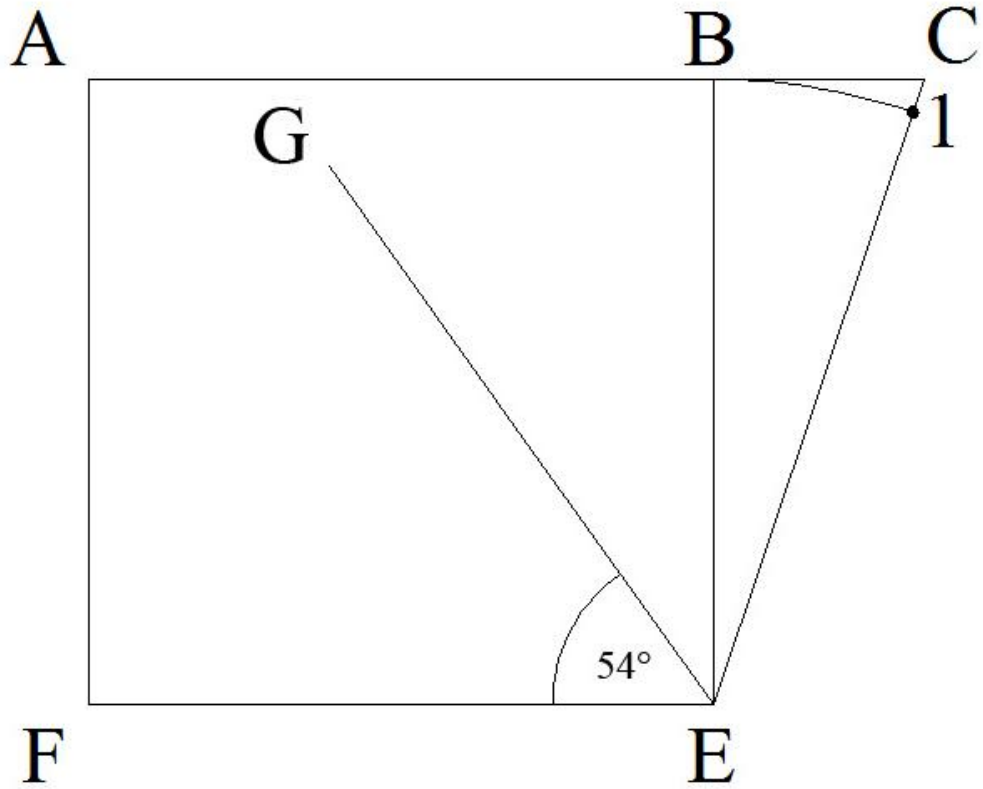


Fig. 14. Suggested sequence for designing the midship frame, step 4.

7) Draw a line from F to 1, so that F1 intersect E-G at H (fig. 15).

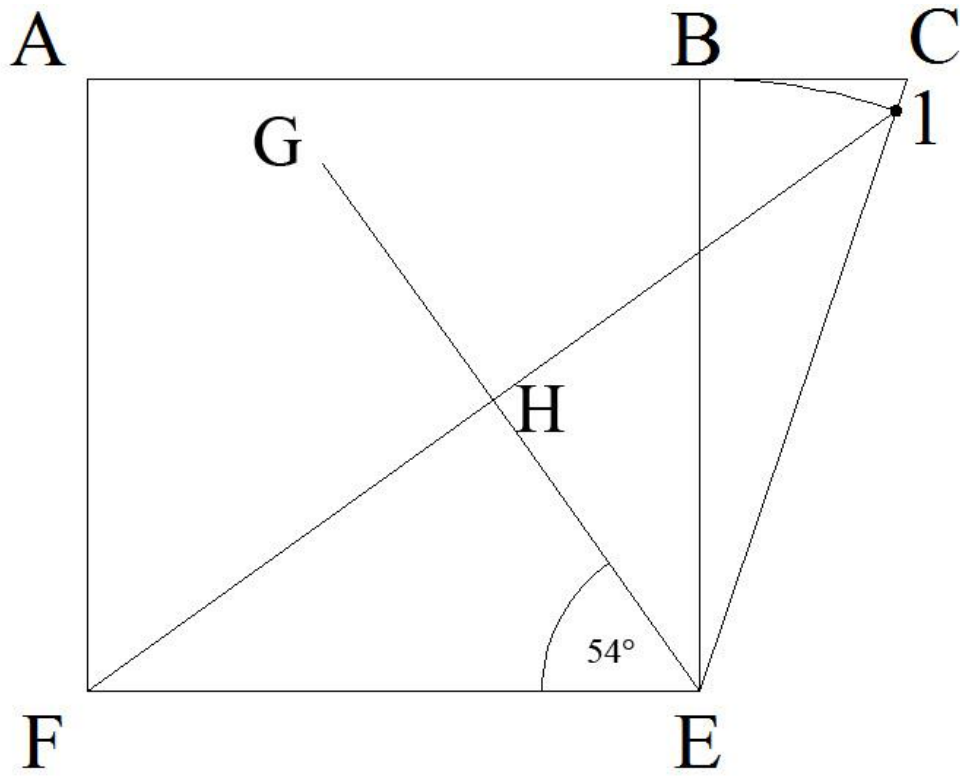


Fig. 15. Suggested sequence for designing the midship frame, step 5.

8) Draw a perpendicular bisector for E-C at 2 so that it intersects E-G at I (fig. 16).

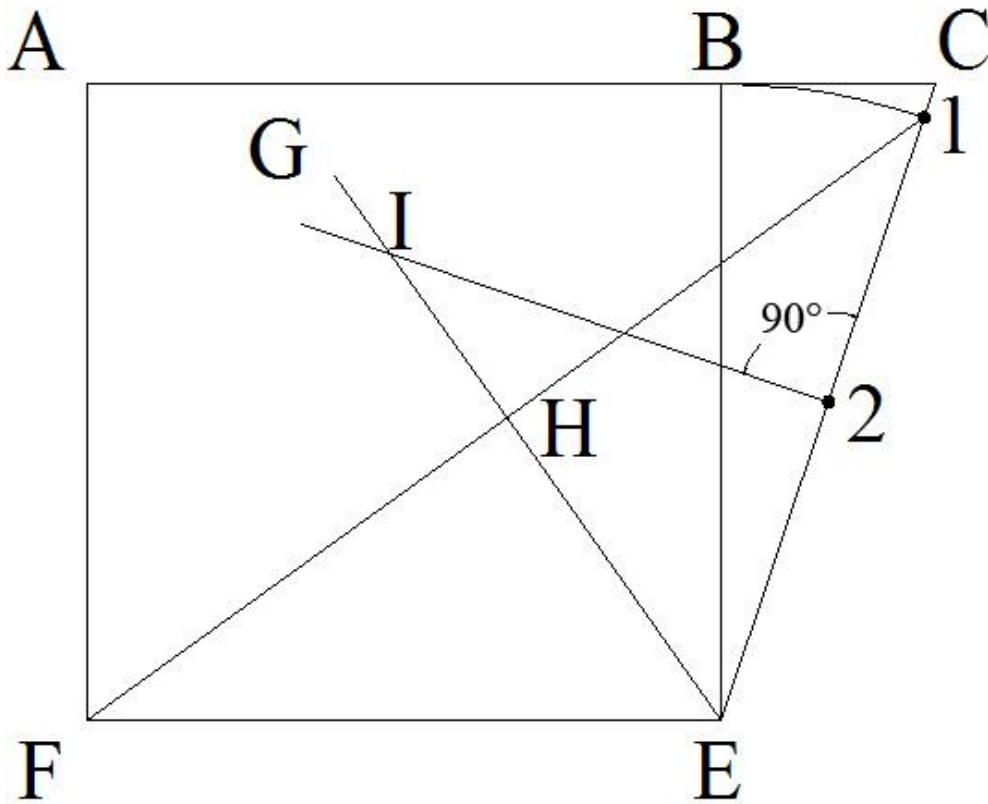


Fig. 16. Suggested sequence for designing the midship frame, step 6.

9) Drop a perpendicular from I to F-E to obtain point L (fig. 17).

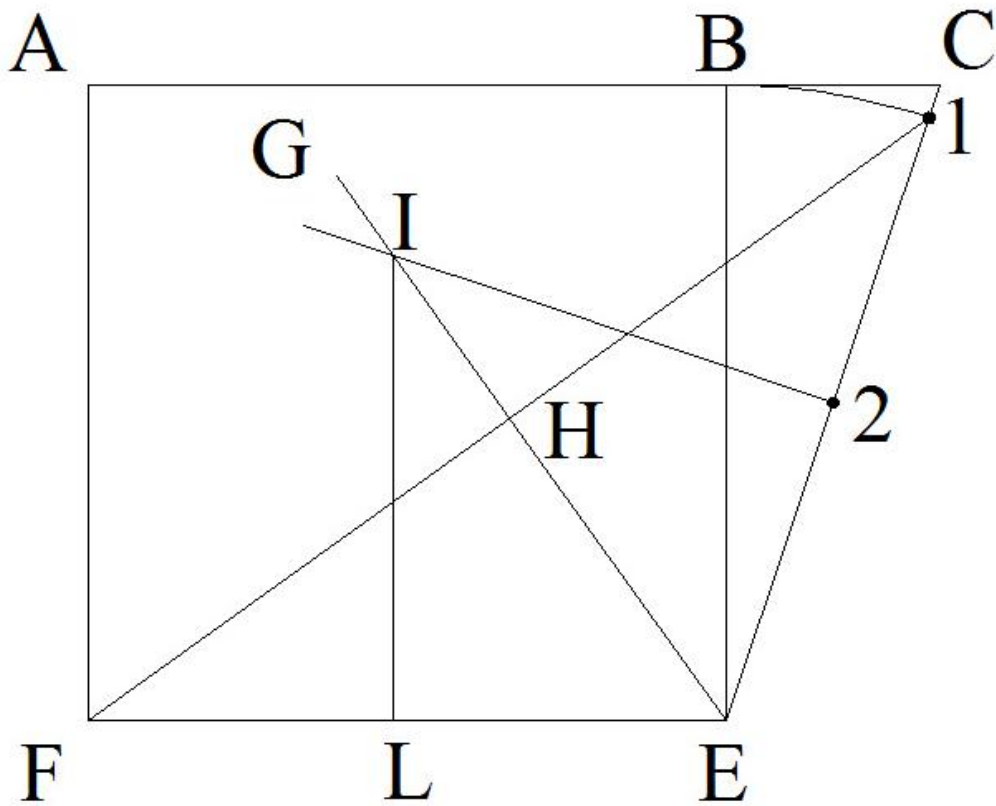


Fig. 17. Suggested sequence for designing the midship frame, step 7.

11) Removing construction lines to obtain half of the midship frame (fig. 19).

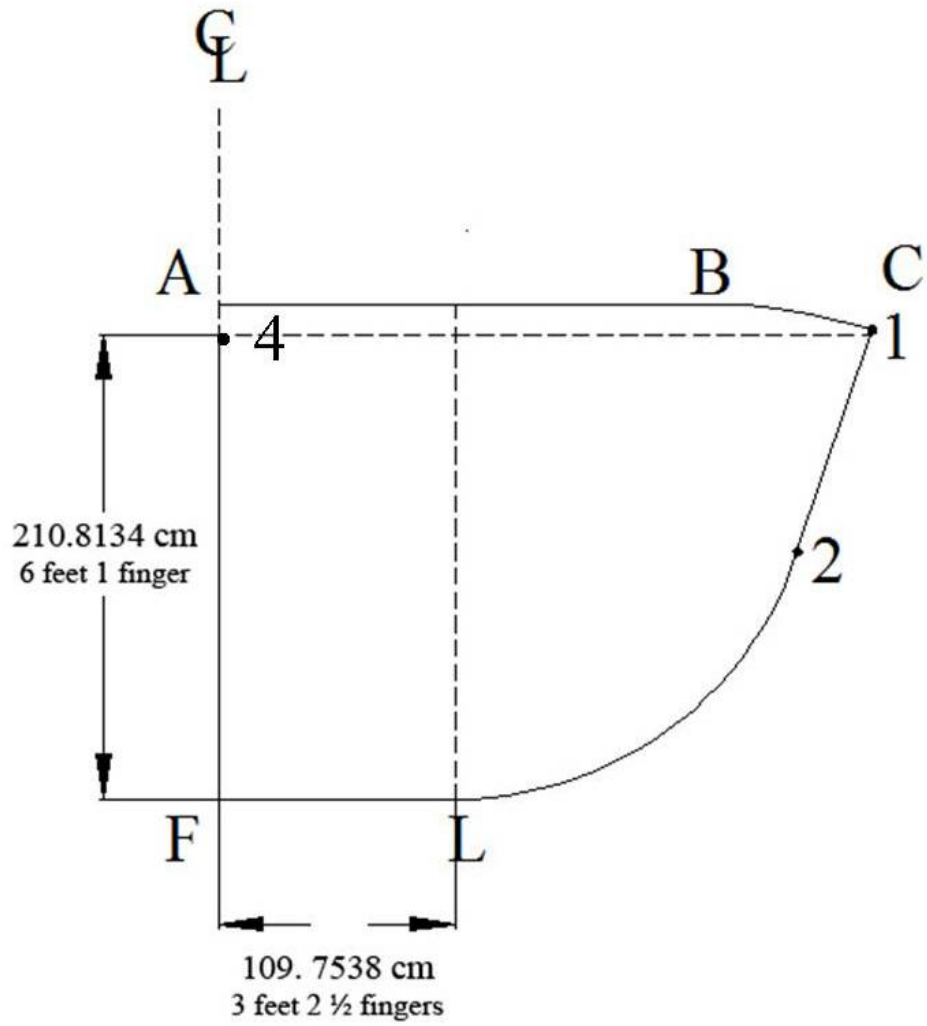


Fig. 19. Suggested sequence for designing the midship frame, step 9.

Points F, L, 2, and 1 form the profile of the midship frame.

F-L is the midship flat (*partison del fondo di poppa*) corresponding to 3 feet and 2 ½ fingerbreadths (109.7538 cm) as specified in the manuscript.

F-4 is the depth in the hold (*pontal*) corresponding to 6 feet and 1 fingerbreadth (210.8134 cm) as specified in the manuscript.

Construction of the Mold

Based on the measurements provided by folios 6v, a suggested construction of the mold (*sesto*) of the *galea da 5* is shown in figure 20. The mold is moved in the direction of the arrow by the increment for each successive station (floor location), resulting in the narrowing of the floors toward either end (*cai de sesto*) of the hull from amidships.

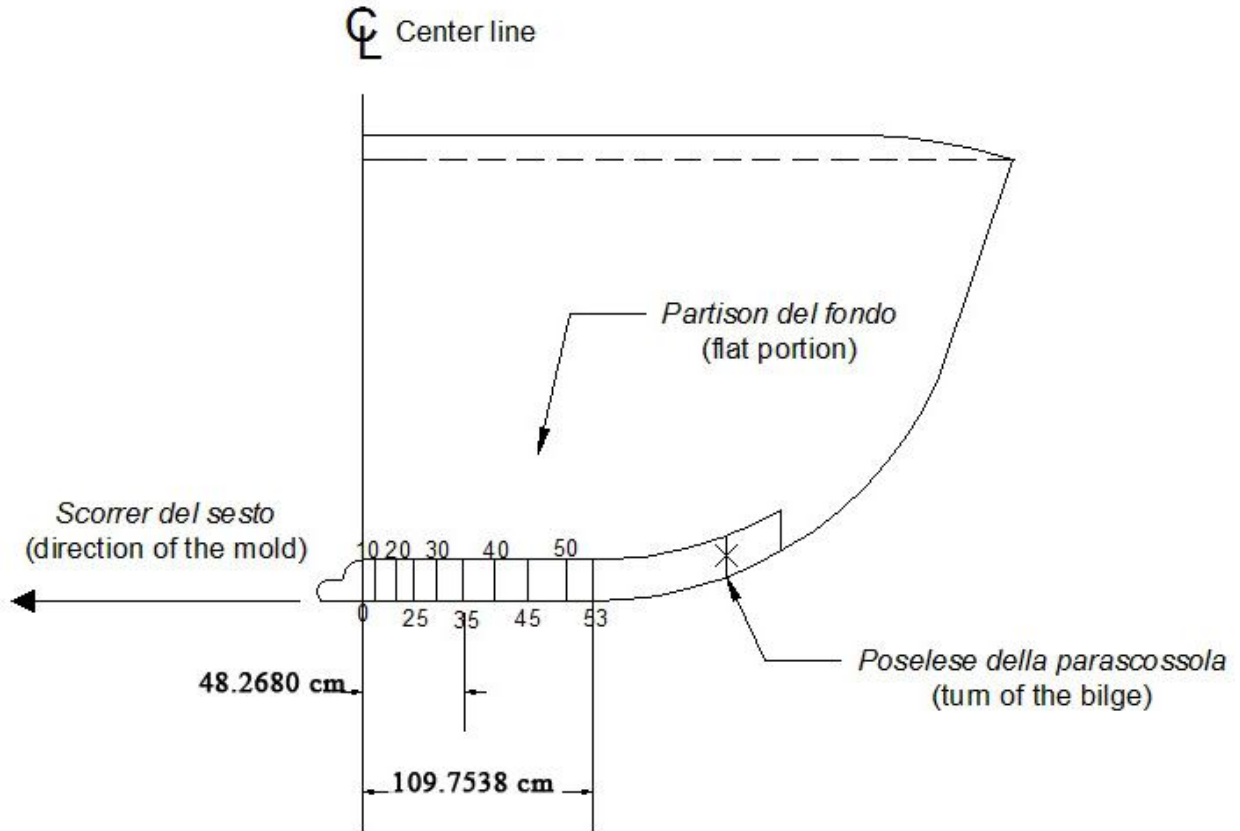


Fig. 20. Construction of the mold for the *galea da 5*.

The manuscript notes that the narrowed length of the flat portion of the designed frame's floor is 3 feet and 2 ½ fingerbreadths, corresponding to 109.7538 cm. The *partison*, or portion of the hull consisting of frames that are narrowed and/or raised by means of geometrical methods, totals 53 stations, or frame locations, in the *galea da 5*.

Thus, the increment of each mark on the mold can be easily calculated using Gauss' formula:

$$\Sigma = n \times \frac{n + 1}{2}$$

$$\Sigma = 53 \times \frac{53 + 1}{2}$$

$$\Sigma = 53 \times 27 = 1431$$

The mold, therefore, consists of 1431 increments.

Dividing the total narrowed length of the flat portion of the designed frame's floor (109.7538 cm) by 1431 gives the exact length each increment:

$$109.75 \text{ cm} \div 1431 = 0.0766 \text{ cm}$$

For example, the narrowed length of the floor flat at the 35th station toward the stern is 48.2580 cm (fig. 20) obtained as follows:

$$\Sigma = 35 \times \frac{35 + 1}{2}$$

$$\Sigma = 35 \times 18 = 630$$

$$0.0766 \text{ cm} \times 630 = 48.2580 \text{ cm}$$

Sheer Plan

Based on the measurements provided by folios 5r-v, a suggested reconstruction of the sheer plan is shown in figure 21. The original text and corresponding translations and calculations are tabulated on Table 5.

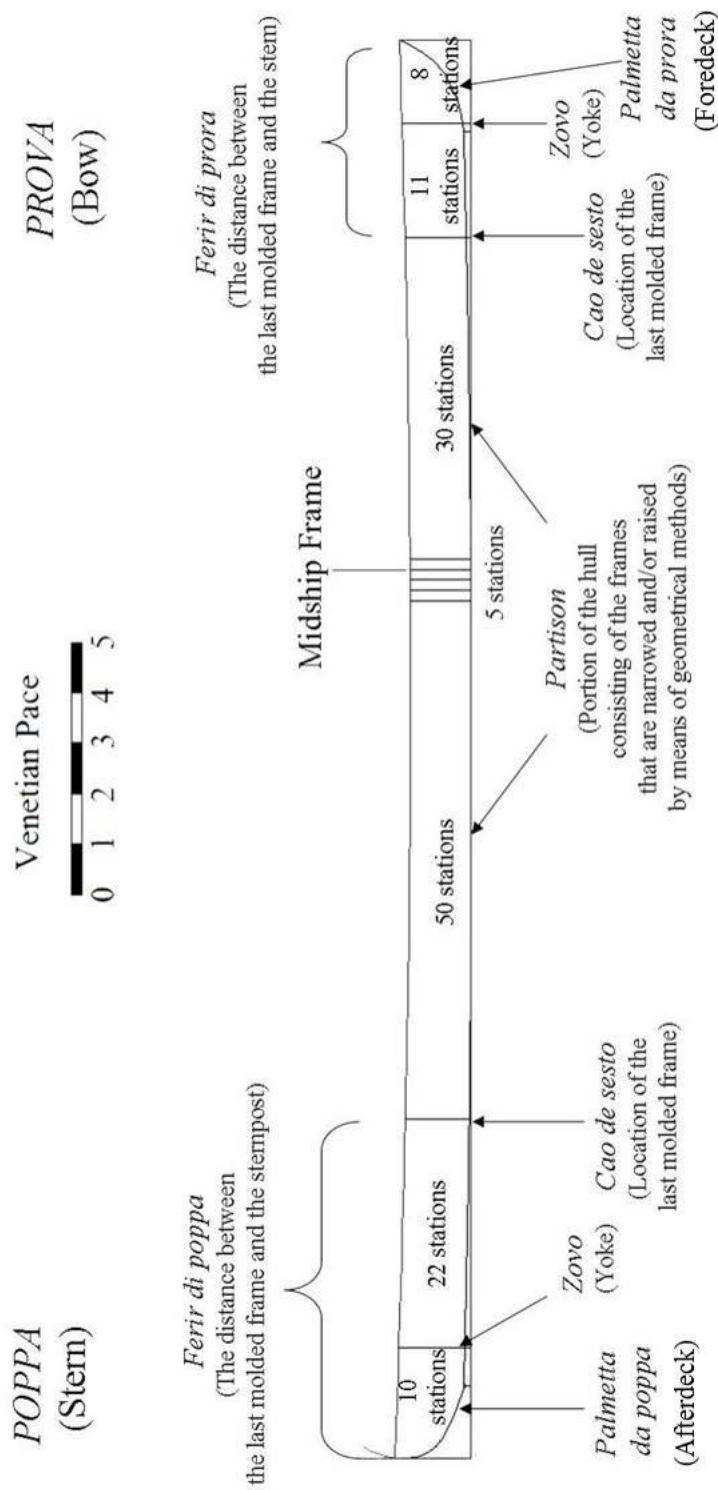


Fig. 21. Reconstruction of the sheer plan of the *galea da 5* based on folios 5r-v of *Misure di vascelli etc. di...proto dell'Arsenale di Venetia*. Drawing: L. Campana.

Table 5. Offset measurements of the sheer plan of the *galea da 5* (fols. 5r-v).

		Transcription	Translation	Calculations	Stations
		Longa passa 28 deda 4 ½ dentro dalle haste	(The galley) is 28 paces and 4 ½ fingerbreadths long measuring between the posts	---	---
<i>Campi</i> Stations	Total	Mo' a deda 16 ½ ha campi 136 con do mezzi	Now, if each station is 16 ½ fingerbreadths, there are 136 stations and 2 ½	Fingerbreadths = 28 × 5 = 140 Fingerbreadths = 140 × 16 = 2,250 2,240 + 4 ½ = 2,244 ½ Stations = 2,244 ½ ÷ 16 ½ = 136.03	136
	Frame in the mid- portion	In mezzo campi 5, pie' 5 deda 2 ½	In the middle portion, there are 5 stations [for a total of] 5 feet and 2 ½ fingerbreadths	Fingerbreadths = 5 × 16 = 80 80 + 2 ½ = 82 ½ Stations = 82 ½ ÷ 16 ½ = 5	5
	<i>Partison</i> (total)	Sono 85, che fanno passa 17 deda 42 ½	There are 85 stations [for a total of] 17 paces and 42 ½ fingerbreadths	Feet = 17 × 5 = 85 Fingerbreadths = 85 × 16 = 1,360 1,360 + 42 ½ = 1,402 ½ Stations = 1,402 ½ ÷ 16 ½ = 85	85

Table 5. Continued.

		Transcription	Translation	Calculations	Stations
<i>Campi</i> Stations	<i>Partison da prova</i> (toward the bow)	In partison da prova deda campi 30, sono pie' 30 deda 15	In the portion of the hull comprising the molded frames toward the bow, there are 30 stations [for a total of] 30 feet and 15 fingerbreadths	Fingerbreadths = $30 \times 16 = 480$ $480 + 15 = 495$ Stations = $495 \div 16 \frac{1}{2} = 30$	30
	<i>Partison da poppe</i> (toward the stern)	In partison da poppe campi 50, sono pie' 51 and deda 9	In the portion of the hull comprising the molded frames toward the stern, there are 50 stations, (that is) 51 feet and 9 fingerbreadths	Fingerbreadths = $51 \times 16 = 816$ $816 + 9 = 825$ Stations = $825 \div 16 \frac{1}{2} = 50$	50
	<i>Ferir da prova</i>	In ferir a prova pie' 19 deda 11	The distance between the last molded forward frame and the stem is 19 feet and 4 fingerbreadths	Fingerbreadths = $19 \times 16 = 304$ $304 + 11 = 315$ Stations = $315 \div 16 \frac{1}{2} = 19.09$	19

Table 5. Continued.

		Transcription	Translation	Calculations	Stations
Campi Stations	<i>Ferir da poppe</i>	In ferir da poppa pie' 33 deda 8 ½	The distance between the last molded after frame and the sternpost is 33 feet and 8 ½ fingerbreadths	Fingerbreadths = 33 × 16 = 528 528 + 8 ½ = 536 ½ Stations = 536 ½ ÷ 16 ½ = 32.51	32
	<i>Palmetta da prova</i>	In palmete a prova pie' 8 deda 5 ½	The distance between the forward yoke and the stem is 8 feet and 5 ½ fingerbreadths	Fingerbreadths = 8 × 16 = 128 128 + 5 ½ = 133 ½ Stations = 133 ½ ÷ 16 ½ = 8.09	8
	<i>Palmetta da poppe</i>	Palmetta a poppe pie' 10 deda 13 ½	The distance between the after yoke and the sternpost is 10 feet and 13 ½ fingerbreadths	Fingerbreadths = 10 × 16 = 160 160 + 13 ½ = 173 ½ Stations = 173 ½ ÷ 16 ½ = 10.51	10
	<i>Cao de sesto al zovo da prova</i>	Le late dal cao de sesto al zovo da prova campi 11	The distance between the last molded forward frame and the forward yoke is 11 stations	Feet and fingerbreadths = 11 × 16 ½ = 181 ½ 181 ½ ÷ 16 = 11.34375= 11 feet and 5 ½ fingerbreadths	11

Table 5. Continued.

		Transcription	Translation	Calculations	Stations
	<i>Cao de sesto al zovo (poppa)</i>	(Le late dal cao de sesto al zovo) a poppe (campi) 22	The distance between the last molded after frame and the after yoke is 22 stations	Feet and fingerbreadths = $22 \times 16 \frac{1}{2} = 363$ $363 \div 16 = 22.6875$ = 22 feet and 11 fingerbreadths	22

An Interpretative Hypothesis of the Anonymous Sixteenth-century Venetian Shipbuilding Manuscript *Misure di vascelli etc. di...proto dell'Arsenale di Venetia*

The author of *Misure di vascelli etc. di...proto dell'Arsenale di Venetia* remains unknown, although it is certain that he was a master shipbuilder who worked in the service of the Arsenal of Venice during the mid-sixteenth century. Tucci proposed some interesting views about its authorship, which, however, must now be disregarded based on new information that came to light while I was conducting research for the present study. The attribution of the manuscript's author is not a simple task, given the fact that, from the study of Venetian Renaissance shipbuilding manuscripts, it seems clear that all the shipwrights considered themselves beholders of the *secrets du métier*

for building *the* perfect galley. As Alberto Tenenti noted, “inside the walls of the Arsenal, all the master shipbuilders engaged in competition [to build the best galley] and to gain some rewards from the State; in order to design galleys, each shipwright employed his own mold, which had to remain secret and should not be revealed.”³⁸

During the fifteenth and the sixteenth centuries, the Venetian government and the Arsenal promoted new designs for building galleys in order to maintain (and later to reaffirm) the Republic’s supremacy at sea. It is not uncommon to read, in the documents preserved at the State Archive of Venice, many decrees promulgated by the *Senato mar* – the office in charge of naval affairs – that provided incentives and authorized the construction of ships based on new designs.³⁹ Toward the end of the sixteenth century, however, the *proto* Baldissera Quintio Drachio on more than one occasion voiced his disapproval of the custom of building galleys according to different designs because it generated confusion and resulted in imperfect ships.⁴⁰ Drachio proposed to standardize the galleys to one design. However, his attempt at reorganizing the Arsenal ended abruptly one night when he was assaulted and beaten by an unidentified group of men. Eventually, Drachio was forced to abandon the Arsenal.⁴¹

³⁸ Tenenti 1962, 31: *A l’intérieur de l’Arsenal plusieurs maîtres se disputaient les commandes de l’État et les récompenses qui y étaient attachées : chacun construisait d’après le modèle de son invention, qui demeurait secret et ne se transmettaient pas, en principe.*

³⁹ See, for example, ASVe, Senato mar, reg. 14, fol. 141r, and fol. 48r (Leonardo Bressan built a *barza*); ASVe, Senato mar, reg. 21, fol. 160r (Leonardo Bressan built a *barza* larger than the usual size, which made it necessary to break the Arsenal wall to get it out); ASVe, Patroni e Provveditori all’Arsenal, env. 133, fol. 107r (Fausto was authorized to build a great galley of his own design).

⁴⁰ ASVe, Patroni e Provveditori all’Arsenal, env. 533 (*Ricordi intorno la casa dell’Arsenal*); ASVe, Archivio Proprio Contarini, env. 25 (*Visione di Baldissera Quintio Drachio*). Translated by Th. Lehmann 1992.

⁴¹ Lehmann 1992, 1.

Returning to the initial question about the authorship of the *Misure di vascelli*, it is necessary to examine the earliest date provided by the manuscript, 25 April 1530. On the very same day, the Proveditors and the Superintendents of the Arsenal authorized the construction of five new great galleys, each one to be built by a different master shipbuilder who had to design their respective galleys by using “their own mold.”⁴² At that time in the Arsenal there were only the *proto* Lunardo Bressan and four foreman shipwrights capable of building great galleys: Ieronimo Rosso, Francesco de Todarin Zoto, Vincenzo Vitturi, and Vettor Fausto.

As already suggested by Tucci, the author of *Misure di vascelli* must be identified with one of the above five master shipbuilders. Tucci concluded, however, that “...both Bressan and Fausto have to be excluded as authors of the manuscript *Misure di vascelli*. For the remaining [foreman shipwrights] – namely Ieronimo Rosso, Francesco de Todarin Zoto, and Vincenzo Vitturi – no documents have surfaced so far revealing which of the them was the author of the manuscript.”⁴³

It is further necessary to consider the second date provided by the manuscript, 1 April 1546, which accompanied the description and instructions to build a galleon. Fausto had died just a few months earlier. A document from the State Archive of Venice, dated 18 January 1546, records that “...the famous *dominus* Vettor Fausto

⁴² ASVe, Patroni e Provveditori all’Arsenal, env. 133, fol. 107r. It should be noted that Vettor Fausto was never a foreman shipwright (*capo cantiere*), as he was never formally hired by the Arsenal.

⁴³ Tucci 1964, 281: *Esclusi il Bressan e il Fausto, il probabile autore di queste ‘Misure di vascelli’ resta, così, incerto tra Francesco de Todarin, Ieronimo Rosso, Vincenzo Vitturi, e non ci sembra che possano invocarsi argomenti in favore dell’uno o dell’altro.*

recently died without leaving any heirs.”⁴⁴ Therefore, Fausto’s sister, Apollonia, claimed his possessions.

An extremely important piece of information provided by documents in the State Archives of Venice is that Fausto, before dying, had just begun building a galleon, which was left unfinished in the Arsenal.⁴⁵ A senatorial decree of 22 October 1547, about one year after Fausto’s death, decided that:

Since the galleon has always given prestige to Our Signory against enemies, and since it is finished up to the first deck, in order to launch it, we have to provide for it. Therefore, according to the opinion of the master shipbuilders of our Arsenal, we have to complete it, also because we have already established by the senatorial decree dated to last November that [the galleon] should be removed from the water and put back on the dockyard. It is established now that the Patrons and Proveditors of this Arsenal have to dismantle a portion of the wall of the Arsenal *Novissimo* toward Murano, so that the galleon could enter the Arsenal and be placed in a dry ship-shed. The galleon has to be put on the stocks, and the shipwrights with the master shipbuilders have to complete it according to its mold and measurements, without modifying its proportions.⁴⁶

⁴⁴ ASVe, Collegio, Notatorio, reg. 26, fol. 51r.

⁴⁵ Fausto also built a “small galleon” and another “huge galleon” in the 1540s. The first one was launched in 1542—and not in 1544 as stated by Concina (1990, 121)—since the Senate, on 13 May 1542, planned to use it against the Uskoks in Dalmatia, but then dismissed the idea (ASVe, Senato mar, reg. 26, fol. 100r). The “huge galleon” (*il galion grande*) was launched on 11 December 1558, but sank the same day just as it reached Malamocco, for the ship’s heavy artillery shifted to one side causing the ship to take in water from the gunports (ASVe, Maggior Consiglio, Deliberazioni, reg. 28, fol. 77r). The salvage operations lasted about two months (ASVe, Senato mar, reg. 35, fol. 15r, and fols. 35v-36r). As noted by Aymard (1991, 263-7), during the sixteenth century, the Arsenal commissioned the construction of several galleons and heavy ships, such as the *barze* built by Leonardo Bressan, and the first galleon ever built in the Arsenal (1526-30) by Matteo Bressan.

⁴⁶ ASVe, Senato mar, reg. 29, fol. 125r: *Havendosi la Signoria Nostra in ogni sorte de tempi servito del galione con molta reputation appresso di cadauno, et essendo quello stà disfatto fino sopra la prima coperta, per esser fatto navigabile, è a proposito delle cose nostre dover far provisione, che per beneficio publico el sia revocato, come consigliano li prothi nostri all’arsenal, che commodamente si possi fare, essendo anco presi novissimo che è’ verso Murano quanto possi capir, et ricever dentro il detto galione, il qual per loro sia fatto tirror in terra dentro l’arsenà predetto, et sia fatto poner sopra i vasi, et sia pontato, pesandolo sotto di cinque novembre passato chel sii tirrorato in terra. Però l’anderà parte, che per autorità di questo consiglio sii imposto alli proveditori er patroni all’arsenal che debbi far apprir tanto della muraglia dell’arsenal nella mezzaria er facendolo da corba a corba su le misure et sesto di quello cavate, restar da quelli prothi et maestri, che a loro parerano esser sufficienti, liquali non debbino azonzer ne sminuir le mesure et sesto.* Pantera Pantero (1614, 40-3) notes that Fausto’s galleon

Remarkably, the Senate also decreed that “...the experts have to diligently record the measurements and the mold (*sesto*) of the galleon,”⁴⁷ which are, in all likelihood, those that are recorded in the manuscript *Misure di vascelli* in folios 17r-19r.

Thus, Fausto’s galleon was completed. Much later, on 30 December 1564, the Senate decided to arm and to outfit the vessel:

In the Arsenal, there is the galleon that was built years ago by our faithful Vettor Fausto, whose knowledge and expertise on naval architecture was acknowledged by the Council. The said galleon, once armed, caulked, outfitted, and rigged with sails, which have to be cut so that they can be rigged either as lateen sails and square sails, could be of great service to our State. Also the Proveditors and the Patrons of the Arsenal, and the master shipbuilders as well, agreed with us [...] Therefore, it is established that, following the authority of this Council, the Proveditors and the Patrons of the Arsenal have to arm and outfit the galleon so that Our Signory can make use of it if needed.⁴⁸

Apparently, six years passed before the galleon could be armed and outfitted.

On 25 April 1570, the two Proveditors of the Arsenal, Giacomo Marcello and Paolo

was 12,000 *salme*, that is to say, about 2,000 tons. From an earlier document, dated to 5 November 1546, we learn that Fausto’s galleon had been built in Poveglia, a small island between Venice and Lido, and that it was rotting (ASVe, Senato mar, reg. 29, fol. 18v).

⁴⁷ ASVe, Senato mar, reg. 29, reg. 125v: *Far tuor da periti diligentemente le misure et il sesto di esso galione.*

⁴⁸ ASVe, Senato mar, reg. 36, fol. 193v: *Si ritrova nella casa nostra dell’arsenal un galeone, che gia alcuni anni fu fabricato dal quondam fidel nostro Vettor Fausto, che fu di quella peritia nelle cose d’esso arsenal, che è ben nota a questo consiglio, il qual galeone, quando fusse fornito delli suoi morsi et di calafado, oltra delli armizi, et delle vele, che deveno esser fatte, si che potranno servire alla latina, et alla quadra, potrebbe in ogni occorrenza apportar grandissimo beneficio, et utile alle cose nostre, il che anche affirmano li Proveditori et Patroni nostri all’arsenal, et li prothi di quello [...] L’anderà parte, che per autorità di questo consiglio sia commesso alli Proveditori et Patroni nostri all’arsenal, che debbano far finire il detto galeone di tutte le cose, che fussero necessarie, sí che in ogni occorrenza la Signoria Nostra potesse valersene nelli sui bisogni.* On the raw materials employed in the Arsenal of Venice for shipbuilding and fitting, see: Vergani 1991, 285-312.

Trun, and the three Patrons, Nicolò Donado, Antonio Moro, and Lorenzo Pisani, “deliberated about the galleon that [had been built] by Vettor Fausto, since it has to be launched as soon as possible, so that it can serve in the present war.”⁴⁹ There is no doubt that the Republic of Venice was organizing its naval fleet for the Battle of Lepanto, fought shortly after the decree, on 12 October 1571. However, due to the deterioration since its construction, upon the judgment of the master shipbuilders, the Proveditors and the Patrons of the Arsenal unanimously decided to reinforce the sternpost of Fausto’s galleon. They assigned the task to Giovanni Maria di Zanetto, known also as Zulle.⁵⁰

Zulle, who had been carpenter (*marangon*) and attendant to the master shipbuilder (*sotto protho*), was elected *proto* on 16 December 1568 by the three Patrons and Proveditors of the Arsenal: Nicolò Donado, Nicolò Suriano, and Gerolamo Contarini.⁵¹ Upon Francesco Bressan’s death, Zulle succeeded him as master shipbuilder at the Arsenal.⁵² In a document dated to 1593, Zulle, during an inquiry conducted by the Arsenal about mechanical problems in the rowing system of galleasses, prided himself on being the apprentice of Vettor Fausto. Zulle explicitly stated that Fausto had taught him his shipbuilding principles for galleys (*el suo*

⁴⁹ ASVe, Patroni e Proveditori all’Arsenal, env. 136, fol. 94v: *Dovendosi deliberar quello che si deve per la presta ispeditione del galion del quondam Ser Vettor Fausto, si che quanto prima si possa butar in acqua, per servirsi in quest’occasione di guerra.*

⁵⁰ ASVe, Patroni e Proveditori all’Arsenal, env. 136, fol. 94v.

⁵¹ ASVe, Patroni e Proveditori all’Arsenal, env. 136, fol. 68v and fol. 93v. See also: ASVe, Senato mar, reg. 36, fol. 72v, dated 23 August 1563, where Zulle is said to be vice-master shipbuilder (*sotto protho*).

⁵² ASVe, Senato mar, reg 34, fol. 114r; ASVe, Senato mar, reg. 36, fol. 72r.

insegnar una come sel fabrica).⁵³ Thus, it seems likely that Zulle can now be identified as the author of the manuscript *Misure di vascelli etc. di...proto dell'Arsenale*, and the ships recorded therein are likely to be those that had been built by Fausto, including light galleys, during the years Fausto spent in the Arsenal.⁵⁴

Unfortunately, none of the technical drawings and Fausto's notes, which must have been preserved in the Archive of the Naval Museum in Venice, survived. Besides the sources discussed in the previous chapter, which provide general information about rowing arrangements of galleys, *Misure di vascelli etc. di...proto dell'Arsenale* is the *only* technical manuscript with detailed records of Fausto's shipbuilding instructions. The manuscript is all the more valuable, considering that Fausto was extremely jealous of his technological innovations and kept his shipbuilding *ratio* secret. The quinquereme was built in a *volto serrato*, a locked ship-shed that permitted entrance only to the shipwrights selected to build the quinquereme.⁵⁵ Also, Fausto requested of the humanists and scholars with whom he discussed the technical aspects of his shipbuilding *ratio* not to spread this information. Giovanni Musler from Oettingen, for example, who met Fausto in 1536 during his law studies at the University of Padua, said that "all the information about the art of shipbuilding that has been conveyed to me

⁵³ ASVe, Patroni e Provveditori all'Arsenale, env 1, fol. 11r. The document is briefly cited by Tucci (1964, 281), who, however, failed to identify Zulle's authorship.

⁵⁴ Fausto started designing light galleys toward the end of his life. By 1544, his light galleys were much in demand by the Venetian sea captains for their seaworthiness (ASVe, Patroni e Provveditori all'Arsenale, env. 135, fol. 73r). The sea captain Cristoforo da Canal said that "...the [light] galleys built by Fausto were the best to have ever been built in the Arsenal..." and that "...the proportions of Fausto's [light] galleys are perfect so that its shape narrows gracefully." Cristoforo da Canale provided a lengthy description of Fausto's trireme (Nani Mocenigo 1930, 65-6).

⁵⁵ Sanuto, XLII, col. 765.

by Vettor Fausto, professor of Greek in Venice and illustrious mathematician, will remain secret.”⁵⁶ Zulle proudly recalled the work of Fausto in the Arsenal, his study of Greek and Latin writers, and how his theoretical knowledge, combined with practical skills acquired in the shipyard over the years, gave him an advantage over the purely empirical shipbuilding practice employed by the *proti*.

At the end of the inquiry, the main question regarding the mechanical problems of the rowing system of the galley was not resolved. Several issues needed assessing: first, the length of the oars, which were pulled by five men sitting on the same bench; second, the distance between the tholes; and third, the length and angle of the benches. The urgency of building more efficient and maneuverable galleys was dictated by the fact that the Venetians—and all of Christendom—realized that the threat of the Ottoman Empire had not been eliminated at the waters of Lepanto, and, in spite of the Christian victory, the Ottomans were in the process of building a much stronger and larger fleet to replace their losses at Lepanto.⁵⁷

⁵⁶ Musler 1538, fol. 33b: *Victoris Fausti illius Graecae linguae Venetiis publici per lectoris, insignis mathematici, qua in vai, eius arte consiliisque extruenda communicavit ἀππέτα manebunt consilia.*

⁵⁷ In 1573, two years after the battle of Lepanto, the *bailo* Marcantonio Barbaro reported to the *Serenissima* that “the Grand Turk has in his Arsenal (*i.e.*, in Galata) 300 rowed ships, among which are 14 *maone* (*i.e.*, merchant vessels that took their name from the Medieval trade joint-stock company called *maona*). He can easily build many ships of any type, due to the abundance of wood that is imported from the Great Sea (*i.e.*, the Black Sea). We have seen that, after the defeat (at Lepanto), in six months the Ottomans were able to build 120 galleys, plus those that have already been built, which [...] was almost impossible to believe, especially because they have already armed and outfitted those new galleys.” In Alberi 1840, III, 2: 306. With regard to Ottoman polyremes, the Sea Captain *Uluzzalì* (Uluch Ali), on 23 March 1573, launched a galley he had had built with 30 benches and seven rowers per bench. The *bailo* Marcantonio Barbaro reported that the galley, however, was “very slow, even though the rowers were strong” (ASVe, Senato, Dispacci, Costantinopoli, string 6, folios not numbered, dispatch dated to 23 March 1573). From the report sent by the *bailo* Giovanni Correr, dated 4 April 1576, it seems that the Ottomans experimented with new rowing systems in this period. The Bassà (Pasha, the Admiral of the Ottoman Navy) consulted “a shipwright from Curzola (Dubrovnik), who offered to show a secret, that is how to build a galley capable of being rowed either with two rowers per bench, or with four.” The

Thus, in 1593, during the inquiry at the Arsenal, the maritime Republic of Venice turned to the most famous professor of mathematics then available, Galileo Galilei. Giacomo Contarini (1536-1595), one of the Proveditors of the Arsenal, wrote to Galilei asking for technical advice on the configuration of the oars and how to enhance their power. Contarini's interest in shipbuilding is shown by the presence in his personal archive (now in the State Archive of Venice) of various manuscripts on Venetian naval architecture. One of the most applicable to his research is *Arte de far vasselli* ("The Art of Building Ships"), which recorded the shipbuilding instructions for building a quadrireme – another galley type invented by Fausto.⁵⁸

Thus, Galilei studied, as Fausto had done some years earlier, the rowing arrangement of galleys from classical periods.⁵⁹ Toward the end of 1638, Galilei published his most authoritative scientific work focused on mechanics, entitled *Discorsi e dimostrazioni matematiche intorno a due nuove scienze attinenti alla meccanica e ai moti locali* ("Discourses and Mathematical Demonstrations on Two New Sciences Concerning Mechanics and Local Motions"). It is by coincidence that

Ottomans, however, never built such a ship, for "the Bassà did not believe him, since—if it were true—the Christians would have already built such a galley" (ASVe, Senato, Dispacci, Costantinopoli, string 9, folios not numbered, dispatch dated 4 April 1576).

⁵⁸ The manuscript *Arte de far vasselli* is in ASVe, Archivio Proprio Contarini, env. 19, and is dated to ca. 1570. It is of interest to note that, on 21 September 1551, four quadriremes sailed in the Venetian fleet. By 1563 in the Arsenal there were five quadriremes that were yet to be completed, and six more that had served for a short period; see ASVe, Senato mar, reg. 35 fol. 42r and 43r-v (the latter dated to 1 June 1563). The quadriremes serving in the Venetian fleet were the Admiralty ships, such as that belonging to Antonio da Canal, who in 1566 attacked some Ottoman galliots in the waters off Corfu (ASVe, Senato mar, reg. 36, fol. 102r). That the Ottoman fleet also had a quadrireme is reported by the *bailo* Gerolamo Ferro (ASVe, Senato, Dispacci, Costantinopoli, string 2-B, folios not numbered, dispatch dated 4 October 1560).

⁵⁹ Renn and Valleriani 2001, 19.

Galilei opens his work with a praise of the Arsenal, which can be regarded probably as the highest recognition and tribute to Vettor Fausto:

A large field for philosophical investigation is open to inquisitive minds by frequenting your famous Arsenal, Venetian gentlemen, and particularly in that branch that is called mechanics, since every sort of instrument and machine is continually put into operation there by a great number of artisans. Among them there must be some who, through observations handed down by their predecessors, as well as through those which they attentively and continually make on their own, are highly expert and capable of the most subtle reasoning.⁶⁰

After the praise for the Arsenal, Galilei mentioned “the great galleass” that was built based on Fausto’s ship design.⁶¹ Thus, the scientific revolution had begun, and Vettor Fausto’s important contributions helped pave the way.

⁶⁰ Galilei 1638, 1.1: *Largo campo di filosofare à gl’intelletti specolativi parmi che porga la frequente pratica del famoso Arsenale di Voi Sig. Veneziani, et in particolare in quella parte che mechanica si domanda, atteso che quivi ogni sorte di strumento e di machine vien continuamente posta in opera da numero grande d’artefici, tra i quail, e per osservazioni fatte da i loro antecessori, e per quelle che di propria avvertenza vanno continuamente per se stessi facendo, è forza che ve ne siano dei peritissimi e di finissimo discorso.* The treatise is a dialogue involving three characters: Salviati, Sagredo, and Simplicio, and takes places on four different days. The citation here is from the dialogue between Salviati and Sagredo that takes place on the first day.

⁶¹ Galilei 1638, 1.2. Galilei, however, claimed that *la gran galeazza* (“the great galleass”) was “...very heavy due to its huge size, which made it inconvenient (*oppressa dal gravissimo peso della sua vasta mole, inconveniente*).

CHAPTER VI

THE LIGHT GALLEY

Introduction

During his tenure in the Arsenal of Venice, Vettor Fausto built other types of vessels after he built the quinquereme, including light galleys and great galleys. The manuscript *Misure di vascelli* records the detailed measurements of both a light galley, which is referred to as a *galea da 3* [“galley with 3 (rowers)”], and a great galley, which is referred to as a *galea da 4* [“galley with 4 (rowers)”]. A theoretical reconstruction of the light and the great galley based on the measurements provided by the manuscript *Misure di vascelli* is proposed in this chapter. The calculations made in order to reconstruct these two types of vessels suggest that a shipbuilding method based on a mathematical formula was employed in designing these galleys. In specific, the mathematical formula used in order to achieve the design of the light and great galley is Gauss’s formula, which is expressed as follows:

$$\Sigma = n \times \frac{n + 1}{2}$$

where n = positive integer and Σ = sum

This formula is the same one that Fausto applied in order to achieve the design of his quinquereme. This chapter argues that the light galley and the great galley recorded in the manuscript *Misure di vascelli* were also designed by Fausto.

Reconstruction of the Light Galley

The measurements of the light galley are recorded in folios 12v-14r. The transcription and the English translation of these folios are reported below.

Transcription

fol. 12v *Galia da 3 longa passa 24 de' 12*
dentro dell'haste a piombo. Perchè la slonga la
squara dei più a de' 14 $\frac{1}{7}$ per campo.
Pie 16 de' 14 a' prora in ferir.
Pie 26 de' 8 $\frac{2}{7}$ in partison da prova de campi 30.
Pie 4 de' 6 $\frac{5}{7}$ in mezzo i campi 5.

fol. 13r *Pie 44 de' 3 $\frac{1}{7}$ in partison da poppe de campi 50.*
Pie 28 de' 11 $\frac{6}{7}$ in ferir a poppe. Sono in tutto
pie 120 de' 12, fanno passa 24 de' 12.
Con late 60. Palmeta a prova pie 7 de' 2.
Palmeta a poppe pie 9 de' 4. Larga la timo-
nera pie 8.

[...]

*Quella da 3 menada tutta avalio resto. In bocca
 al mezan in alteza del sfogio pie 15 de' 4, al
 zovo da poppe pie 7 de' 12, a quel da prova
 pie 6 de' 11 $\frac{1}{3}$, al cao de sesto da poppe pie 11
 de' 8, a quel da prova pie 11 de' 3, al 25 da
 poppe 14 de' 4, al 15 da prova pie 14 de' 4
 al'oro dentro del magier de bocca per tutto.
 Alta in pontal pie 5 de' 12 al mezanin, al 25 da poppe
 pie 6 de' 1 $\frac{1}{4}$, al cao de sesto da poppe pie 6 de' 14 $\frac{5}{8}$,
 al 15 da prova pie 5 de' 13 $\frac{2}{7}$, al cao de sesto da prova
 pie 6 de' 1 scarso, al zovo da poppe pie 8 scarsi,
 al zovo da prova pie 6 de 6 boni, dalla ligna
 che passa su per el cantier come si misura et
 questo s'intende al'oro di sora del sfogio.*

Translation

fol. 12v The [light] galley with 3 [rowers per bench]
 is 24 paces and 12 fingerbreadths long
 measuring inside the endposts with a plum line.
 Each room is 14 $\frac{1}{7}$ fingerbreadths long.
 The distance between the last molded forward frame and the stem

is 16 feet and 14 fingerbreadth long.

The portion of the hull toward the bow consisting of the frames that are narrowed and raised is 26 feet and $8 \frac{2}{7}$ fingerbreadths long, and comprises 30 rooms.

The central portion of the hull is 4 feet and $6 \frac{5}{7}$ fingerbreadths, and comprises 5 rooms.

fol. 13r The portion of the hull toward the stern consisting of the frames that are narrowed and raised is 44 feet and $3 \frac{1}{7}$ fingerbreadths long, and comprises 50 rooms.

The distance between the last molded after frame and the sternpost is 28 feet and $11 \frac{6}{7}$ fingerbreadths.

In total, [the galley is] 120 feet and 12 fingerbreadths long, [which is equal to] 24 paces and 12 fingerbreadths.

There are 60 deck beams. The distance between the forward yoke and the stem is 7 feet and 2 fingerbreadths long.

The distance between the after yoke and the sternpost is 9 feet and 4 fingerbreadths.

The transmon is 8 feet long.

[...]

fol. 13v

3

[Measurements] of a light galley with 3 [rowers]. The maximum width of the midship frame is 15 feet and 4 fingerbreadths.

[The width of the frame placed] at the after yoke
is 7 feet and 12 fingerbreadths,
[the width of the frame placed] at the forward yoke
6 feet and $11 \frac{1}{3}$ fingerbreadths,
[the width] of the last molded after frame
is 11 feet and 8 fingerbreadths,
[the width] of the last molded forward frame
is 11 feet and 3 fingerbreadths,
[the width of the frame placed] at the 25th station toward the stern
is 14 feet and 4 fingerbreadths,
[the width of the frame placed] at the 15th station toward the bow
is 14 feet and 4 fingerbreadths,
measuring from the inner side [of the frames].
The height of the midship frame is 5 feet and 12 fingerbreadths,
[the height] of the last molded after frames is
6 feet and $1 \frac{1}{4}$ fingerbreadths,
[the height of the frame placed] at the 25th station toward the stern
is 6 feet and $14 \frac{5}{8}$ fingerbreadths,
[the height of the frame placed] at the 15th station toward the bow
is 5 feet and $13 \frac{2}{7}$ fingerbreadths,
[the height] of the last molded forward frame is
6 feet and about 1 fingerbreadths,

[the height of the frame placed] at the after yoke

is about 8 feet,

[the height of the frame placed] at the forward yoke

is 6 feet and a good 6 fingerbreadths.

[These measurements are taken] by measuring from the top face of the

keel up to the extremity of the frames.

As a premise, all measurements provided by the manuscript are based on the Venetian system of linear measurement. Thus, 1 pace is equal to 5 feet, and 1 foot is equal to 16 fingerbreadths. For the calculations presented in this chapter, the following abbreviations are used:

F = foot/feet

fb = fingerbreadth/fingerbreadths

p = pace/paces

The measurements provided by the manuscript allow us to reconstruct the light galley's sheer view and breadth plan, along with the narrowing and the rising of the frames. The manuscript does not provide detailed measurements for reconstructing the midship frame, with the exception of its height (*pontal*) and maximum breadth (*bocca*). What is missing for reconstructing the midship frame are the measurements for designing its curvature. However, all that a shipwright required to replicate the midship

frame of Fausto's light galley was the height and the maximum width, since the necessary information for calculating the narrowing and rising of each frame are provided by the manuscript.

Sheer View and Rising of the Frames

The light galley is 24 paces and 12 fingerbreadths long, which is equal to 120 feet and 12 fingerbreadths (41.98 meters). It is useful to recall here that, in Venetian ship design, vessels were divided into five main portions, namely the *mezzo*, the *partison da poppe*, the *partison da prora*, the *ferir da poppe*, and the *ferir da prora*.

The *mezzo* is the central portion of the hull not subject to the narrowing and rising of the frame by means of geometrical methods; thus, it is the flat portion of the hull. The *partison da poppe* is the portion of the hull toward the stern comprising the frames involved in the narrowing and rising by means of geometrical methods; the *partison da prora* is the portion of the hull toward the bow comprising the frames involved in the narrowing and rising by means of geometrical methods. The *cao de sesto da poppe* (*cao da sesto* literally means "the end of the mold") marks the location of the last molded after frame; the *cao de sesto da prora* marks the location of the last molded forward frame. The *ferir da poppa* is the the portion of the hull between the last molded after frame (*cao da sesto da poppe*) and the sternpost, and the *ferir da prora* is the portion of the hull between the last molded forward frame (*cao da sesto da prora*) and the stem.

The *ferir* is divided into two main sub-portions, the *palmetta* and the *zovo*. The *ferir da poppe* comprises the *zovo da poppe*, which is the after yoke, and the *palmetta*, which is the afterdeck. The *palmetta da poppe* is the distance between the *zovo da poppe* and the sternpost. The *ferir da prora* comprises the *zovo da prora*, which is the forward yoke, and the *palmetta da prora*, which is the foredeck. The *palmetta da prora* is the distance between the *zovo da prora* and the stem.

Each of the hull portions above comprises a number of *campi* (rooms), which mark the location of each frame. The manuscript provides the length of each room (*campo*), which is equal to $14 \frac{1}{7}$ fingerbreadths. It has to be pointed out that the word *campo* (singular of *campi*) may refer either to a station (i.e., the location of a frame) and/or to a room (i.e., the space between two consecutive frames). Depending on the context, we can understand whether the author of the manuscript refers to the stations or to the rooms. Thus, when the author of the manuscript *Misure di vascelli* reports the length of the *campo*, he is referring to the room. Conversely, when he provides the location of a frame, he is referring to a station.

The lengths of the *partison da prora*, the *ferir da prora*, the *mezzo*, the *partison da poppa*, and the *ferir da poppa* are provided in the manuscript. The *mezzo* measures 4 feet and $6 \frac{5}{7}$ fingerbreadths, the *partison da poppa* measures 44 feet and $3 \frac{1}{7}$ fingerbreadths, the *partison da prora* measures 26 feet and $8 \frac{2}{7}$ fingerbreadths, the *ferir da poppa* measures 28 feet and $11 \frac{6}{7}$ fingerbreadths, and the *ferir da prora* measures 16 feet and 14 fingerbreadths (fig. 22). The sum of these measurements

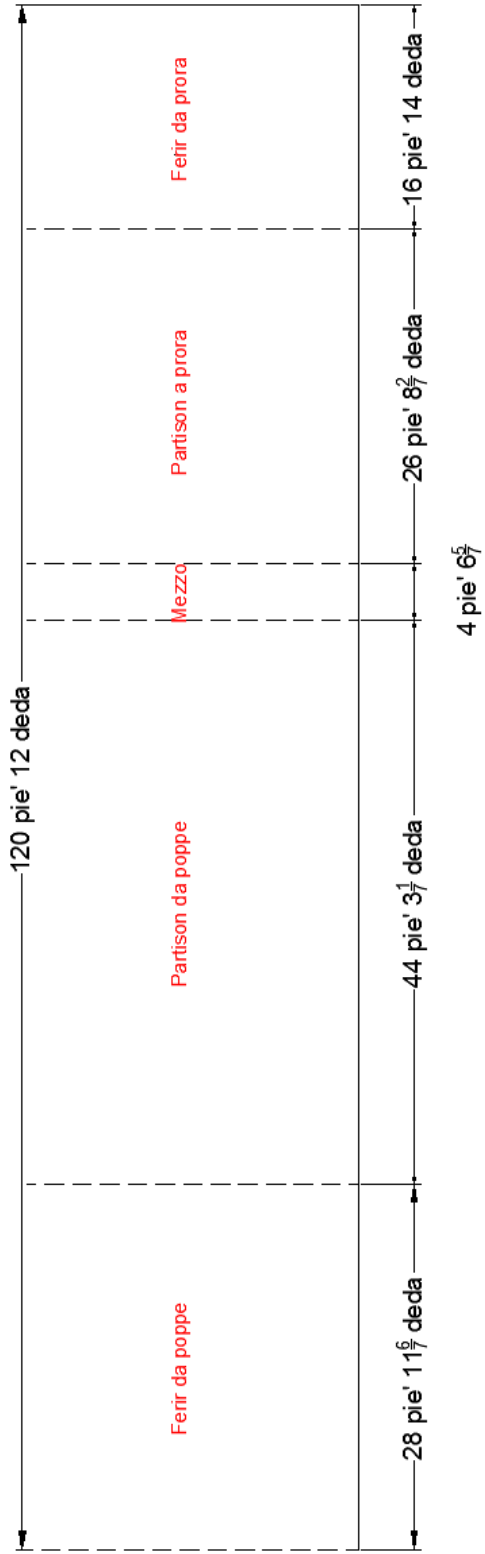


Fig. 22. Length overall of the light galley and the measurements of its portions. Drawing L. Campana.

corresponds to the length over all (LOA) of the galley, which is 120 feet and 12 fingerbreadths, as shown below.

$$\begin{aligned}
 \text{LOA (fb)} &= \textit{Mezzo} + \textit{partison da poppe} + \textit{partison da prora} + \textit{ferir da poppe} + \textit{ferir da prora} \\
 &= (4 F + 6 \frac{5}{7} \text{ fb}) + (44 F + 3 \frac{1}{7} \text{ fb}) + (26 F + 8 \frac{2}{7} \text{ fb}) + (28 F + 11 \frac{6}{7} \text{ fb}) + (16 F + 14 \text{ fb}) \\
 &= [(4 F \times 16 \text{ fb}) + 6 \frac{5}{7} \text{ fb}] + [(44 F \times 16 \text{ fb}) + 3 \frac{1}{7} \text{ fb}] + [(26 F \times 16 \text{ fb}) + 8 \frac{2}{7} \text{ fb}] + [(28 F \times 16) + 11 \frac{6}{7} \text{ fb}] + [(16 F \times 16 \text{ fb}) + 14 \text{ fb}] \\
 &= [64 \text{ fb} + 6 \frac{5}{7} \text{ fb}] + [704 \text{ fb} + 3 \frac{1}{7} \text{ fb}] + [416 \text{ fb} + 8 \frac{2}{7} \text{ fb}] + [448 \text{ fb} + 11 \frac{6}{7} \text{ fb}] + [256 \text{ fb} + 14 \text{ fb}] \\
 &= 70 \frac{5}{7} \text{ fb} + 707 \frac{1}{7} \text{ fb} + 424 \frac{2}{7} \text{ fb} + 459 \frac{6}{7} \text{ fb} + 270 \text{ fb} \\
 &= 1930 \frac{14}{7} \\
 &= 1930 + 2 \\
 &= 1932 \text{ fb}
 \end{aligned}$$

which corresponds to 120 feet and 12 fingerbreadths, as shown below

$$\begin{aligned}
 \text{LOA (F and fb)} &= 1932 \text{ fb} \div 16 \text{ fb} \\
 &= 120.75 \text{ fb}
 \end{aligned}$$

where 120 indicates the feet and 0.75 is equal to 12 fingerbreadths, since

$$\begin{aligned} \text{fb} &= 0.75 \text{ fb} \times 16 \text{ fb} \\ &= 12 \text{ fb} \end{aligned}$$

In addition, the manuscript records the number of *campi* contained in the *mezzo*, in the *partison da poppe*, and in the *partison da prora*; the *mezzo* comprises 5 *campi*, the *partison da poppe* comprises 50 *campi*, and the *partison da prora* comprises 30 *campi* (fig. 23).

The manuscript does not show how many *campi* there are in the *ferir da prora* and in the *ferir da poppa*; however, this information may easily be gathered, since the length of one *campo* is known. Thus, by dividing the length of *ferir da poppe* by the length of one *campo*, we obtain 32 *campi*, as shown below.

$$\begin{aligned} \text{Campi} &= \text{length of the } \textit{ferir da poppe} \div \text{length of 1 } \textit{campo} \\ &= (28 \text{ F} + 11 \frac{6}{7} \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \end{aligned}$$

As the length of 1 *campo* is given in fingerbreadths, 28 feet has to be converted into fingerbreadths (1 foot is equal to 16 fingerbreadths). Thus,

$$\begin{aligned}
\text{Campi} &= [(28 F \times 16 \text{ fb}) + 11 \frac{6}{7} \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\
&= [448 \text{ fb} + 11 \frac{6}{7} \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\
&= 459 \frac{6}{7} \text{ fb} \div 14 \frac{1}{7} \text{ fb} \\
&= 32 \text{ campi}
\end{aligned}$$

Thus, the *ferir da poppe* consists of 32 *campi* (fig. 24). In the same way, the number of *campi* comprising the *ferir da prora* may be calculated, as shown below.

$$\begin{aligned}
\text{Campi} &= \text{length of } \textit{ferir da prora} \div \text{length of 1 } \textit{campo} \\
&= (16 F + 14 \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \\
&= [(16 F \times 16 \text{ fb}) + 14 \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\
&= [256 \text{ fb} + 14 \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\
&= 270 \text{ fb} \div 14 \frac{1}{7} \text{ fb} \\
&= 19 \text{ campi}
\end{aligned}$$

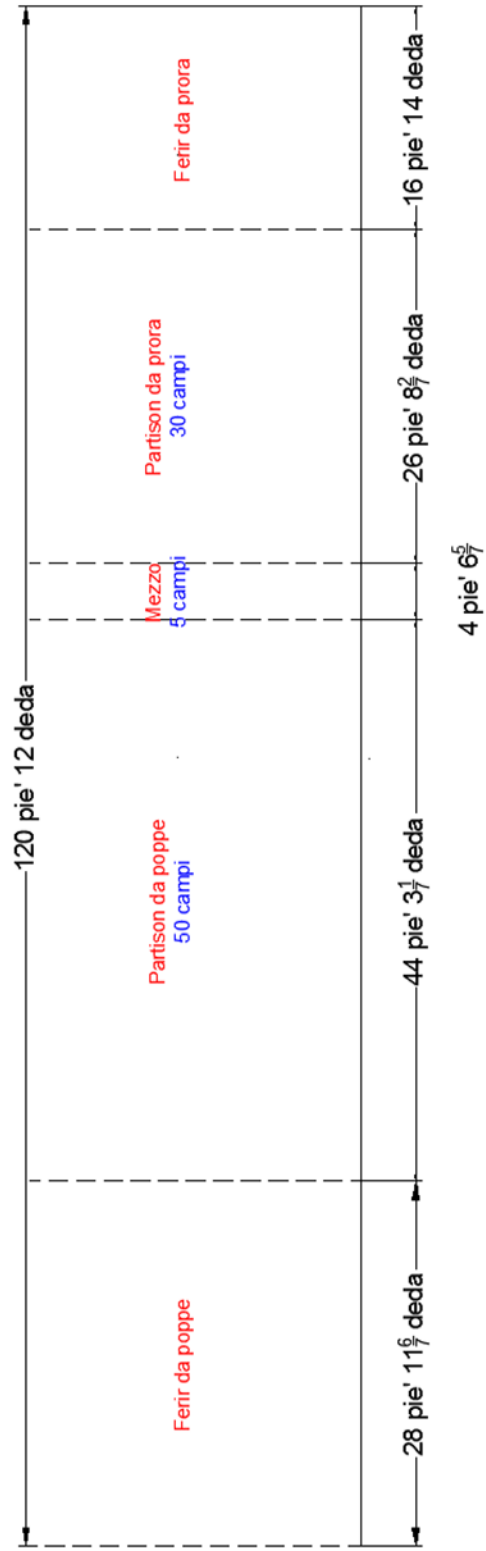
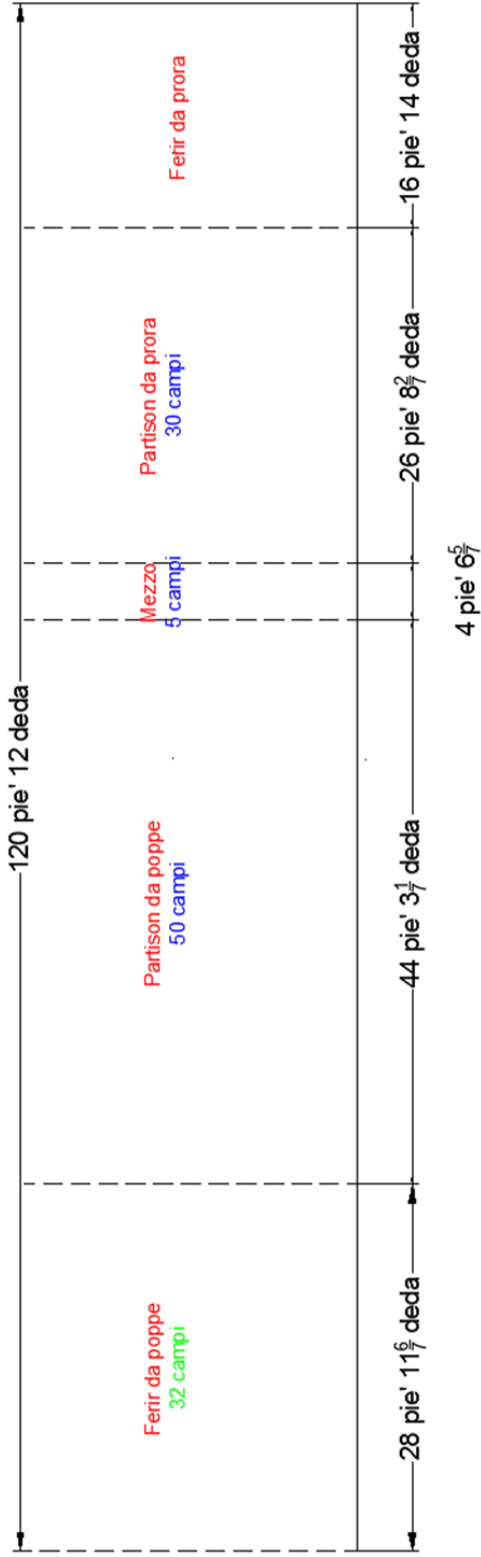


Fig. 23. Division in *campi* (rooms) of the light galley. Drawing L. Campana.



185 Fig. 24. Total number of *campi* (rooms) in the *ferir da poppe* (the distance between the last molded frame at the stern and sternpost) of the light galley. Drawing L. Campana.

Thus, the *ferir da prora* contains 19 *campi* (fig. 25).

In addition, the manuscript provides the length of the *palmetta da prora* (foredeck) and the *palmetta da poppe* (afterdeck). This information is crucial to the location of the *zovo* (yoke), which is exactly at the point where the *palmetta* starts. The *palmetta da poppe* (foredeck) measures 9 feet and 4 fingerbreadths in length (fig. 26). Since 1 *campo* is $14 \frac{1}{7}$ fingerbreadths long, the *palmetta da poppe* contains 10 *campi*, as shown below.

$$\begin{aligned} \text{Campi} &= \text{length of } \textit{palmetta da poppe} \div \text{length of 1 } \textit{campo} \\ &= (9 \text{ F} + 4 \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \\ &= [(9 \text{ F} \times 16 \text{ fb}) + 4 \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\ &= (144 \text{ fb} + 4 \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \\ &= 148 \text{ fb} \div 14 \frac{1}{7} \text{ fb} \\ &= 10 \text{ campi} \end{aligned}$$

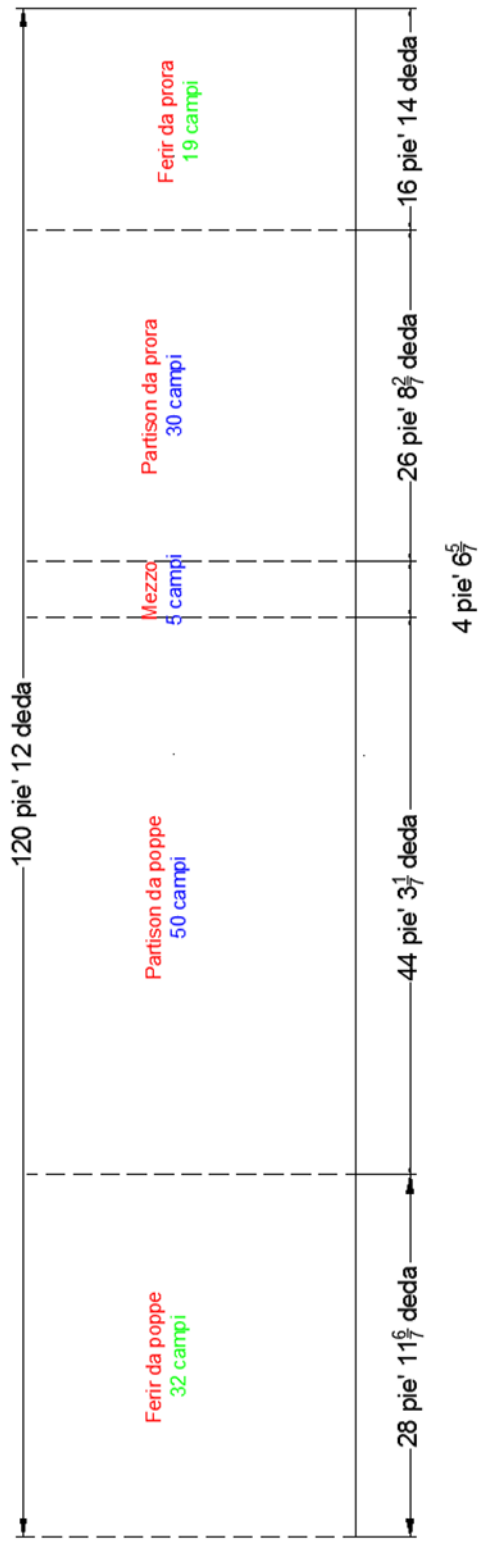


Fig. 25. Total number of *campi* (rooms) in the *fenir da prora* (the distance between the last molded frame at the bow and the stem) of the light galley. Drawing L. Campana.

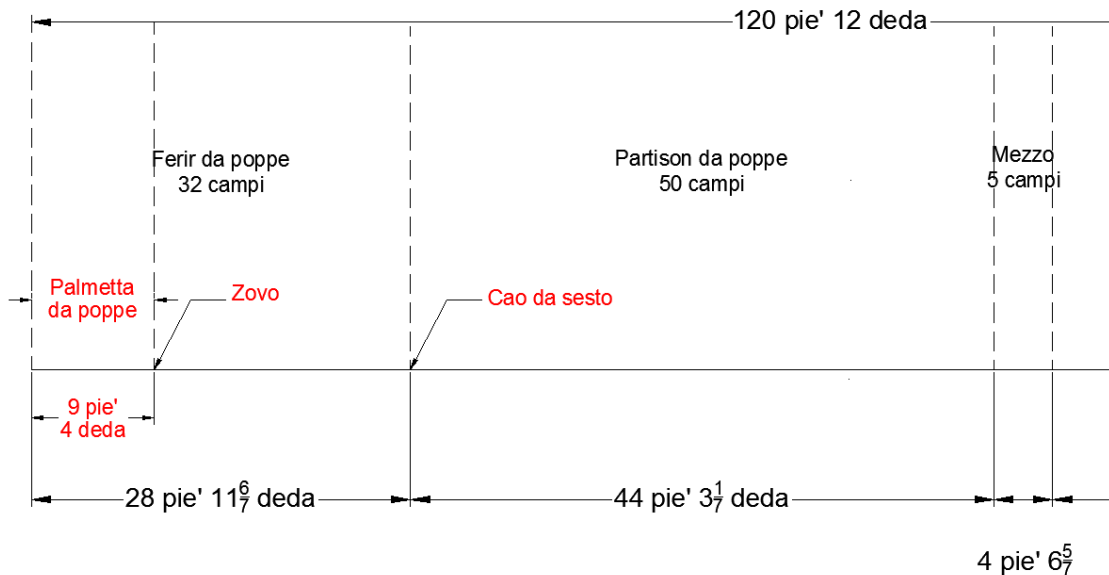


Fig. 26. Length of the light galley's *palmetta da poppe* (foredeck). Drawing L. Campana.

Thus, the *palmetta da poppe* contains 10 *campi*. By subtracting the length of the *palmetta da poppe*, which is equal to 9 feet and 4 fingerbreadths, from the length of the *ferir da poppe*, which is equal to 28 feet and 11 $\frac{6}{7}$ fingerbreadths, the length of the portion between the *zovo da poppe* (after yoke) and the *cao da sesto da poppe* (the last molded after frame) is obtained, as shown below.

Length between *zovo da poppe* and *cao da sesto da poppe*

$$\begin{aligned}
 &= \text{length of the } \textit{ferir da poppe} - \text{length of the } \textit{palmetta da poppe} \\
 &= 28 \text{ F } 11 \frac{6}{7} \text{ fb} - 9 \text{ F } 4 \text{ fb} \\
 &= [(28 \text{ F} \times 16 \text{ fb}) + 11 \frac{6}{7} \text{ fb}] - [(9 \text{ F} \times 16 \text{ fb}) + 4 \text{ fb}]
 \end{aligned}$$

$$\begin{aligned}
&= [448 \text{ fb} + 11 \frac{6}{7} \text{ fb}] - [148 \text{ fb} + 4 \text{ fb}] \\
&= 459 \frac{6}{7} \text{ fb} - 148 \text{ fb} \\
&= 311 \frac{6}{7} \text{ fb} \\
&= 311 \frac{6}{7} \text{ fb} \div 16 \text{ fb} \\
&= 19 \text{ feet } 7 \frac{6}{7} \text{ fb}
\end{aligned}$$

Since it is known that the *ferir da poppe* comprises 32 *campi* and that the *palmetta da poppe* comprises 10 *campi*, the portion of the hull between the *zovo da poppe* and the *cao da sesto da poppe* may be calculated to contain 22 *campi* (fig. 27).

In the same way, the number of *campi* in the *palmetta da prora*, which measures 7 feet and 2 fingerbreadths, may be calculated (fig. 28).

$$\begin{aligned}
\text{Campi} &= \text{length of the } \textit{palmetta da prora} \div \text{length of 1 } \textit{campo} \\
&= (7 \text{ F} + 2 \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \\
&= [(7 \text{ F} \times 16 \text{ fb}) + 2 \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\
&= [112 \text{ fb} + 2 \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\
&= 114 \text{ fb} \div 14 \frac{1}{7} \text{ fb} \\
&= 8 \text{ campi}
\end{aligned}$$

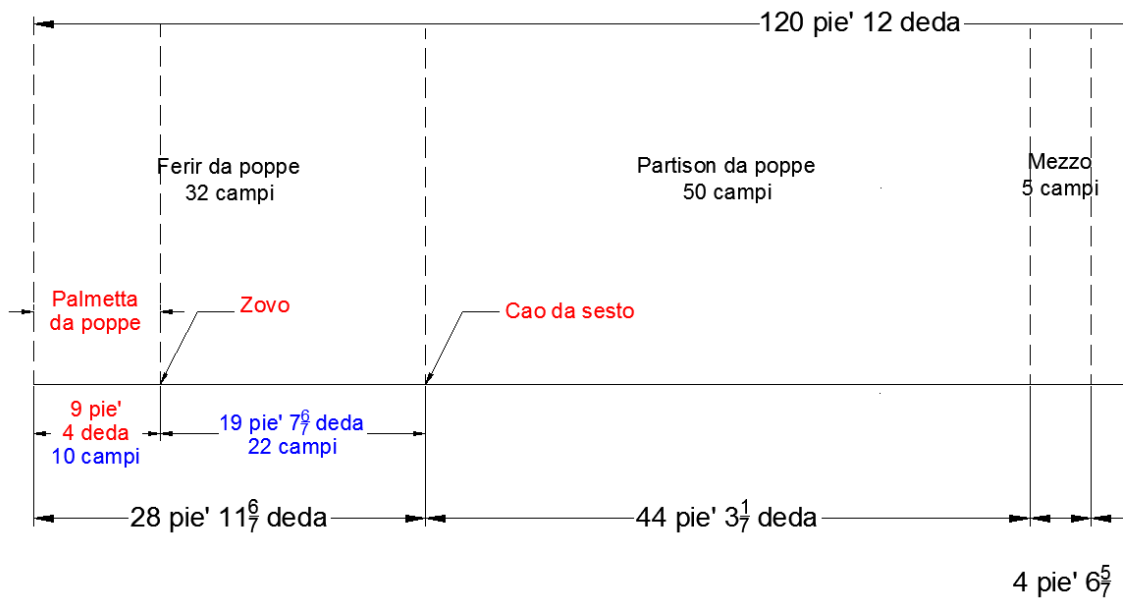


Fig. 27. Total number of *campi* (rooms) in the *palmetta da poppe* (afterdeck) and in the *zovo da poppe* (after yoke). Drawing L. Campana.

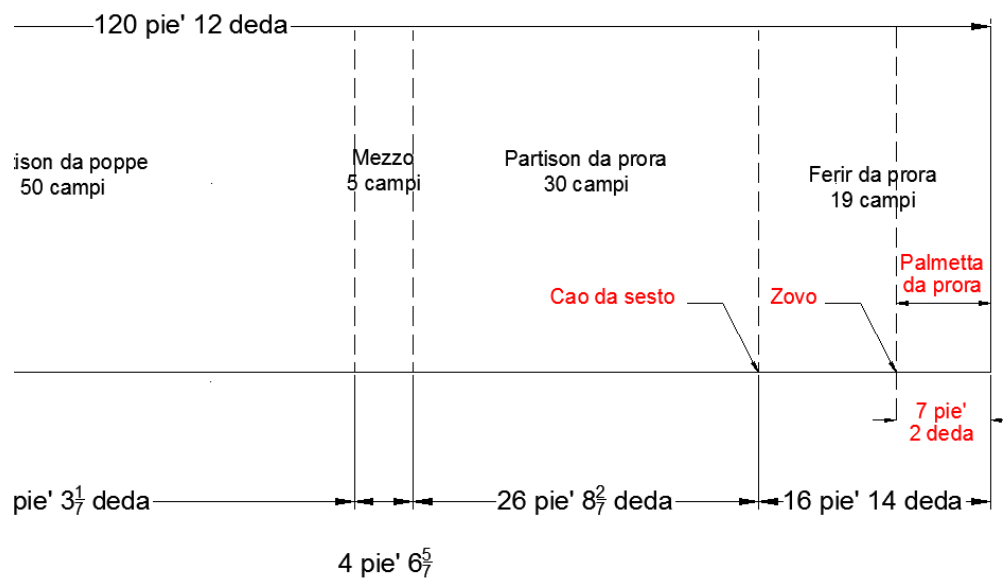


Fig. 28. Length of the light galley's *palmetta da prora* (foredeck). Drawing L. Campana.

Thus, the *palmetta da prora* comprises 8 *campi*. By subtracting the length of the *palmetta da prora*, which is equal to 7 feet and 2 fingerbreadths, from the length of the *ferir da prora*, which is equal to 16 feet and 14 fingerbreadths, the length of the portion between the *zovo da prora* (forward yoke) and the *cao da sesto da prora* (the last molded forward frame) is obtained, as shown below.

Length between *zovo da prora* and *cao da sesto da prora*

$$\begin{aligned}
 &= \text{length of the } \textit{ferir da prora} - \text{length of the } \textit{palmetta da prora} \\
 &= 16 \text{ F } 14 \text{ fb} - 7 \text{ F } 2 \text{ fb} \\
 &= [(16 \text{ F} \times 16 \text{ fb}) + 14 \text{ fb}] - [(7 \text{ F} \times 16 \text{ fb}) + 2 \text{ fb}] \\
 &= [256 \text{ fb} + 14 \text{ fb}] - [112 \text{ fb} + 2 \text{ fb}] \\
 &= 270 \text{ fb} - 114 \text{ fb} \\
 &= 156 \text{ fb} \\
 &= 156 \text{ fb} \div 16 \text{ fb} \\
 &= 9 \text{ feet } 12 \text{ fb}
 \end{aligned}$$

Since the *ferir da prora* contains 19 *campi* and the *palmetta da prora* contains 8 *campi*, the portion of the hull between the *zovo da prora* and the *cao da sesto da prora* therefore contains 11 *campi* (fig. 29).

In sum, the hull portions based on the measurements provided in the manuscript *Misure di vascelli* may thus be reconstructed.

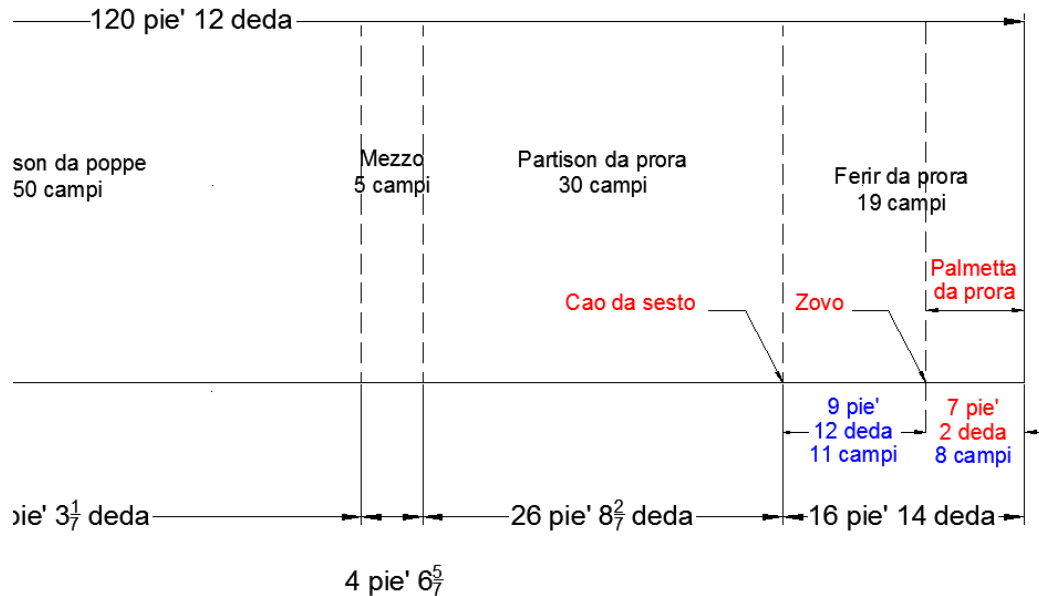


Fig. 29. Total number of *campi* (rooms) in the *palmetta da prora* (foredeck) and in the *zovo da prora* (forward yoke). Drawing L. Campana.

As the second step, to obtain the sheer view of the light galley, one has to establish the exact location of the midship frame. The midship frame must be located within the central portion of the hull, which consists of 5 rooms (*campi*) and, thus, 6 frames, each of which could be the midship frame. The frames in the central flat portion of the hull have the same design as the midship frame and, thus, they are identical in shape. After a series of calculations (and trials) that are not shown here due to their tedious nature, we have established the midship frame to be the second frame from the bow (fig. 30). Thus, the central portion of the hull consists of one frame toward the bow, the midship frame, and four frames toward the stern. For convenience,

the two frames delimiting the central portion of the hull are labelled Frame A and Frame B (fig. 31).

Determining the exact location of the midship frame is a crucial step in the reconstruction of any ship. In addition, after fixing the location of the midship frame, one can know how many *campi* are found within the distance between the midship frame and the end of each portion (fig. 32). This information is crucial for determining the rising and the narrowing of the frames.

The manuscript then records the height of a number of frames placed at specific locations along the hull, namely, the height of the frame placed at the twenty-fifth station toward the stern, the height of the last molded after frame (*cao da sesto da poppe*), the height of the frame placed at the after yoke (*zovo da poppe*), the height of the sternpost (*asta da poppe*), the height of the frame placed at the fifteenth station toward the bow, the height of the last molded forward frame (*cao da sesto da prora*), the height of the frame placed at the forward yoke (*zovo da prora*), and the height of the stem (*asta da prora*).

The height of the frame placed at the twenty-fifth station toward the stern is 6 feet and $1 \frac{1}{4}$ fingerbreadths; the height of the last molded after frame (*cao da sesto da poppe*) is 6 feet and $14 \frac{5}{8}$ fingerbreadths; the height of the frame placed at the after yoke (*zovo da poppe*) is “about 8 feet;” the height of the sternpost (*asta da poppe*) is 8 feet and 10 fingerbreadths. Toward the bow, the height of the frame placed at the fifteenth station is 5 feet and $13 \frac{2}{7}$ fingerbreadths; the height of the last molded forward frame (*cao da sesto da prora*) is “6 feet and about 1 fingerbreadth;” the height

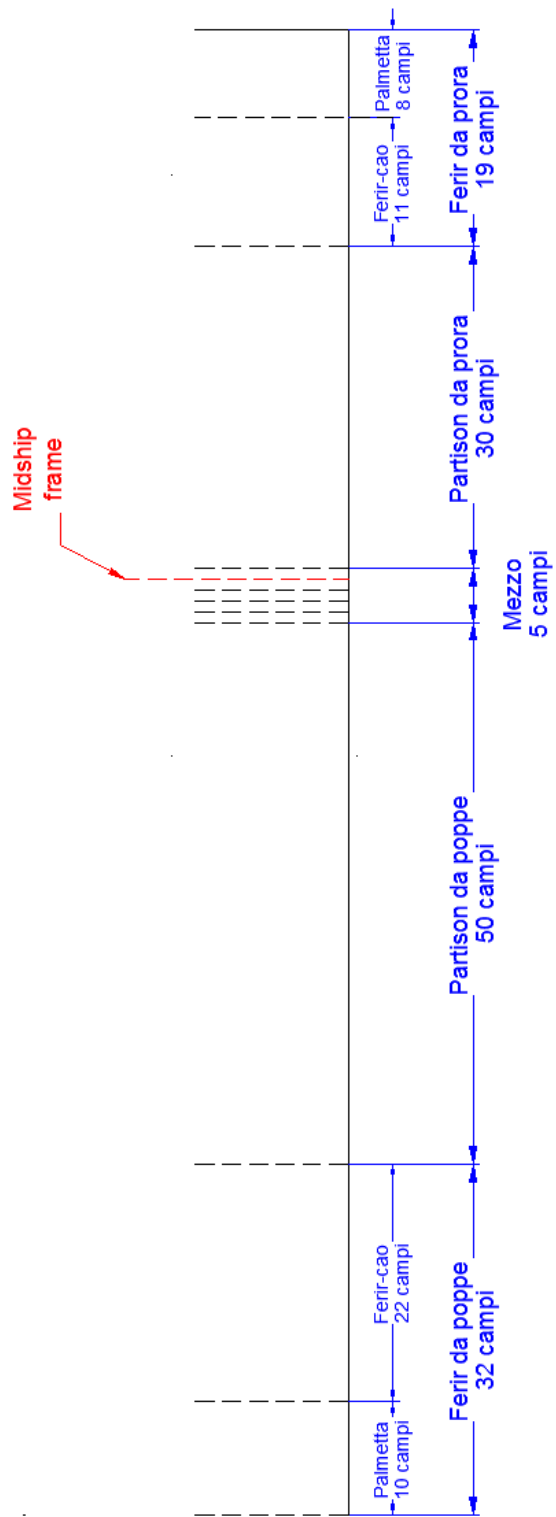


Fig. 30. Location of the light galley's midship frame. Drawing L. Campana.

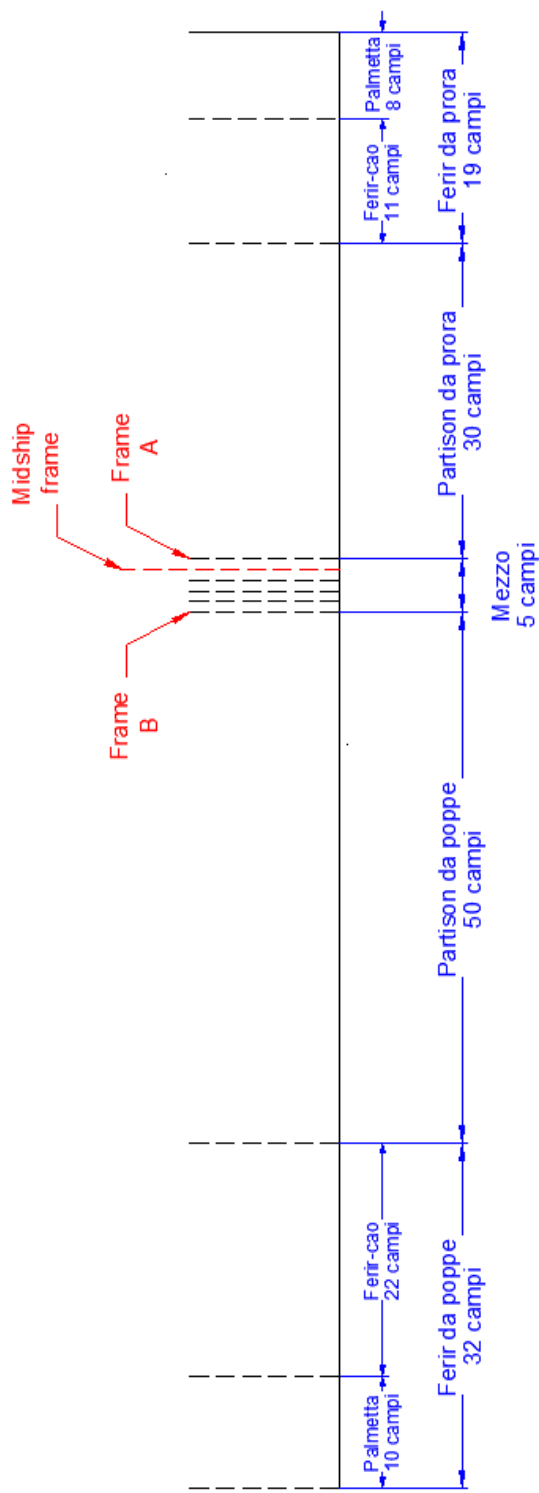


Fig. 31. Flat portion of the light galley's hull as delimited by Frame A and Frame B. Drawing L. Campana.

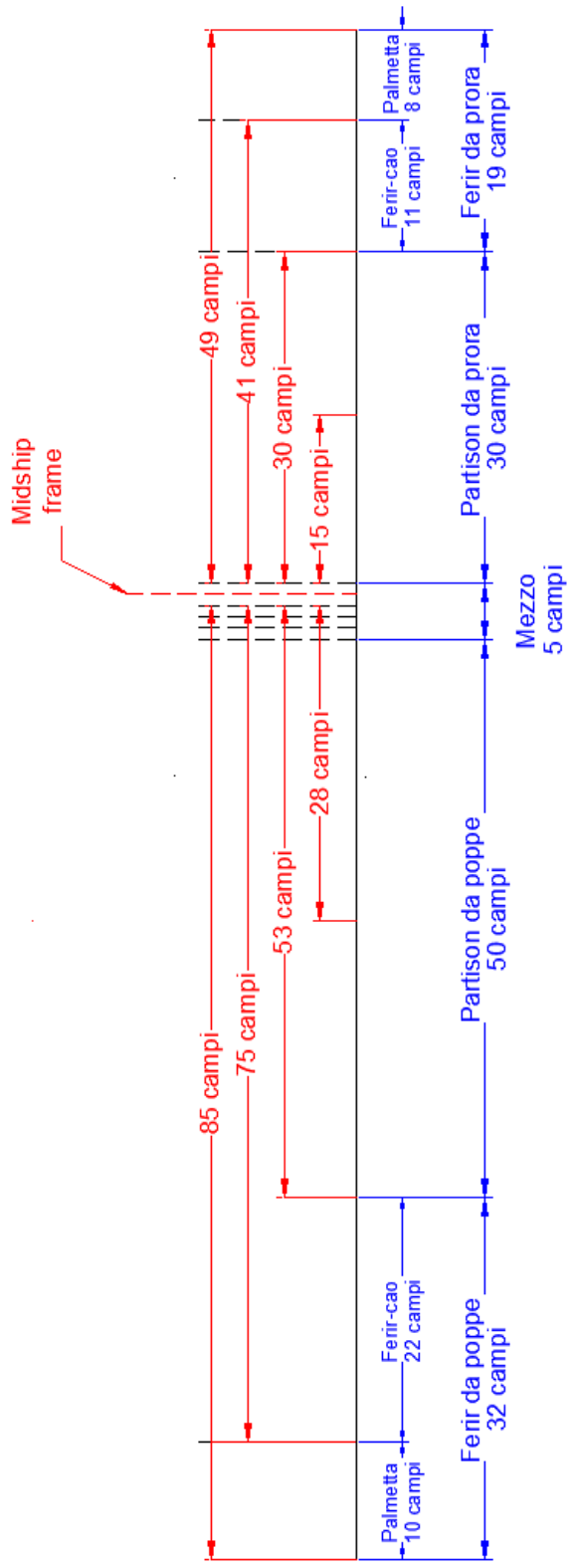


Fig. 32. Number of *campi* (rooms) in the light galley's hull portions after determining the location of the midship frame. Drawing L. Campana.

of the frame placed at the forward yoke (*zovo da prora*) is “6 feet and 6 good fingerbreadths;” and the height of the stem (*asta da prora*) is 6 feet and $9 \frac{1}{7}$ fingerbreadths. To these heights, one has to add the height of the midship frame (*pontal*), which is 5 feet and 12 fingerbreadths.

These heights are crucial in determining the rising of the frames and in designing the catenary, which, in geometry, is the curve that an idealized hanging cable assumes under its own weight when supported only at its ends. In ship design, the catenary is the curve describing the sheer line of a ship. However, some of the measurements provided by the manuscript are only approximate and do not allow for the design of the sheer line. The measurements that are approximations are the height of the frame placed at the location of the after yoke (“about 8 feet”), the height of the last molded forward frame (“6 feet and about 1 fingerbreadth”), and the height of the frame placed at the forward yoke (“6 feet and 6 good fingerbreadths”).

In order to be able to determine the sheer line of the light galley, the exact height of each frame may be calculated by applying Gauss’s formula. First, one has to determine to which station each frame corresponds, forward Frame A and after Frame B, as shown in the table below (heights that are approximatively provided by the manuscript are indicated in red). It is noteworthy that, toward the stern, after the room of the midship frame, there are 3 additional rooms, resulting from the identification of the location of the midship frame, as previously discussed. Conversely, toward the stem, the total number of rooms remain the same.

Table 6. Height of the frames placed at specific stations along the hull and their corresponding number of rooms.

	Frame location	Height	Rooms
MIDSHIP	Midship frame	5 feet and 12 fingerbreadths	0
BOW	15 th station	5 feet and 13 ² / ₇ fingerbreadths	15
	Last molded forward frame	6 feet and about 1 fingerbreadth	30
	Fore yoke	6 feet and a good 6 fingerbreadths	41
	Stem	6 feet and 9 ¹ / ₇ fingerbreadths	49
STERN	25 th station	6 feet and 1 ¹ / ₄ fingerbreadths	28
	Last molded after frame	6 feet and 14 ⁵ / ₈ fingerbreadths	53
	Aft yoke	About 8 feet	75
	Stern	8 feet and 10 fingerbreadths	85

As the next step, one has to calculate the triangular number (Δ_n) for each of the corresponding rooms by applying Gauss's formula, as shown below. This calculation gives the exact number of increments of the frame placed at a given station along the hull.

$$\Sigma = n \times \frac{n + 1}{2}$$

Midship frame $\Delta_0 = 0$

$$\Sigma = n \times \frac{n + 1}{2}$$

$$\Sigma = 0 \times \frac{0 + 1}{2}$$

$$\Sigma = 0$$

Increments of the frame placed at the fifteenth station toward the bow ($\Delta_{15} = 120$)

$$\Sigma = 15 \times \frac{15 + 1}{2}$$

$$\Sigma = 15 \times \frac{16}{2}$$

$$\Sigma = 15 \times 8$$

$$\Sigma = 120$$

Increments of the last molded forward frame ($\Delta_{30} = 465$)

$$\Sigma = 30 \times \frac{30 + 1}{2}$$

$$\Sigma = 30 \times \frac{31}{2}$$

$$\Sigma = 30 \times 15.5$$

$$\Sigma = 465$$

Increments of the frame placed at the forward yoke ($\Delta_{41} = 861$)

$$\Sigma = 41 \times \frac{41 + 1}{2}$$

$$\Sigma = 41 \times \frac{42}{2}$$

$$\Sigma = 41 \times 21$$

$$\Sigma = 861$$

Increments of the frame placed at the stem ($\Delta_{49} = 1225$)

$$\Sigma = 49 \times \frac{49 + 1}{2}$$

$$\Sigma = 49 \times \frac{50}{2}$$

$$\Sigma = 49 \times 25$$

$$\Sigma = 1225$$

Increments of the frame placed at the twenty-fifth station toward the stern ($\Delta_{28} = 406$)

$$\Sigma = 28 \times \frac{28 + 1}{2}$$

$$\Sigma = 28 \times \frac{29}{2}$$

$$\Sigma = 28 \times 14.5$$

$$\Sigma = 406$$

Increments of the last molded after frame ($\Delta_{53} = 1431$)

$$\Sigma = 53 \times \frac{53 + 1}{2}$$

$$\Sigma = 53 \times \frac{54}{2}$$

$$\Sigma = 53 \times 27$$

$$\Sigma = 1431$$

Increments of the frame placed at the after yoke ($\Delta_{75} = 2850$)

$$\Sigma = 75 \times \frac{75 + 1}{2}$$

$$\Sigma = 75 \times \frac{76}{2}$$

$$\Sigma = 75 \times 38$$

$$\Sigma = 2850$$

Increments of the frame placed at the sternpost ($\Delta_{85} = 3655$)

$$\Sigma = 85 \times \frac{85 + 1}{2}$$

$$\Sigma = 85 \times \frac{86}{2}$$

$$\Sigma = 85 \times 43$$

$$\Sigma = 3655$$

Once the number of increments comprised by the frames placed at the stations mentioned in the manuscript is calculated, one may proceed to calculating the rising of these frames. In order to do so, first the total amount of rising, both toward the bow and toward the stern, has to be determined. This information is simple to obtain, as the manuscript provides the heights of the midship frame and the height of the stem and the sternpost. The total rising toward the stem is obtained by subtracting the height of the midship frame from the height of the stem, as shown below. As before, units in feet have to be converted into fingerbreadths, with 1 foot equal to 16 fingerbreadths. It has to be pointed out that the rising of the frames occurs only in the portion of the hull called *partison*, which is the part between the outermost frames of the central flat portion of the hull and the last molded frame (*cao da sesto*). However, the series of

calculations reported here will permit determining the exact amount of rising for all the other frames beyond the *partison*. This is extremely important as the manuscript does not provide precise measurements for some of the heights, as was discussed earlier. In addition, this procedure proves that the entire hull length of the light galley was designed by means of mathematical formulas, and not just that of the *partison*.

$$\begin{aligned}
 \text{Total rising of stem} &= \text{Height of the stem} - \text{height of the midship frame} \\
 &= 6 F 9 \frac{1}{7} \text{ fb} - 5 F 12 \text{ fb} \\
 &= [(6 F \times 16 \text{ fb}) + 9 \frac{1}{7} \text{ fb}] - [(5 F \times 16 \text{ fb}) + 12 \text{ fb}] \\
 &= [96 \text{ fb} + 9 \frac{1}{7} \text{ fb}] - [80 \text{ fb} + 12 \text{ fb}] \\
 &= 105 \frac{1}{7} \text{ fb} - 92 \text{ fb} \\
 &= 13 \frac{1}{7} \text{ fb}
 \end{aligned}$$

Thus, the total rising of the light galley toward the stem is to 13 $\frac{1}{7}$ fingerbreadths, which corresponds to 28.56 cm. Once the exact total rising toward the stem is known, the amount of each rising increment toward the stem may be calculated by dividing the total rising, which corresponds to 13 $\frac{1}{7}$ fingerbreadths, by the total number of increments toward the stem, which is 1225, the triangular number of 49 (the rooms comprised between the midship frame and the sternpost).

1 rising increment of stem (fb)

$$= \text{total rising toward the stem} \div \text{total number of increments toward the stem}$$

$$= 13 \frac{1}{7} \text{ fb} \div 1225$$

$$= 0.010728863 \text{ fb}$$

The result obtained is seemingly small. However, if it is multiplied by the number of increments of the frames placed at the specific locations, the rising of the frame placed at that specific location will be obtained, as shown below.

Rising of the frame at the fifteenth station toward the stem ($\Delta_{15} = 120$)

$$= (\text{total rising} \div \text{total number of increments}) \times 120$$

$$= (13 \frac{1}{7} \text{ fb} \div 1225) \times 120$$

$$= 0.010728863 \text{ fb} \times 120$$

$$= 1.28 \text{ fb}$$

Rising of the last molded forward frame ($\Delta_{30} = 465$)

$$= (\text{total rising} \div \text{total number of increments}) \times 465$$

$$= (13 \frac{1}{7} \text{ fb} \div 1225) \times 465$$

$$= 0.010728863 \text{ fb} \times 465$$

$$= 4.98 \text{ fb}$$

Rising of the frame at the forward yoke ($\Delta_{41} = 861$)

$$= (\text{total rising} \div \text{total number of increments}) \times 861$$

$$= (13 \frac{1}{7} \text{ fb} \div 1225) \times 861$$

$$= 0.010728863 \text{ fb} \times 861$$

$$= 9.23 \text{ fb}$$

Rising of the frame at the stem ($\Delta_{49} = 1225$)

$$= (\text{total rising} \div \text{total number of increments}) \times 1225$$

$$= (13 \frac{1}{7} \text{ fb} \div 1225) \times 1225$$

$$= 0.010728863 \text{ fb} \times 1225$$

$$= 13.14 \text{ fb}$$

Thus, the rising of the frames toward the stem placed at the locations specified above is determined. The same procedure has to be applied for calculating the rising of the frames placed at the locations toward the stern. First, one must calculate the total rising of the frames toward the stern by subtracting the height of the midship frame from the height of the sternpost, as shown below.

$$\text{Total rising of stern} = \text{Height of the sternpost} - \text{height of the midship frame}$$

$$= 8 \text{ F } 10 \text{ fb} - 5 \text{ F } 12 \text{ fb}$$

$$= [(8 \text{ F} \times 16 \text{ fb}) + 10 \text{ fb}] - [(5 \text{ F} \times 16 \text{ fb}) + 12 \text{ fb}]$$

$$= [128 \text{ fb} + 10 \text{ fb}] - [80 \text{ fb} + 12 \text{ fb}]$$

$$= 138 \text{ fb} - 92 \text{ fb}$$

$$= 46 \text{ fb} (2 \text{ F } 14 \text{ fb})$$

Thus, the total rising of the light galley toward the stern totals 46 fingerbreadths (2 feet and 14 fingerbreadths), which corresponds to 99.97 cm. Once the total rising of the frames toward the stern is known, each rising increment toward the stern may be calculated by dividing the total rising, which corresponds to 46 fingerbreadths, by the total number of increments toward the stern, which is 3655, the triangular number of 85 (the rooms comprised between the midship frame and the sternpost).

1 rising increment at stern (fb)

$$\begin{aligned}
 &= \text{total rising toward the stern} \div \text{total number of increments toward the stern} \\
 &= 46 \text{ fb} \div 3655 \\
 &= 0.0125854993 \text{ fb}
 \end{aligned}$$

Again, the result thus obtained seems extremely small. However, if it is multiplied by the number of increments of the frames placed at the specific locations, the rising of the frame placed at that specific location will be obtained, as shown below. It is useful to remember that, toward the stern, there are three additional rooms resulting from the identification of the location of the midship frame. Thus, for example, the twenty-fifth station corresponds to the twenty-eighth station.

Rising of the frame at the twenty-fifth station toward the stern ($\Delta_{28} = 406$)

$$\begin{aligned}
 &= (\text{total rising} \div \text{total number of increments}) \times 406 \\
 &= (46 \text{ fb} \div 3655) \times 406
 \end{aligned}$$

$$= 0.0125854993 \times 406$$

$$= 5.10 \text{ fb}$$

Rising of the last molded after frame ($\Delta_{53} = 1431$)

$$= (\text{total rising} \div \text{total number of increments}) \times 1431$$

$$= (46 \text{ fb} \div 3655) \times 1431$$

$$= 0.0125854993 \times 1431$$

$$= 18.00 \text{ fb}$$

Rising of the frame at the after yoke ($\Delta_{75} = 2850$)

$$= (\text{total rising} \div \text{total number of increments}) \times 2850$$

$$= (46 \text{ fb} \div 3655) \times 2850$$

$$= 0.0125854993 \times 2850$$

$$= 35.86 \text{ fb}$$

Rising of the frame at the sternpost ($\Delta_{85} = 3655$)

$$= (\text{total rising} \div \text{total number of increments}) \times 3655$$

$$= (46 \text{ fb} \div 3655) \times 3655$$

$$= 0.0125854993 \times 3655$$

$$= 46 \text{ fb}$$

If to each of these results the height of the midship frame is added, the exact heights of the frames placed at these locations are obtained. This step is important because it allows for the determination of those frame heights that are only approximate, as well as verifying whether the other heights are correct or not.

Height of the frame at the fifteenth station toward the stem

$$\begin{aligned}
 &= \text{Rising of the frame at fifteenth station toward the stem} + \text{height of the midship frame} \\
 &= 1.28 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\
 &= 5 \text{ F } 13.28 \text{ fb} \\
 &= 5 \text{ F } 13 \frac{2}{7} \text{ fb}
 \end{aligned}$$

Height of the last molded forward frame

$$\begin{aligned}
 &= \text{Rising of the frame at the fore last molded frame} + \text{height of the midship frame} \\
 &= 4.98 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\
 &= 6 \text{ F } 0.98 \text{ fb}
 \end{aligned}$$

Height of the frame at the forward yoke

$$\begin{aligned}
 &= \text{Rising of the frame at the fore yoke} + \text{height of the midship frame} \\
 &= 9.23 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\
 &= 6 \text{ F } 5.23 \text{ fb}
 \end{aligned}$$

Height of the frame at the stem

$$\begin{aligned} &= \text{Rising of the frame at the stem} + \text{height of the midship frame} \\ &= 13.14 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\ &= 6 \text{ F } 9.14 \text{ fb} \\ &= 6 \text{ F } 9 \frac{1}{7} \text{ fb} \end{aligned}$$

Height of the frame at the twenty-fifth station toward the stern

$$\begin{aligned} &= \text{Rising of the frame at the twenty-fifth station toward the stern} + \text{height of the} \\ &\quad \text{midship frame} \\ &= 5.10 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\ &= 6 \text{ F } 1.1 \text{ fb} \end{aligned}$$

Height of the last molded after frame

$$\begin{aligned} &= \text{Rising of the frame at the last molded frame} + \text{height of the midship frame} \\ &= 18.00 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\ &= 6 \text{ F } 14 \text{ fb} \end{aligned}$$

Height of the frame at the after yoke

$$\begin{aligned} &= \text{Rising of the frame at the aft yoke} + \text{height of the midship frame} \\ &= 35.86 \text{ fb} + 5 \text{ F } 12 \text{ fb} \\ &= 7 \text{ F } 15.86 \text{ fb} \end{aligned}$$

Height of the frame at the sternpost

= Rising of the frame at the sternpost + height of the midship frame

= 46 fb + 5 F 12 fb

= 8 F 10 fb

Thus, the precise heights of the frames placed at the locations mentioned in the manuscript are obtained. The table below compares the heights that were just calculated to the heights provided by the manuscripts. It is apparent that the degree of accuracy of the measurements from the manuscript is remarkably high; in some cases, the measurements from the manuscripts match perfectly those that were just calculated. In some other cases, the margin of error can be measured in millimeters.

Table 7. Comparison of the heights of frames placed at specific stations along the hull as provided by the manuscript with those obtained by calculations

	Frame (F) location	Calculated F heights	F heights from the ms.	Error (mm)
BOW	15 th station	5 F 13 $\frac{2}{7}$ fb	5 F 13 $\frac{2}{7}$ fb	0
	Last molded forward frame	6 F 0.98 fb	6 F and about 1 fb	0
	Fore yoke	6 F 5.23 fb	6 F and a good 6 fb	16.5
	Stem	6 F 9 $\frac{1}{7}$ fb	6 F 9 $\frac{1}{7}$ fb	0
STERN	25 th station	6 F 1.1 fb	6 F 1 $\frac{1}{4}$ fb	3
	Last molded after frame	6 F 14 fb	6 F 14 $\frac{5}{8}$ fb	13.36
	Aft yoke	7 F 15.86 fb	About 8 feet	0
	Stern	8 F 10 fb	8 F 10 fb	0

In order to design the light galley's sheer line, first the calculated heights of the frames at the exact locations as recorded in the manuscript have to be plotted (fig. 33). Then, the upper extremities of each height have to be joined with a smooth line to one another. Thus, the sheer line is obtained (fig. 34). Once the sheer line is drawn and the profile of the stem and sternpost are added, the sheer view of the light galley is obtained (fig. 35). The portion representing the rising of the frames is shown visually in figure 36, and the rising of each frame is listed in the table below.

Table 8. Rising of the frames at specific locations along the hull.

	Frame location	Rising of the frame	Measurements in cm
BOW	15 th station	1.28 fb	2.78
	Last molded forward frame	4.98 fb	10.82
	Fore yoke	9.23 fb	20.05
	Stem	13.14 fb	28.55
STERN	25 th station	5.10 fb	11.08
	Last molded after frame	18 fb	39.11
	Aft yoke	35.86 fb	77.93
	Stern	46 fb	99.97

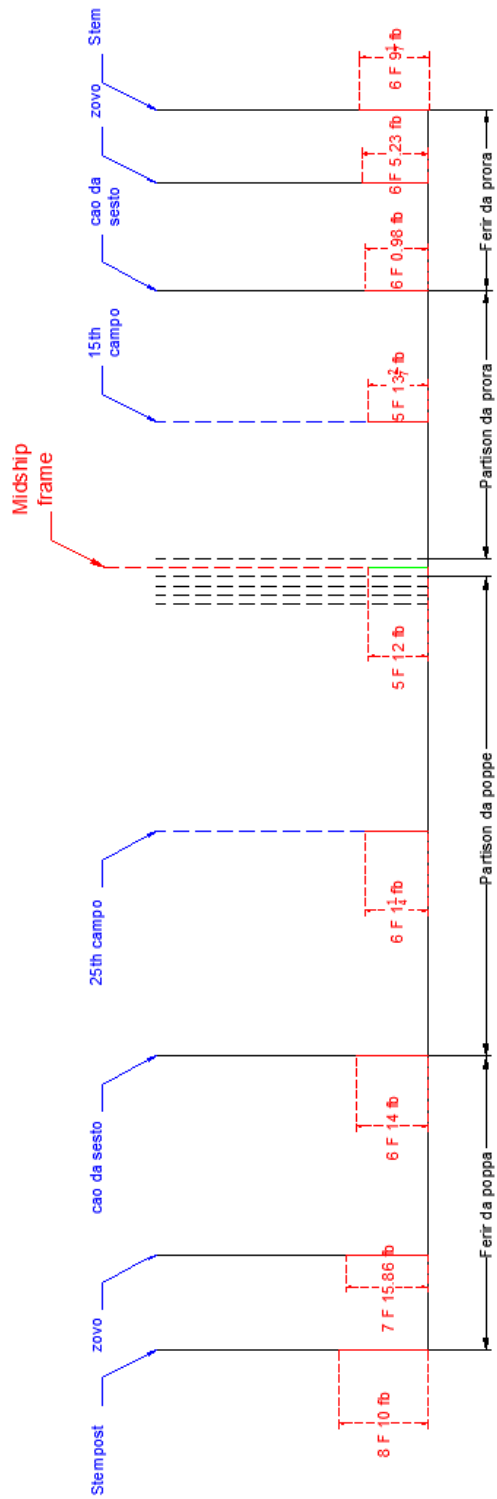


Fig. 33. Heights of frames at specific locations along the light galley's hull. Drawing L. Campana.

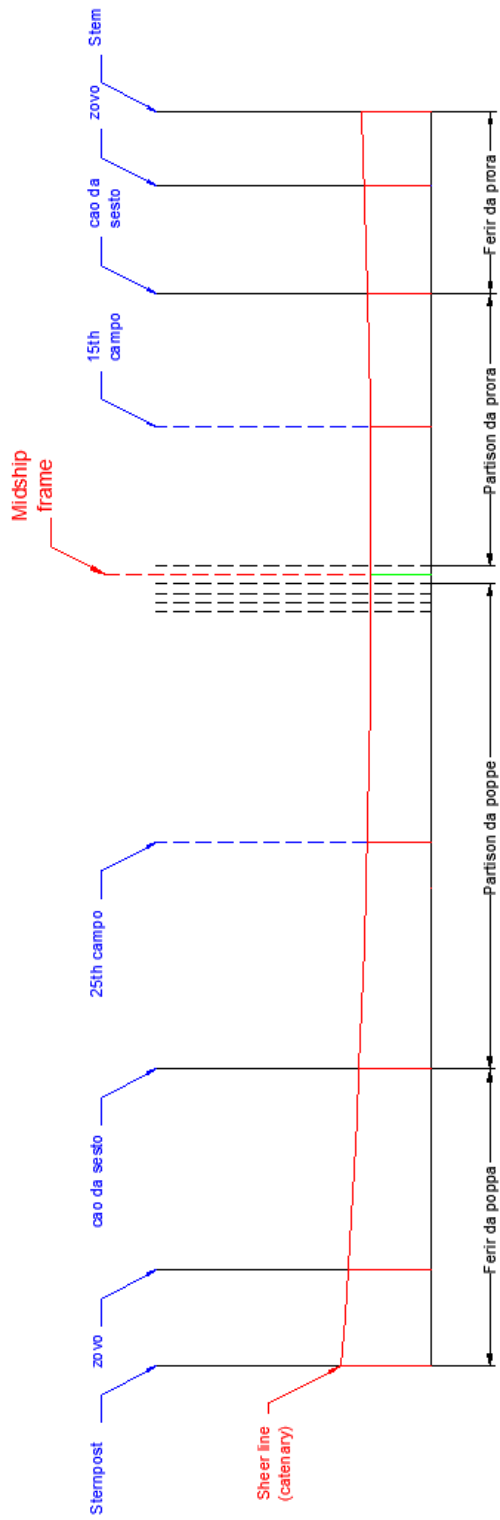


Fig. 34. Sheer line of the light galley. Drawing L. Campana.

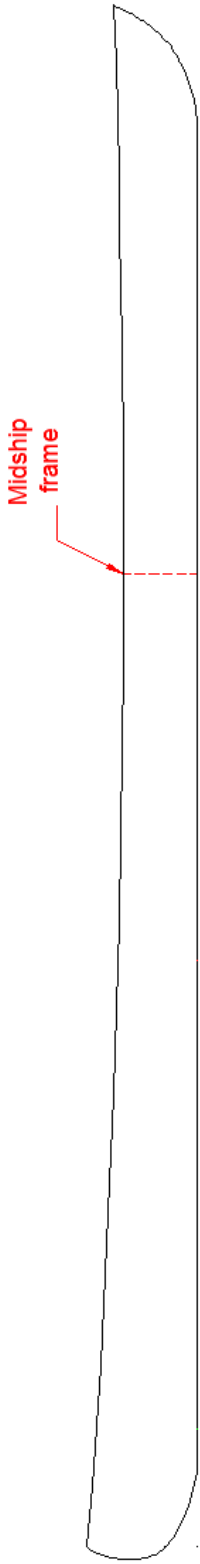


Fig. 35. Sheer view of the light galley. Drawing L. Campana.

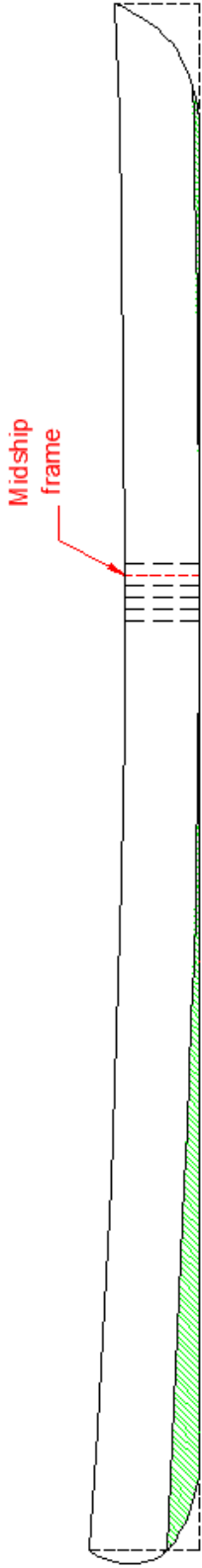


Fig. 36. Portion representing the rising of the frames (in green). Drawing L. Campana.

Breadth Plan and Narrowing of the Frames

In order to design the plan view of the light galley, one must determine the width of the frames and how much they narrow along the length of the hull. The manuscript provides detailed measurements for the widths of the frames placed at specific locations, which are the same as those given for the depts. The midship frame (*mezan*) is 15 feet and 4 fingerbreadths wide (*bocca*), the frame placed at the fifteenth station (*campo*) toward the bow is 14 feet and 4 fingerbreadths, the last molded forward frame (*cao da sesto da prova*) is 11 feet and 3 fingerbreadths, the frame at the forward yoke (*zovo da prova*) is 6 feet and 11 $\frac{1}{3}$ fingerbreadths wide, the frame at the twenty-fifth station (*campo*) toward the stern is 14 feet and 4 fingerbreadths wide, the last molded after frame (*cao da sesto da poppe*) is 11 feet and 8 fingerbreadth, the frame at the after yoke (*zovo da poppe*) is 7 feet and 12 fingerbreadths wide, and the transom (*triganto*) is 4 feet wide (Table 9).

Table 9. Widths of the frames placed at specific stations along the hull of the light galley as provided by the manuscript.

	Frame location	Width of the frames
MIDSHIP	Midship frame	15 feet and 4 fingerbreadths
BOW	15 th station	14 feet and 4 fingerbreadths
	Last molded forward frame	11 feet and 3 fingerbreadths
	Forward yoke	6 feet and 11 $\frac{1}{3}$ fingerbreadths
STERN	25 th station	14 feet and 4 fingerbreadths

Table 9. Continued.

	Frame location	Width of the frames
	Last molded after frame	11 feet and 8 fingerbreadths
	After yoke	7 feet and 12 fingerbreadths
	Transom	4 feet

In order to obtain the plan view of the light galley, the frame widths have to be first plotted at the locations provided by the manuscript (fig. 37). Then, the extremities of the segments representing the widths have to be joined in order to obtain the plan view of the light galley (fig. 38).

Once the plan view is obtained, one can calculate the narrowing of the frames along the length of the hull by a series of simple calculations involving—as in the case of the rising of the frames—Gauss’s formula. It has to be pointed out that, during the sixteenth century, in the Arsenal of Venice, shipwrights usually narrowed by means of geometrical methods only the frames comprising the *partison* (fig. 39). In reconstructing the light galley as recorded by the *Misure di vascelli*, it becomes evident that whoever designed the galley has changed his *modus operandi* and adopted a new practice. The series of calculations proposed here indicates that the narrowing of the frames was achieved by applying Gauss’s formula up to the frame placed at the yokes, or *zovi* (fig. 40). In addition to providing a better ship design, it is clear that this new

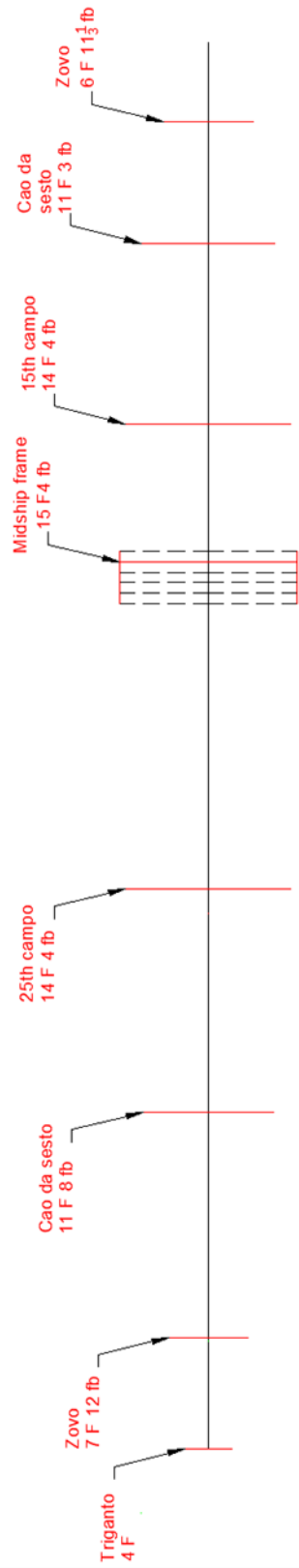


Fig. 37. Widths of the frames at specific locations along the light galley's hull. Drawing L. Campana.

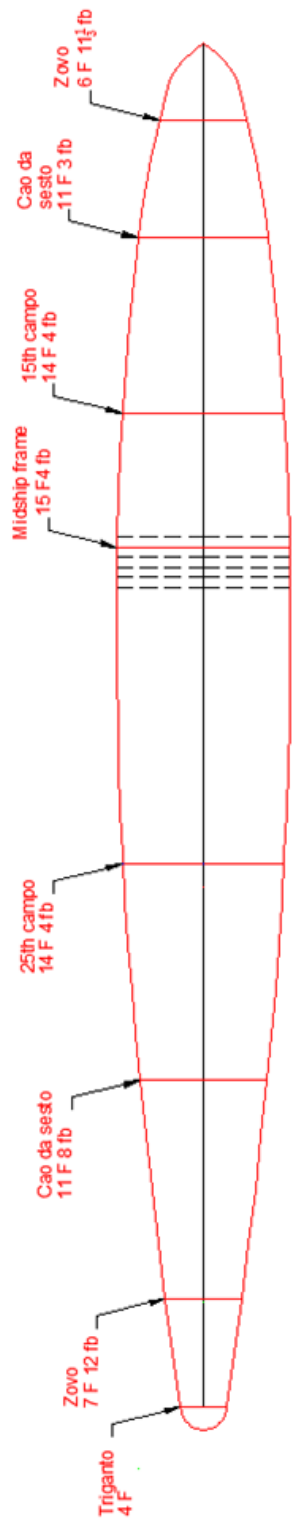


Fig. 38. Breadth plan of the light galley. Drawing L. Campana.

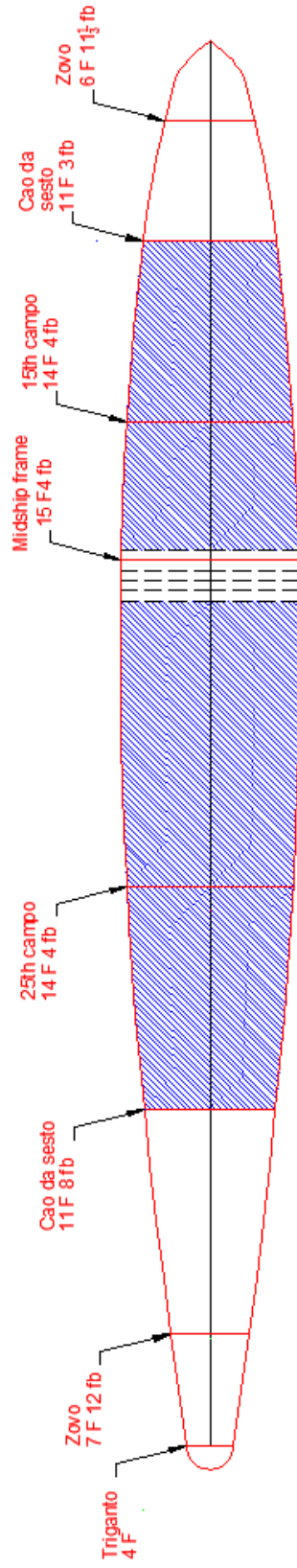


Fig. 39. Portion of the light galley's hull comprising the frames to be narrowed (*partison*) according to Venetian shipbuilding practice based on geometrical methods. Drawing L. Campana.

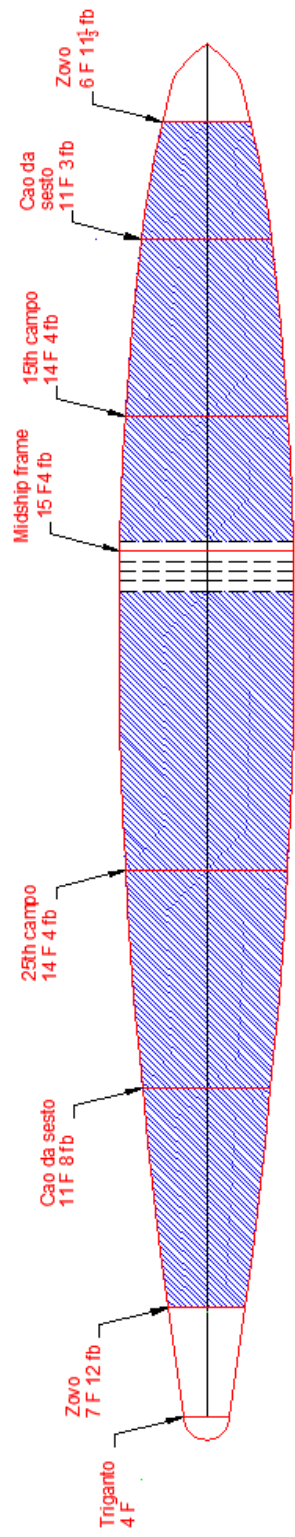


Fig. 40. Portion of the light galley's hull comprising the frames to be narrowed according to Fausto's shipbuilding method based on mathematical formulas. Drawing L. Campana.

practice was meticulously carried out not by means of geometrical methods, but by mathematical formulas discussed below. The background knowledge necessary to carry out such complex ship design was certainly not that of a shipwright, but rather of an erudite person like Fausto.

Since the narrowing of the frames will be calculated only for one half of the ship (the other half will be identical), as a first step, the widths of the frames at the locations provided by the manuscript have to be converted from feet (F) into fingerbreadths (fb), and then divided by 2, as shown in the table below.

Table 10. Half-width of the frames at specific stations.

	Frame location	Width of the frame	Conversion into fingerbreadths	÷ 2
MIDSHIP	Midship frame	15 F 4 fb	$(15 F \times 16 \text{ fb}) + 4 \text{ fb} = 244 \text{ fb}$	122
BOW	15 th station	14 F 4 fb	$(14 F \times 16 \text{ fb}) + 4 \text{ fb} = 228 \text{ fb}$	114
	Last molded forward frame	11 F 3 fb	$(11 F \times 16 \text{ fb}) + 3 \text{ fb} = 179 \text{ fb}$	89.5
	Forward yoke	6 F 11 $\frac{1}{3}$ fb	$(6 F \times 16) + 11 \frac{1}{3} \text{ fb} = 107.33 \text{ fb}$	53.66
STERN	25 th station	14 F 4 fb	$(14 F \times 16 \text{ fb}) + 4 \text{ fb} = 228 \text{ fb}$	114
	Last molded after frame	11 F 8 fb	$(11 F \times 16 \text{ fb}) + 8 \text{ fb} = 184 \text{ fb}$	92
	After yoke	7 F 12 fb	$(7 F \times 16 \text{ fb}) + 12 \text{ fb} = 124 \text{ fb}$	62
	Transom	4 F	$(4 F \times 16 \text{ fb}) = 64 \text{ fb}$	32

Now the total narrowing toward the bow and toward the stern may be calculated. In order to know the total narrowing at the bow, the half-width of the frame located at the forward yoke (53.66 fingerbreadths) has to be subtracted from the half-width of the midship frame (122 fingerbreadths), as shown below.

Total narrowing at the bow

= half-width of midship frame – half-width of frame at forward yoke

= 122 fb – 53.66 fb

= 68.34 fb

In order to determine the exact amount of narrowing for each increment, this measurement (68.34 fingerbreadths) has to be divided by the total number of increments comprised in the portion between the midship frame and the forward yoke. As shown above, the total number of increments between the midship frame and the forward yoke is provided by the triangular number of the stations comprised within this portion (i.e., from the midship frame to the frame placed at the forward yoke-station). The portion of the hull between the midship frame and the forward yoke contains 41 rooms and, thus, it contains 42 stations or frames. Therefore, in order to determine the narrowing of the frame placed at the forward yoke-station, the number of increments for the forty-second forward frame (which corresponds to the frame placed at the forward yoke) has to be calculated by using Gauss's formula, as shown below.

Increments of the frame at the forward yoke ($\Delta_{42} = 903$)

$$\Sigma = 42 \times \frac{42 + 1}{2}$$

$$\Sigma = 42 \times \frac{43}{2}$$

$$\Sigma = 42 \times 21.5$$

$$\Sigma = 903$$

As mentioned above, in order to calculate the amount of narrowing toward the bow for each increment, the total amount of narrowing toward the bow (68.34 fingerbreadths) has to be divided by the total number of increments contained between Frame A and the frame located at the forward yoke (903), as shown below.

1 narrowing increment at bow

= total amount of narrowing between Frame A and the frame at the location of the forward yoke \div total number of increments between Frame A and the frame at the forward yoke

= 68.34 fb \div 903 increments

= 0.0756810631 fb/increments

Once the amount of a single increment is determined, then the exact narrowing for each frame placed at the specific locations provided by the manuscript may be calculated, simply by multiplying the value of the increment by the total number of increments within each portion of the hull. However, a crucial point in this step is to bear in mind that, as the central portion of hull not involved in the narrowing contains 5 rooms (that is, 6 frames), the number of frames contained between Frame A and the fifteenth station are actually 14, and not 15. Likewise, the number of frames between Frame A and the last molded forward frame is 29, and not 30. Thus, the triangular number (Δ_n) for 14 and 29 may be calculated, as shown below.

Frame A – frame at 15th station ($\Delta_{14} = 105$)

$$\Sigma = 14 \times \frac{14 + 1}{2}$$

$$\Sigma = 14 \times \frac{15}{2}$$

$$\Sigma = 14 \times 7.5$$

$$\Sigma = 105$$

Frame A – last molded forward frame ($\Delta_{29} = 435$)

$$\Sigma = 29 \times \frac{29 + 1}{2}$$

$$\Sigma = 29 \times \frac{30}{2}$$

$$\Sigma = 29 \times 15$$

$$\Sigma = 435$$

Between Frame A and the frame placed at the forward yoke there are 42 frames, for a total of 903 increments. The narrowing of the frame at the locations provided by the manuscript may be calculated, as shown below.

Narrowing of the frame at fifteenth station toward the stem ($\Delta_{14} = 105$)

= 1 increment \times total number of increments of the frame at the fifteenth station

= 0.0756810631 fb \times 105

= 7.94 fb

Narrowing of the frame at the last molded forward frame ($\Delta_{29} = 435$)

= 1 increment \times total number of increments of the last molded forward frame

= 0.0756810631 fb \times 435

$$= 32.92 \text{ fb}$$

Narrowing of the frame at the forward yoke ($\Delta_{42} = 903$)

$$= 1 \text{ increment} \times \text{total number of increments of the frame at the forward yoke}$$

$$= 0.0756810631 \text{ fb} \times 903$$

$$= 68.34 \text{ fb}$$

The total amount of narrowing toward the stern may be calculated. In order to do so, the half-width of the frame located at the after yoke has to be subtracted from the half-width of the midship frame. It should be pointed out here that there appears to be an error in the manuscript with regard to the width of the frame placed at the after yoke. The manuscript records that the width of the frame at the forward yoke is 7 feet and 12 fingerbreadths. However, after a series of calculations, we believe that the exact height of the frame placed at the forward yoke is 7 feet and 2 fingerbreadths. The copyist may have mistakenly written 12, rather than 2, by adding 1 before the 2. Indeed, if the narrowing of the frame toward the stern is calculated using 7 feet and 12 fingerbreadths, the error is seen to be around 2 centimeters, which is significant considering the accuracy of the other measurements provided by the manuscript. Conversely, if the value of 7 feet and 2 fingerbreadths is used, then the margin of error is within a few millimeters.

In order to calculate the total narrowing of the frame toward the stern, first 7 feet and 2 fingerbreadths has to be converted into fingerbreadths. Then, the result must be divided by 2, since only the half-width is needed.

Height of the frame at the forward yoke

$$= [(7 \text{ F} \times 16 \text{ fb}) + 2 \text{ fb}] \div 2$$

$$= [112 \text{ fb} + 2 \text{ fb}] \div 2$$

$$= 114 \text{ fb} \div 2$$

$$= 57 \text{ fb}$$

Now, the total narrowing of the frames toward the stern may be calculated by subtracting the half-width of the frame at the forward yoke from the half-width of the midship frame, as shown below.

Total narrowing toward the stern

$$= \text{half-width midship frame} - \text{half-width frame at after yoke}$$

$$= 122 \text{ fb} - 57 \text{ fb}$$

$$= 65 \text{ fb}$$

Then, the amount of one narrowing increment toward the stern is calculated by dividing the total amount of narrowing toward the stern by the total number of increments comprised between Frame B and the frame located at the after yoke.

However, since the total number of rooms between the frame placed at the after yoke and Frame B is 72, the frame placed at the forward yoke has to be the seventy-third frame from Frame B. Therefore, the number of increments in the seventy-third frame may be determined by calculating the triangular number (Δ_n) of 73, as show below.

Increments between Frame B and frame at the after yoke ($\Delta_{73} = 2701$)

$$\Sigma = 73 \times \frac{73 + 1}{2}$$

$$\Sigma = 73 \times \frac{74}{2}$$

$$\Sigma = 73 \times 37$$

$$\Sigma = 2701$$

The value of one narrowing increment toward the stern can be calculated by dividing the total amount of narrowing between Frame B and the frame at the after yoke, by the total number of increments between Frame B and the frame at the forward yoke.

one narrowing increment stern

= total amount of narrowing between Frame B and the frame at the after yoke ÷ total number of increments between Frame B and the frame at the after yoke

$$= 65 \div 2701$$

$$= 0.0240651611 \text{ fb}$$

Once the value of one increment is known, the exact narrowing for each frame placed at the specific locations provided by the manuscript may be calculated simply by multiplying the increment value by the total number of increments within each portion of the hull. However, a crucial point in this step is to keep in mind that, as the central portion of hull not involved in the narrowing comprises five rooms (that is, six frames), the number of frames between Frame B and the twenty-fifth station are actually 24, and not 25. Likewise, the number of frames between Frame B and the last molded after frame are 49, and not 50. Thus, the triangular numbers (Δ_n) of 24 and 49 have to be calculated, as shown below.

Increments between Frame B and frame at the twenty-fifth station ($\Delta_{24} = 435$)

$$\Sigma = 24 \times \frac{24 + 1}{2}$$

$$\Sigma = 24 \times \frac{25}{2}$$

$$\Sigma = 24 \times 12.5$$

$$\Sigma = 300$$

Increments between Frame B and last molded after frame ($\Delta_{49} = 1225$)

$$\Sigma = 49 \times \frac{49 + 1}{2}$$

$$\Sigma = 49 \times \frac{50}{2}$$

$$\Sigma = 49 \times 25$$

$$\Sigma = 1225$$

The exact narrowing for each frame placed at the specific locations provided by the manuscript may be calculated simply by multiplying one increment by the number of total increments comprised in the frame at the specified location, as shown below.

Narrowing of the frame at twenty-fifth station toward the stem ($\Delta_{24} = 300$)

= 1 increment \times total number of increments of the frame at the 25th station

= 0.0240651611 fb \times 300

$$= 7.21 \text{ fb}$$

Narrowing of the frame at the last molded after frame ($\Delta_{49} = 1225$)

$$= 1 \text{ increment} \times \text{total number of increments of the last molded after frame}$$

$$= 0.0240651611 \text{ fb} \times 1225$$

$$= 29.47 \text{ fb}$$

Narrowing of the frame at the after yoke ($\Delta_{73} = 2701$)

$$= 1 \text{ increment} \times \text{total number of increments of the frame at the after yoke}$$

$$= 0.0240651611 \text{ fb} \times 2701$$

$$= 65 \text{ fb}$$

The following table lists the narrowing calculated for each of the frames placed at the locations provided by the manuscript.

Table 11. Narrowing of the frames of the ligh galley.

	Frame location	Narrowing
MIDSHIP	Midship frame	0 fb
BOW	15 th station	7.94 fb
	Last molded forward frame	32.92 fb
	Forward yoke	68.34 fb
STERN	25 th station	7.21 fb

Table 11. Continued.

	Frame location	Narrowing
	Last molded after frame	29.47 fb
	After yoke	65 fb

By adding the amount of narrowing of each frame at the specific locations to the half-width of the corresponding frame, the half-width of the midship frame (122 fingerbreadths) is obtained, as shown in the table below.

Table 12 . Countercheck of the narrowing of the frames of the light galley

	Frame location	Narrowing	Narrowing + half-width of the frame
MIDSHIP	Midship frame	0 fb	$122 \text{ fb} + 0 \text{ fb} = 122 \text{ fb}$
BOW	15 th station	7.94 fb	$114 \text{ fb} + 7.94 \text{ fb} = 121.94 \text{ fb}$
	Last molded forward frame	32.92 fb	$89.5 \text{ fb} + 32.92 \text{ fb} = 122.42 \text{ fb}$
	Forward yoke	68.34 fb	$53.66 \text{ fb} + 68.34 \text{ fb} = 122 \text{ fb}$
STERN	25 th station	7.21 fb	$114 \text{ fb} + 7.21 \text{ fb} = 121.21 \text{ fb}$
	Last molded after frame	29.47 fb	$92 \text{ fb} + 29.47 \text{ fb} = 121.47 \text{ fb}$
	After yoke	65 fb	$62 \text{ fb} + 60 \text{ fb} = 122 \text{ fb}$

If these measurements are now subtracted from the half-width of the midship frame, this will not only verify whether the measurements provided by the manuscript are correct, but also indicate the amount of error, as shown in the table below.

Table 13. Margin of error (in mm) in the narrowing of the frames of the light galley

	Frame location	Half-width of midship frame – (Narrowing + half-width of the frame)	Error
MIDSHIP	Midship frame	$122 \text{ fb} - 0 \text{ fb} = 0 \text{ fb}$	0 mm
BOW	15 th station	$122 \text{ fb} - 121.94 = 0.06 \text{ fb}$	0 mm
	Last molded forward frame	$122.42 \text{ fb} - 122 \text{ fb} = 0.42 \text{ fb}$	9.1 mm
	Forward yoke	$122 \text{ fb} - 122 \text{ fb} = 0 \text{ fb}$	0 mm
STERN	25 th station	$122 \text{ fb} - 121.21 \text{ fb} = 0.79 \text{ fb}$	17.1 mm
	Last molded after frame	$122 \text{ fb} - 121.47 \text{ fb} = 0.53 \text{ fb}$	11.5 mm
	After yoke	$122 \text{ fb} - 122 \text{ fb} = 0 \text{ fb}$	0 mm

As the margin of error shown in Table 13 varies minimally between 0 and 17.1 mm, this may be taken as proof that the design of the light galley was achieved by means of mathematical formulas, and not by geometrical (empirical) methods. Such deep mathematical knowledge could only have been possessed by a genius like Fausto.

CHAPTER VII
THE GREAT GALLEY FOR THE PROVVEDITOR OF THE SEA
AND OTHER VESSELS BUILT BY FAUSTO

Introduction

Along with measurements for building a quinquereme and a light galley, the manuscript *Misure di vascelli* also records measurements for a galleon (a sailing vessel) and for three different types of great galleys, which were rowed by four rowers on a single bench pulling one long sweep.

The Galleon

During his tenure in the Arsenal, Fausto built two galleons: a “small galleon” and another “huge galleon” in the 1540s, during the years before his death in 1546. The first one was launched in the first months of 1542,⁶² and, on 13 May 1542, the Senate planned to use it against the Uskoks in Dalmatia, but later dismissed the idea.⁶³ The “large galleon” (*il galion grando*) was launched on 11 December 1558, but sank the same day just as it reached Malamocco, for the ship’s heavy artillery shifted to one side, causing the ship to take in water from the gunports.⁶⁴ The salvage operations lasted about two months and the ship was raised.⁶⁵ During the sixteenth century, prior

⁶² Concina (1990, 121) erroneously stated that the “small galleon” built by Fausto was launched in 1544.

⁶³ ASVe, Senato mar, reg. 26, fol. 100r.

⁶⁴ ASVe, Maggior Consiglio, Deliberazioni, reg. 28, fol. 77r.

⁶⁵ ASVe, Senato mar, reg. 35, fol. 15r, and fols. 35v-36r.

to the construction of Fausto's galleons, the Arsenal commissioned the construction of several other galleons and heavy ships, such as the *barze* built by Leonardo Bressan, and the first galleon ever built in the Arsenal by Matteo Bressan in 1526-30.⁶⁶

The measurements for building a galleon are recorded in folios 17r-18v. The *incipit* of folio 17r reports the date as 1 April 1546 and, thus, it is likely that the measurements refer to the Fausto's "large galleon." This hypothesis is validated by the cargo capacity of the galleon recorded by the author of the manuscript *Misure di vascelli*, 1500 *botti*, which was the maximum cargo capacity of Venetian merchant ships.⁶⁷

Unfortunately, the section on the galleon is descriptive in its nature and provides only the length overall (20 *passa*, or 34.7 m), the maximum beam (33 *pie* ', or 11.5 m), and the depth in hold (11 *pie* ', or 3.8 m). These measurements can give an idea of the overall size of the galleon, but do not allow for a reconstruction. However, the fact that the measurements for the galleon are limited to its length overall, maximum beam, and depth in the hold may indicate that the galleon was already built and decked and, thus, it would have been impossible to record it in detail.

The author of the manuscript *Misure di vascelli* describes the galleon in terms of its armament and sails. The galleon had two decks: the upper deck, or weather deck,

⁶⁶ Aymard 1991, 263-7.

⁶⁷ One Venetian *botte* was equal to 751 kg; see Martini 1883, 818. The *botte* was used in Venetian trade since the fourteenth century. Its earliest mention in Venetian records are found in a decree of the Great Council, dated 16 May 1333 (ASVe, Maggior Consiglio, Spiritus, fol. 65r). It was officially introduced in Venice on 5 July 1362, to avoid *inequalitas in extimationibus navigiorum* [disparity in estimating (the cargo capacity) of ships], which were previously rated in *migliara* (ASVe, Maggior Consiglio, Novella, fol. 83r). One *milliaro* or *migliaro* corresponded to 477 kg; see Martini 1883, 818.

was 2.2 m high, whereas the lower deck was 3.8 m high, as indicated above. The galleon carried 10 guns of 50 libbers, 8 guns of 20 libbers, 8 culverines of different sizes, and 12 swivel guns and personal arms (*moschetti*). The galleon had a square-rigged main mast and a lateen-rigged mizzen mast.

The most distinctive feature of Fausto's galleon was that it could have been propelled both by sails and by rowers. Filippo Pigafetta (1533-1604), who visited the Arsenal of Venice sometime toward the end of the sixteenth century, records that the galleon was rowed by 21 rowers on either side, and that the oars were 14.25 m long.⁶⁸

The Great Galley for the Provveditor of the Sea

The three great galleys recorded in the manuscript are a standard great galley (*galea da 4*), a great galley for an admiral (*galea da zeneral*), and a great galley for the Provveditor of the Sea (*galea da proveditor*). Unfortunately, it is possible to reconstruct only the great galley for the Provveditor, since the measurements for the other two great galleys are not complete. For the standard great galley, even though the height and the width of the frames are recorded, the length of the hull portions are missing, whereas for the great galley of an admiral, the length of the hull portions and the height of the frames are given, but the width of the frames is missing. The manuscript also records some measurements for a galleon, but these are far from complete and the text is more descriptive in nature in terms of artillery and armament.

⁶⁸ Milan, BA, Ms. R 99 Sup., fols. 283r-v.

Thus, in this chapter, only the galley with complete measurements in the manuscript, that is, the great galley for the Provveditor of the Sea, will be reconstructed. The measurements for this galley are recorded in folios 6v-7r and folios 11r. The transcription and English translation of these folios are reported below.

Transcription

fol. 6v *Galia da Provedidor a 4*

Longa dentro dalle haste pie' 122 dea 2 ½

fol. 7r *sono la sua lunghezza menada a valio.*

In bocca pie' 16;

al zovo da prove pie' 6 dea 13 ½;

a quel da poppe pie' 8 dea 8 ½;

al 15 da prova pie' 14 dea 13 ½;

al 25 da poppe pie' 14 dea 11 ½;

in triganto pie' 5 dea 8;

al cao de sesto da prova pie 11 dea 7;

a quel da poppe pie' 11 dea 13 ¾.

Et tutte queste misure s'intende al'oro de dentro

del magier de bocca.

Alta in pontal al mezzanin pie' 5 dea $\frac{2}{3}$;

al zovo da prova pie' 6 dea 7

et a quel da poppe pie 7 dea $14\frac{1}{2}$.

[...]

fol. 11 r

Galia da Provedador sono longhe passa 24 pie 2 de' $2\frac{1}{2}$

hasta alta a poppe pie 9 de' $13\frac{1}{2}$

et a prova sono alta pie 6 de' $8\frac{2}{3}$.

A dea $14\frac{1}{7}$ per campo,

pie 17 de' $11\frac{2}{7}\frac{1}{2}$ a prova in ferir.

Pie 26 de' $4\frac{2}{7}$ in partison da prova de campi 30,

pie 4 de' $2\frac{5}{7}$ in mezzo in campi 5,

pie 44 de' $13\frac{1}{7}$ in partison da poppe de campi 50, pie 29 de' $2\frac{4}{7}$ in

ferir a poppe.

Translation

fol. 6v

The great galley for the Provveditor with 4 [rowers per bench]

is 122 feet and $2\frac{1}{2}$ fingerbreadths long,

fol. 7r

measuring from the inner edge of the endposts.

The maximum width of the midship frame is 16 feet

[the width of the frame] at the forward yoke is

6 feet and $13 \frac{1}{2}$ fingerbreadths;

[the width of the frame] at the after yoke is

8 feet and $8 \frac{1}{2}$ fingerbreadths;

[the width of the frame] at the fifteenth station toward the bow

is 14 feet and $13 \frac{1}{2}$ fingerbreadths;

[the width of the frame] at the twenty-fifth station toward the stern

14 fingerbreadths and $11 \frac{1}{2}$ fingerbreadths;

[the width] of the transom is 5 feet and 8 fingerbreadths;

[the width] of the last molded forward frame

is 11 feet and 7 fingerbreadths;

[the width] of the last molded after frame

is 11 feet and $13 \frac{3}{4}$ fingerbreadths;.

All these measurements were taken by measuring from the inner side of the frames.

The height of the midship frame is 5 feet and $2 \frac{2}{3}$ fingerbreadths;

[the height of the frame] at the forward yoke

is 6 feet and 7 fingerbreadths;

[the height of the frame] at the after yoke

is 7 feet and $14 \frac{1}{2}$ fingerbreadths.

[...]

fol. 11 r

The galley of a Provveditor [of the Sea]

is 24 paces, 2 feet and $2 \frac{1}{2}$ fingerbreadths long;

the sternpost is 8 feet and $13 \frac{1}{2}$ fingerbreadths high,

the stem is 6 feet and $8 \frac{2}{3}$ fingerbreadths high.

One room is $14 \frac{1}{7}$ fingerbreadths long;

the distance between the last molded forward frame and the stem

is 17 feet and $11 \frac{2}{7} \frac{1}{2}$ fingerbreadths long;

the portion of the hull toward the bow consisting of the frames that are

narrowed and raised is 26 feet and $4 \frac{2}{7}$ fingerbreadths long,

and comprises 30 rooms;

the central flat portion of the hull is 4 feet and $2 \frac{5}{7}$ fingerbreadths long,

and comprises 5 rooms.

The portion of the hull toward the stern consisting of the frames that are

narrowed and raised is 44 feet and $13 \frac{1}{7}$ fingerbreadths long,

and comprises 50 rooms;

the distance between the last molded after frame and the sternpost

is 29 feet and $2 \frac{4}{7}$ fingerbreadths long.

Reconstruction of the Great Galley for the Provveditor of the Sea

As a premise, all measurements provided by the manuscript are according to the Venetian measurement system. Thus, 1 pace is equal to 5 feet, and 1 foot is equal to 16 fingerbreadths. For the calculations presented in this chapter, the following abbreviations are used:

F = foot/feet

fb = fingerbreadth/fingerbreadths

p = pace/paces.

As in the case of the light galley, the measurements provided by the manuscript allow for the reconstruction of the great galley's sheer plan and breadth plan, along with the narrowing and the rising of the frames. Except for its height (*pontal*) and maximum breadth (*bocca*), the manuscript does not provide measurements for fully reconstructing the midship frame. What is missing are the measurements for obtaining the curvature of the midship frame. As already pointed out, however, a shipwright would have been able to replicate the shape of the midship frame for Fausto's great galley since its height and maximum width is given in the manuscript. What is really important for the reconstruction is the amount of narrowing and rising of each frame, and these may be obtained from the measurements recorded in the manuscript.

Sheer Plan

The great galley is 24 paces, 2 feet and 2 $\frac{1}{2}$ fingerbreadths long, which is equal to 122 feet and 2 $\frac{1}{2}$ fingerbreadths (42.96 meters). Thus, it was slightly longer than the light galley recorded in the manuscript (41.98 meters). It is useful to recall here that, in Venetian ship design, the hull was divided into five main portions, namely the *mezzo*, the *partison da poppe*, the *partison da prora*, the *ferir da poppe*, and the *ferir da prora*.

The *mezzo* is the central portion of the hull not subject to the narrowing and rising of the frames by means of geometrical methods; thus, it is the flat portion of the hull. The *partison da poppe* is the portion of the hull toward the stern comprising the frames that are narrowed and raised by means of geometrical methods; the *partison da prora* is the portion of the hull toward the bow also with frames that were narrowed and raised by means of geometrical methods. The *cao de sesto da poppe* (*cao da sesto* literally means “the end of the mold”) marks the location of the last molded after frame, and the *cao de sesto da prora* marks the location of the last molded forward frame, while the *ferir da poppa* corresponds to the portion of the hull between the last molded after frame (*cao da sesto da poppe*) and the sternpost, and the *ferir da prora* is the portion of the hull that is between the last molded forward frame (*cao da sesto da prora*) and the stem. Unlike in the case of the light galley, the manuscript does not provide the measurements for the *palmetta da poppe* (afterdeck) and the *palmetta da prora* (foredeck).

Each of the above hull portions comprises a number of *campi* (rooms), which mark the location of each frame. The manuscript provides the length of each room

(*campo*), which is $14 \frac{1}{7}$ fingerbreadths. It must be pointed out that the word *campo* (singular of *campi*) may refer either to a station (i.e., the location of a frame) and/or to a room (i.e., the space between two consecutive frames). Depending on the context of the manuscript, one can determine with certainty whether the author of the manuscript refers to stations or to rooms. When the author reports on the length of the *campo*, obviously he is referring to the room, and when providing the specific location of a frame, he is referring to a station.

The length of the *partison da prora*, the *ferir da prora*, the *mezzo*, the *partison da poppa*, and the *ferir da poppa* are provided by the manuscript. The *mezzo* measures 4 feet and $2 \frac{5}{7}$ fingerbreadths; the *partison da poppa* measures 44 feet and $13 \frac{1}{7}$ fingerbreadths; the *partison da prora* measures 26 feet and $4 \frac{2}{7}$ fingerbreadths; the *ferir da poppa* measures 29 feet and $2 \frac{4}{7}$ fingerbreadths; and the *ferir da prora* measures 17 feet and $11 \frac{2}{7} \frac{1}{2}$ fingerbreadths (fig. 41). The sum of these measurements corresponds to the length over all (LOA) of the galley, which is 122 feet and $2 \frac{1}{2}$ fingerbreadths, as shown below.

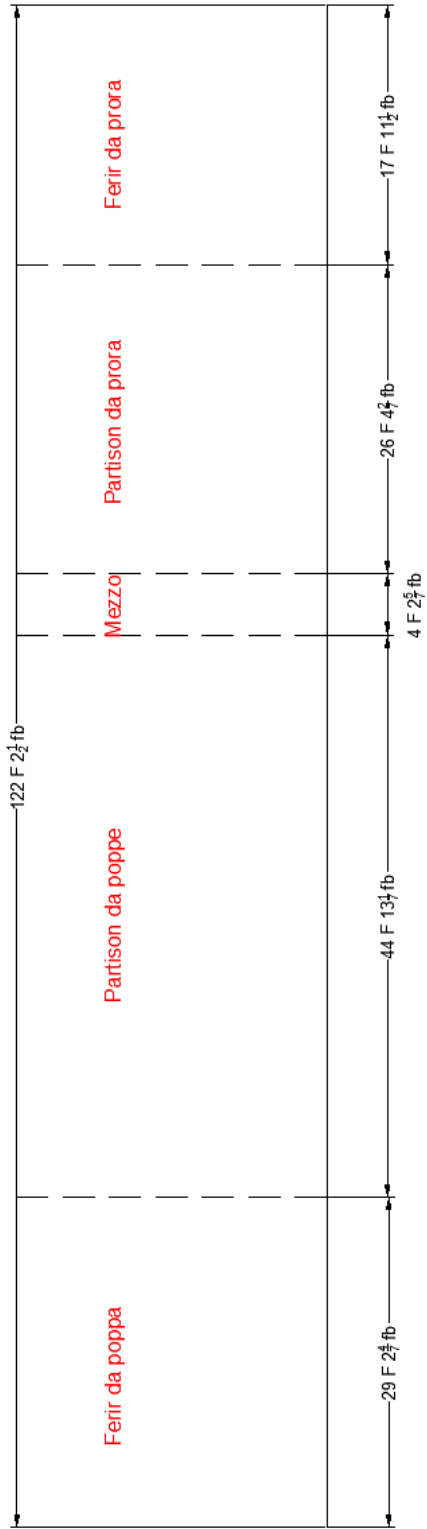


Fig. 41. Length overall of the great galley and its measurements. Drawing L. Campana.

$$\begin{aligned}
\text{LOA} &= \textit{Mezzo} + \textit{partison da poppe} + \textit{partison da prora} + \textit{ferir da poppe} + \textit{ferir} \\
&\quad \textit{da prora} \\
&= (4 F + 2 \frac{5}{7} \text{ fb}) + (44 F + 13 \frac{1}{7} \text{ fb}) + (26 F + 4 \frac{2}{7} \text{ fb}) + (29 F + 2 \frac{4}{7} \\
&\quad \text{fb}) + (17 F + 11 \frac{2}{7} \frac{1}{2} \text{ fb}) \\
&= [(4 F + 44 F + 26 F + 29 F + 17 F) \times 16 \text{ fb}] + (2 \frac{5}{7} \text{ fb} + 13 \frac{1}{7} \text{ fb} + 4 \\
&\quad \frac{2}{7} \text{ fb} + 2 \frac{4}{7} \text{ fb} + 11 \frac{2}{7} \frac{1}{2} \text{ fb}) \\
&= [120 F \times 16 \text{ fb}] + 34 \frac{2}{7} \frac{1}{2} \text{ fb} \\
&= 1920 \text{ fb} + 34 \frac{1}{2} \text{ fb} \\
&= 1954 \frac{1}{2} \text{ fb}
\end{aligned}$$

which corresponds to 122 feet and $2 \frac{2}{7} \frac{1}{2}$ fingerbreadths, as shown below

$$\begin{aligned}
\text{LOA} &= 1954 \frac{1}{2} \text{ fb} \div 16 \text{ fb} \\
&= 122.15625 \text{ fb}
\end{aligned}$$

where 122 are the feet and 0.15625 are equal to $2 \frac{1}{2}$ fingerbreadths (or 2.5 fb), since

$$\begin{aligned}
\text{fb} &= 0.15625 \text{ fb} \times 16 \text{ fb} \\
&= 2.5 \text{ fb}
\end{aligned}$$

In addition, the manuscript records the number of *campi* as follows: the *mezzo* comprises 5 *campi*, the *partison da poppe* comprises 50 *campi*, and the *partison da prora* comprises 30 *campi* (fig. 42).

The manuscript does not explain how many *campi* there are in the *ferir da prora* and in the *ferir da poppa*; however, this information can be easily obtained, since the length of one *campo* is known. Thus, by dividing the length of the *ferir da poppe* for the length of one *campo*, one obtains 32 *campi*, as shown below.

$$\begin{aligned} \text{Campi} &= \text{length of the } \textit{ferir da poppe} \div \text{length of 1 } \textit{campo} \\ &= (29 \text{ F} + 2 \frac{4}{7} \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \end{aligned}$$

As the length of 1 *campo* is given in fingerbreadths, 29 feet have to be converted into fingerbreadths (1 foot is equal to 16 fingerbreadths). Thus,

$$\begin{aligned} \text{Campi} &= [(29 \text{ F} \times 16 \text{ fb}) + 2 \frac{4}{7} \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\ &= [464 \text{ fb} + 2 \frac{4}{7} \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\ &= 468 \frac{4}{7} \text{ fb} \div 14 \frac{1}{7} \text{ fb} \\ &= 33 \text{ fb} \end{aligned}$$

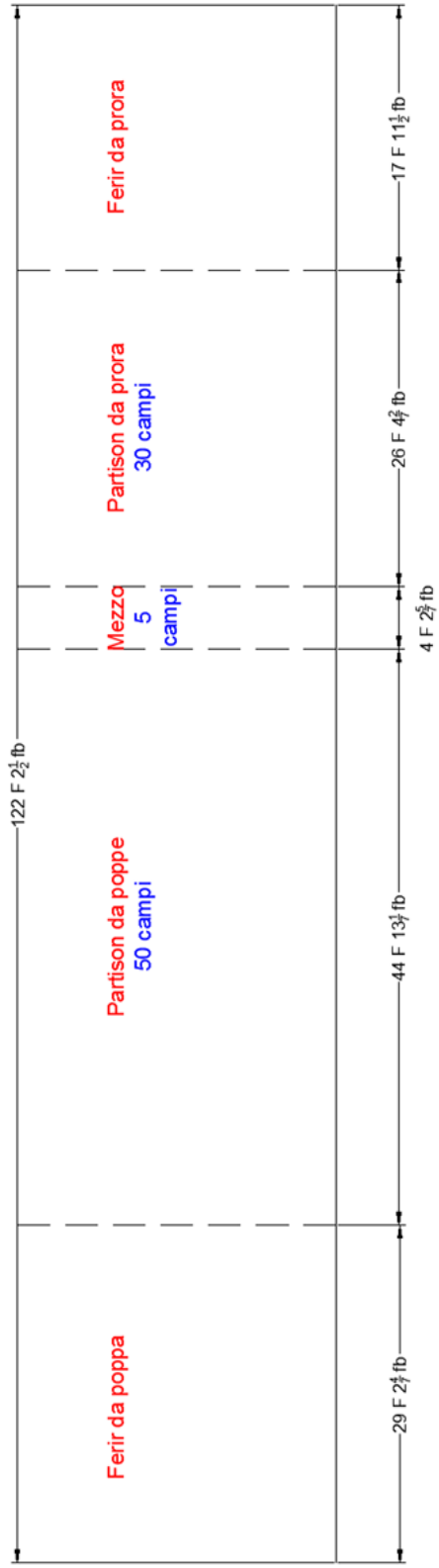


Fig. 42. Division in *campi* (rooms) of the great galley. Drawing L. Campana.

Thus, the *ferir da poppe* comprises 33 *campi* (fig. 43).

In the same way, the number of *campi* in the *ferir da prora* may be calculated, as shown below.

$$\begin{aligned} \text{Campi} &= \text{length of the } \textit{ferir da prora} \div \text{length of 1 } \textit{campo} \\ &= (17 \text{ F} + 11 \frac{2}{7} \frac{1}{2} \text{ fb}) \div 14 \frac{1}{7} \text{ fb} \\ &= [(17 \text{ F} \times 16 \text{ fb}) + 11 \frac{2}{7} \frac{1}{2} \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\ &= [272 \text{ fb} + 11 \frac{2}{7} \frac{1}{2} \text{ fb}] \div 14 \frac{1}{7} \text{ fb} \\ &= 283 \frac{2}{7} \frac{1}{2} \text{ fb} \div 14 \frac{1}{7} \text{ fb} \\ &= 20 \text{ fb} \end{aligned}$$

Thus, we have calculated that the *ferir da prora* comprises 20 *campi* (fig. 44).

Unlike the documentation of the light galley, the manuscript does not provide the measurements for the *palmetta da prora* (foredeck) and the *palmetta da poppe* (afterdeck).

As a second step, in order to obtain the great galley's sheer plan, the exact location of the midship frame has to be determined. The midship frame has to be located within the central portion of the hull, which comprises 5 rooms (*campi*) and, thus, 6 frames, each of which could be the midship frame. The frames in the central flat portion of the hull have the same design of the midship frame and, thus, they are all identical. After a series of calculations (and trials) that are not reported here because they are long and tedious, the midship frame is established as the second frame from

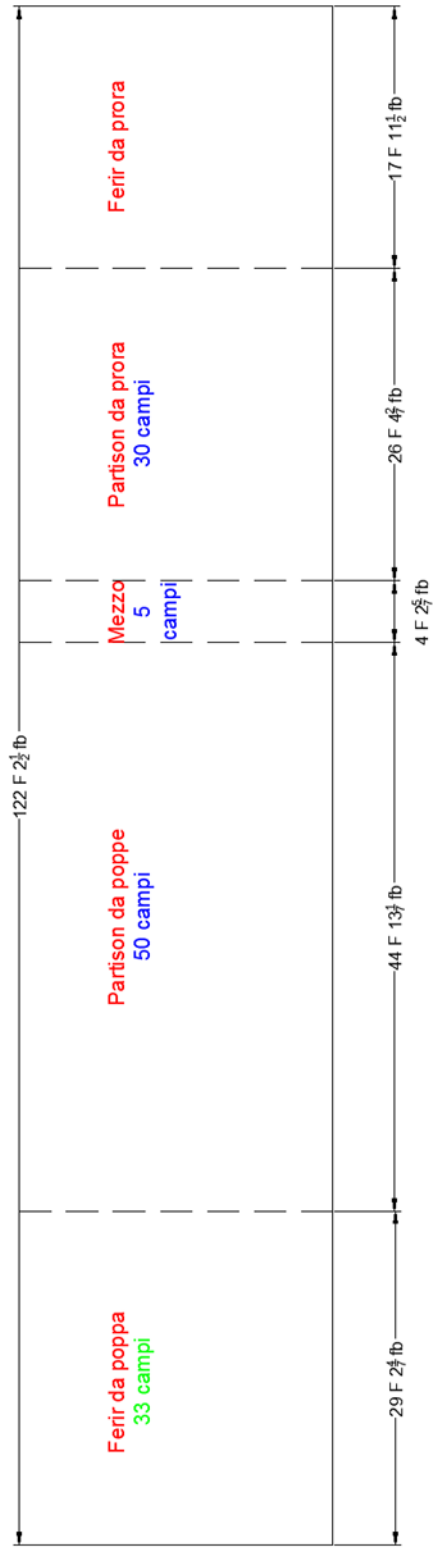


Fig. 43. Total number of *campi* (rooms) in the *ferir da poppe* of the great galley. Drawing L. Campana.

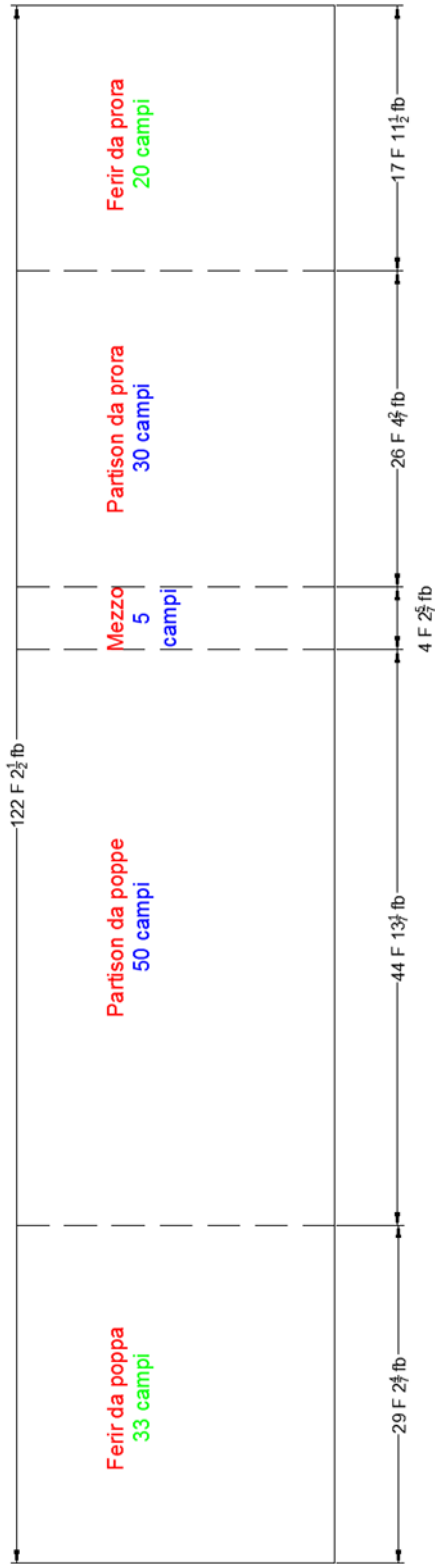


Fig. 44. Total number of *campi* (rooms) in the *ferir da prora* of the great galley. Drawing L. Campana.

the bow (fig. 45). Thus, the central portion of the hull consists of one frame toward the bow, the midship frame, and four frames toward the stern. For convenience, the two frames delimiting the central portion of the hull are termed Frame A and Frame B (fig. 46).

Determining the exact location of the midship frame is a crucial step in the reconstruction of any ship. After determining the location of the midship frame, the number of *campi* between the midship frame and the end of each portion may be established (fig. 47). This information is extremely important in order to determine the rising and the narrowing of the frames.

The manuscript then records the height of a number of frames placed at specific locations along the length of the hull, namely, the height of the frame placed at the after yoke (*zovo da poppe*), the height of the sternpost (*asta da poppe*), the height of the frame placed at the forward yoke (*zovo da prora*), and the height of the stem (*asta da prora*). The manuscript does not provide the height for the last molded after frame, the last molded forward frame, nor the other frames placed at intermediate locations. This is unfortunate, as a more complete list of measurements would have been helpful in reconstructing the great galley. However, the fact that the manuscript provides the height for the frames placed at the yokes confirms indirectly our hypothesis that Fausto designed by means of mathematical formulas the frames placed between the after and the forward yokes, and not only the frames between the last molded after frames and the last molded forward frames.

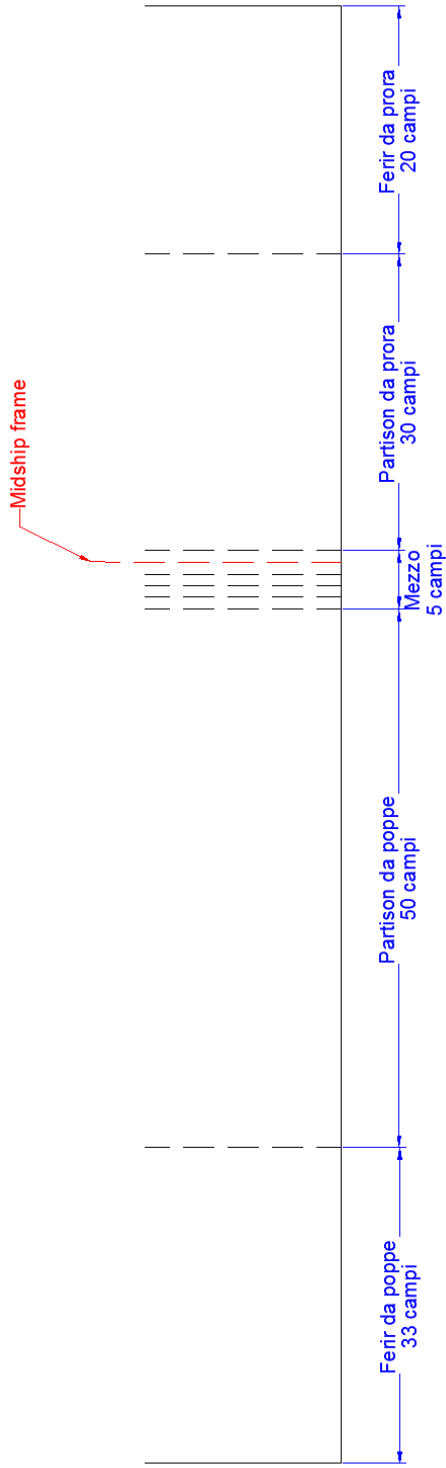


Fig. 45. Location of the great galley's midship frame. Drawing L. Campana.

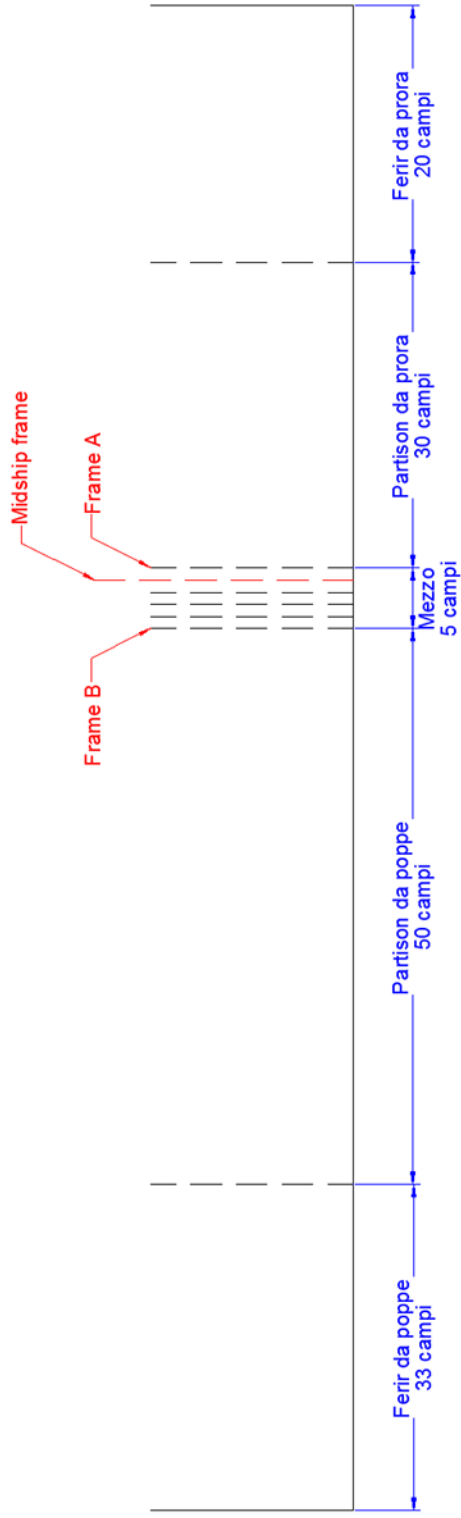


Fig. 46. Flat portion of the great galley's hull delimited by Frame A and Frame B. Drawing L. Campana.

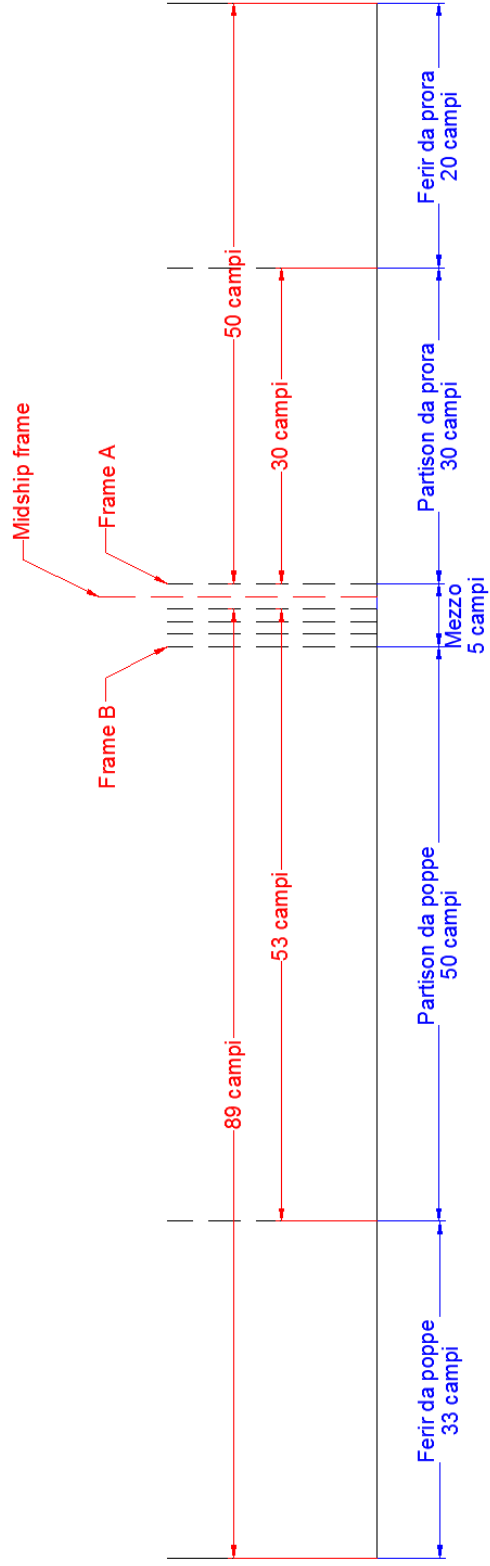


Fig. 47. Number of *campi* (rooms) in the great galley's hull portions after determining the location of the midship frame. Drawing

L. Campana.

The height of the midship frame is 5 feet and $2 \frac{2}{3}$ fingerbreadths, the height of the frame placed at the forward yoke (*zovo da prora*) is 6 feet and 7 fingerbreadths, and the height of the frame at the after yoke (*zovo da poppe*) is 7 feet and $14 \frac{1}{2}$ fingerbreadths. In addition, the manuscript provides the heights of the sternpost (8 feet and $13 \frac{1}{2}$ fingerbreadths), and of the stem (6 feet and $8 \frac{2}{3}$ fingerbreadths).

These heights are crucial in determining the rising of the frames and in designing the catenary, which, in geometry, is the curve that an idealized hanging cable assumes under its own weight when supported only at its ends. In ship design, the catenary is the curve describing the sheer line of a ship.

In order to design the great galley's sheer line, first the heights of the frames that were calculated have to be plotted at the exact locations as recorded in the manuscript. However, although the locations of the midship frame and of the endpost are known, the locations of the frame at the forward yoke and of the frame at the after yoke are not known and have to be determined. Nonetheless, since at least three points are needed in order to design a curve, the great galley's sheer line may be drawn, since the location of the midship frame and that of the endposts are known (fig. 48). Then, the upper extremities of each frame height are joined with a line to one another, thus generating the sheer line (fig. 49).

The portion representing the rising of the frames is shown visually in figure 50; however, since the locations of the frames along the great galley's hull are not known (except that of the midship frame), it is impossible to calculate the rising increments for the frames. Nonetheless, the total amount of rising may be calculated toward the stern

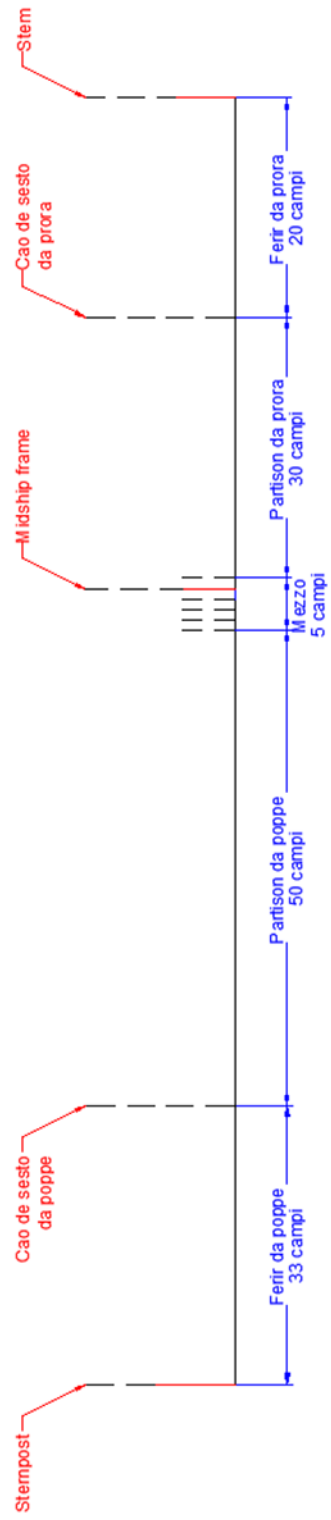


Fig. 48. Heights of the midship frame and of the stem and stermpost of the great galley. Drawing L. Campana.

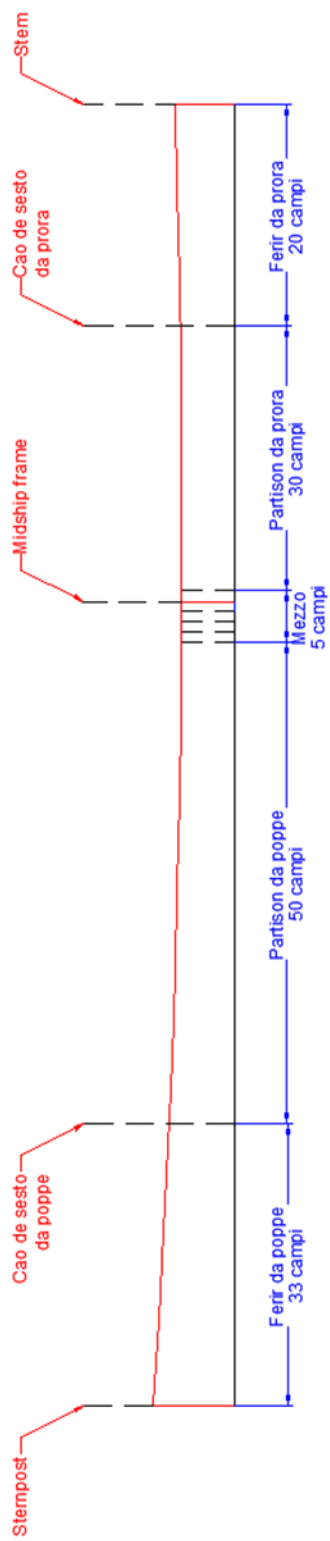


Fig. 49. Sheer line of the great galley. Drawing L. Campana.

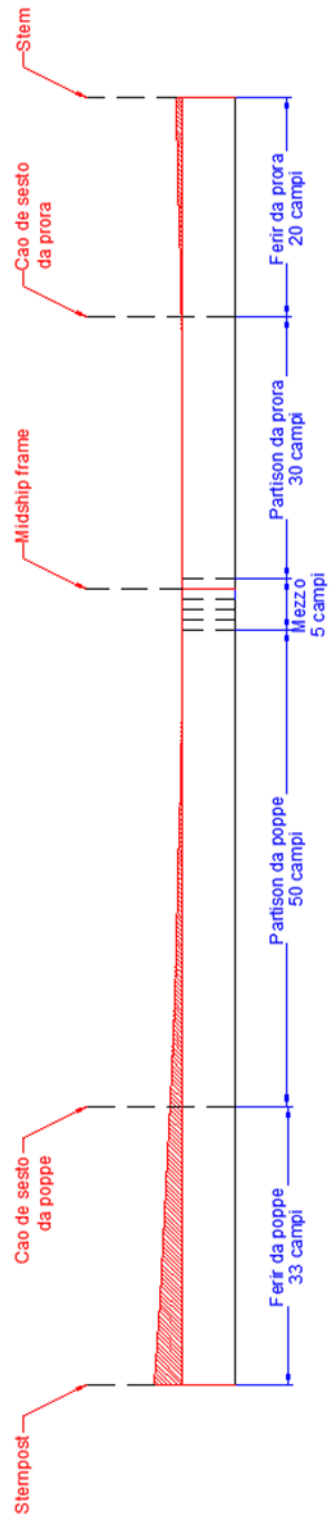


Fig. 50. Portion representing the rising of the frames (in red). Drawing L. Campana.

and toward the bow simply by subtracting the height of the midship frame from the height of the sternpost, and from the height of the stem, as shown below. To do so, as before, the feet have to be converted into fingerbreadths by multiplying by 16.

Total rising of the frames toward the stern

$$\begin{aligned}
 &= \text{Height of the sternpost} - \text{height of the midship frame} \\
 &= (8 \text{ F } 13 \frac{1}{2} \text{ fb}) - (5 \text{ F } 12 \frac{2}{3} \text{ fb}) \\
 &= [(8 \text{ F} \times 16 \text{ fb}) + 13 \frac{1}{2} \text{ fb}] - [(5 \text{ F} \times 16 \text{ fb}) + 12 \frac{2}{3} \text{ fb}] \\
 &= [128 \text{ fb} + 13 \frac{1}{2} \text{ fb}] - [80 \text{ fb} + 12 \frac{2}{3} \text{ fb}] \\
 &= 141 \frac{1}{2} \text{ fb} - 92 \frac{2}{3} \text{ fb} \\
 &= 48.9 \text{ fb}
 \end{aligned}$$

Total rising of the frames toward the stem

$$\begin{aligned}
 &= \text{Height of the stem} - \text{height of the midship frame} \\
 &= (6 \text{ F } 8 \frac{2}{3} \text{ fb}) - (5 \text{ F } 12 \frac{2}{3} \text{ fb}) \\
 &= [(6 \text{ F} \times 16 \text{ fb}) + 8 \frac{2}{3} \text{ fb}] - [(5 \text{ F} \times 16 \text{ fb}) + 12 \frac{2}{3} \text{ fb}] \\
 &= [96 \text{ fb} + 8 \frac{2}{3} \text{ fb}] - [80 \text{ fb} + 12 \frac{2}{3} \text{ fb}] \\
 &= 104 \frac{2}{3} \text{ fb} - 92 \frac{2}{3} \text{ fb} \\
 &= 12 \text{ fb}
 \end{aligned}$$

Breadth Plan

In order to design the breadth plan of the great galley, the widths of the frames and how much they narrow along the hull must be known. The manuscript provides detailed measurements for the width of the frames placed at specific locations. The width of the midship frame (*mezan*) is 16 feet, the frame placed at the fifteenth station (*campo*) toward the bow is 14 feet and $13 \frac{1}{2}$ fingerbreadths wide, the last molded forward frame (*cao da sexto da prova*) is 11 feet and 7 fingerbreadths wide, the frame at the forward yoke (*zovo da prova*) is 6 feet and $13 \frac{1}{3}$ fingerbreadths wide, the frame at the twenty-fifth station (*campo*) toward the stern is 14 feet and $11 \frac{1}{2}$ fingerbreadths wide, the last molded after frame (*cao da sexto da poppe*) is 11 feet and $13 \frac{3}{4}$ fingerbreadth wide, the frame at the after yoke (*zovo da poppe*) is 8 feet and $8 \frac{1}{2}$ fingerbreadths wide, and the transom (*triganto*) is 5 feet and 8 fingerbreadths wide (Table 14).

Table 14. Widths of the frames placed at specific stations along the hull of the great galley as provided by the manuscript.

	Frame location	Width of the frames
MIDSHIP	Midship frame	16 feet
BOW	15 th station	14 feet and $13 \frac{1}{2}$ fingerbreadths
	Last molded forward frame	11 feet and 7 fingerbreadths
	Forward yoke	6 feet and $13 \frac{1}{3}$ fingerbreadths
STERN	25 th station	14 feet and $11 \frac{1}{2}$ fingerbreadths

Table 14. Continued.

	Frame location	Width of the frames
	Last molded after frame	11 feet and $13 \frac{3}{4}$ fingerbreadths
	After yoke	8 feet and $8 \frac{1}{2}$ fingerbreadths
	Transom	5 feet and 8 fingerbreadths

In order to obtain the breadth plan of the great galley, these widths have to be plotted at the locations provided by the manuscript (fig. 51). Then, the extremities of the segments representing the widths have to be joined in order to obtain the breadth plan of the light galley (fig. 52). However, since the manuscript does not provide the locations of the forward yoke and of the after yoke, it is not possible to plot the heights of the frames located at the yokes in the breadth plan. As a result, the breadth plan cannot be completed.

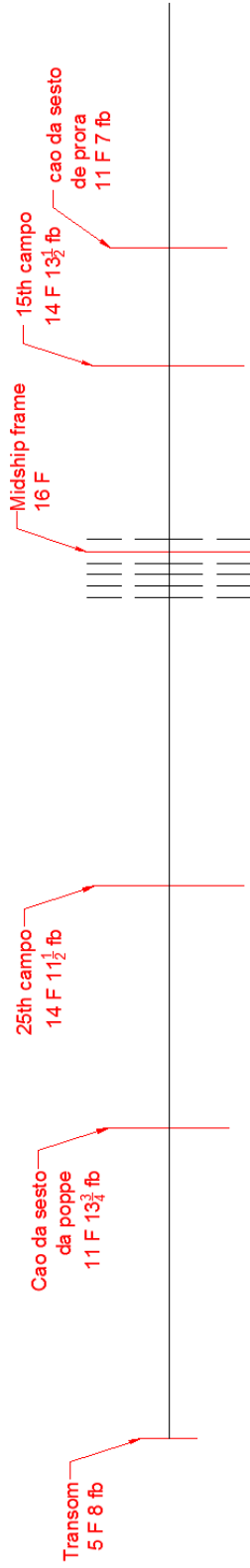


Fig. 51. Widths of the frames at specified locations along the great galley's hull. Drawing L. Campana.

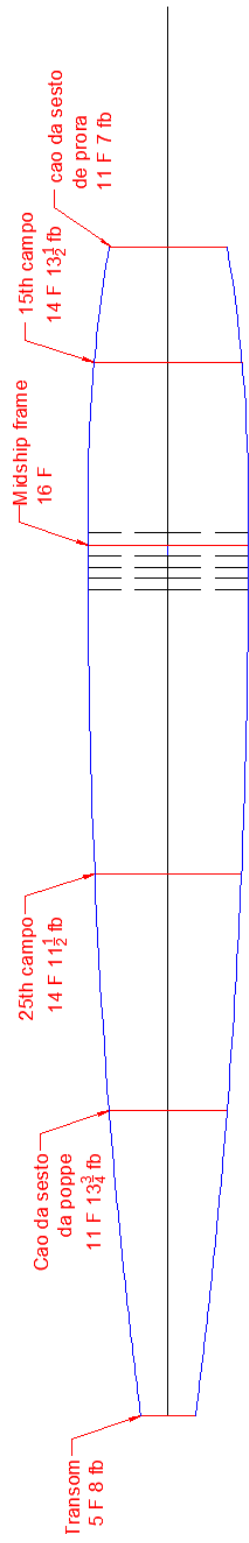


Fig. 52. Breadth plan of the great galley. Drawing L. Campana.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Vettor Fausto was well ahead of his time; he was able to combine his theoretical humanistic knowledge with practical shipbuilding skills. No one after Fausto was able to build a galley according to ancient Greek and Roman proportions: his ability as a *marina architectura* (naval architecture) lived and died with him. Although Fausto represented an isolated figure and an exception among the shipbuilders in the Venetian Arsenal who relied on empirical shipbuilding practices, he nevertheless profoundly influenced the history of naval architecture.

In the first decade of the sixteenth century, Fausto began his studies at the prestigious School of Saint Mark in Venice. In 1509, however, the War of the League of Cambrai drastically changed the situation in the Republic of Venice, and the School temporarily closed its doors during the war. Fausto then undertook a six-year-long journey that brought him to other Italian maritime cities, Spain, and France. Upon his return to Venice he wished to place his newly-gained knowledge at the service of the *Serenissima*, the Most Serene Republic of Venice. In 1518, Fausto was appointed professor of Greek at the School of Saint Mark, which had opened its doors after the termination of the war in 1511. In 1526, Fausto proposed to the Venetian Senate the construction of a new, superior type of galley he called the quinquereme, the proportions of which he based on his knowledge of ancient Greek and Roman ships. With some skepticism, the Senators approved the proposal and, in 1529, Fausto

launched his quinquereme in the Grand Canal, where the ship won a race against a light galley.

In the fourteenth century, Italian humanists recovered the foundations of ancient learning through the rediscovery of Classical Greek and Latin works which had fallen into obscurity and lay buried in many European libraries and monasteries. The rebirth (*rinascimento*) of the Classical tradition and the spread of classically-inspired values resulted in significant cultural changes and achievements in many fields, from art and literature to philosophy and architecture. Vettor Fausto purported to introduce into naval architecture a shipbuilding principle that he applied in the design of his quinquereme. According to Fausto the naval architecture (*marina architettura*) had to be based on the knowledge that derived from the study of ancient Greek mathematicians, and not only on experience and practical skills.

The Renaissance idea of beauty, which derived from the harmony of proportions, led to major changes in the rules and application of shipbuilding practices. The art of shipbuilding, as with all crafts based on oral knowledge, retained its conservative character throughout the centuries. New techniques and designs have always had difficulty penetrating the minds of shipwrights, who primarily relied on practical expertise and repetitive gestures for building ships. Thanks to the past works of eminent scholars of manuscripts on naval architecture, our knowledge and understanding of shipbuilding practices have increased significantly. Starting at least from the second half of the fourteenth century, shipwrights designed ships by means of molds (*sesti*) and gauges (*morelli*) that were calibrated with progressive markings. The

calibrations on these tools were generated by simple geometrical methods, which were often graphically represented in shipbuilding manuscripts, such as the *Libro di Zorzi Trombetta da Modon* (“The Notebook of Zorzi Trombetta from Modon”), dated to 1444-1449. In designing ships, the shipwrights manipulated the molds and gauges along each station, or frame location, thus obtaining the narrowing and the rising of each frame.

These new shipbuilding methods were based on rules of geometry, such as proportions, and are referred to in Venetian manuscripts as *ragioni fabricatorie*, or building methods. The establishment of the *navium ratio* (shipbuilding principle) based on mathematical calculations led, through the centuries, to the birth of modern naval architecture. In the present study, it has been suggested that Fausto based his shipbuilding principle on the works of Greek mathematicians and philosophers, such as Aristotle, Apollonius of Perga, and Euclid.

The sixteenth century was a period of many technical innovations in naval architecture. Fausto purported to introduce in naval architecture a shipbuilding principle that he applied in the design of his quinquereme. In this, Fausto basically codified the empirical shipbuilding methods of the Venetian shipwrights into a mathematical formula, which is known to later mathematicians as the Gaussian formula.

Renaissance documents and naval treatises provide descriptions of Fausto’s quinquereme and illuminate, to some extent, its technical features, such as the number of benches, the rowing system, and the steering mechanism he used. Fausto claimed

that he recreated the ancient quinquereme used by the Romans in their wars and, in doing so, he relied on ancient Greek texts for generating the proportions for his quinquereme.

The most revealing document on this matter is the manuscript titled *Misure di vascelli etc. di...proto dell'Arsenale di Venetia* ("Measurements of Vessels etcetera by...a Master Shipbuilder of the Arsenal of Venice"), which contains shipbuilding instructions for several types of ships. Originally belonging to the private collection of the erudite Giovan Vincenzo Pinelli (1535-1601), this manuscript has never been fully studied, and its authorship has as yet to be established. Perhaps, due in part to the lack of sufficient technical shipbuilding knowledge, modern scholars have failed to note the relationship between Fausto's work at the Arsenal and this manuscript, a source well known since the nineteenth century, but still regrettably misinterpreted.

The series of calculations in this manuscript are based on ancient and modern mathematics, requiring an extensive knowledge of both mathematics that only Fausto could have possessed. The hypothesis advanced in this thesis is that the manuscript is the work of Fausto's apprentice, Giovanni di Maria di Zanetto, nicknamed Zulle, who became *proto* (master shipbuilder) of the Arsenal in 1570. Zulle, at the eve of the Battle of Lepanto, was requested by the Venetian Senate to build the last galleon *alla Faustina* (in the Fausto way), which was to become the flagship of the Papal contingent, led by Marcantonio Colonna, of the great Christian fleet against the Turks. The "Greek dream" of Fausto and his *marina architectura*, however, met their demise

off the coast of Ragusa, never to be reborn, when the galleon was struck by lightning and completely destroyed.

Nevertheless, Vettor Fausto, although an outsider to the fiercely guarded world of shipbuilding, paved the way for the foundations of a scientific revolution in the conservative realm of the Venetian Arsenal.

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Senato, Dispacci, Costantinopoli, filza 2-B
Senato, Dispacci, Costantinopoli, filza 6
Senato, Dispacci, Costantinopoli, filza 9
Senato mar, reg. 14.
Senato mar, reg. 18
Senato mar, reg. 21
Senato mar, reg. 26
Senato mar, reg. 29

- Senato mar, reg. 34
 Senato mar, reg. 35
 Senato mar, reg. 36
 Senato terra, reg. 1
 Senato terra, reg. 15
 Senato terra, reg. 17
 Senato terra, reg. 20
 Senato terra, reg. 26
- BA Ms. D 199 Inf., fol. 91r
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- BCVe Cons. IX, d. 1-2, Cittadini veneziani
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- BdG Ms. XXIII 1.62, fols. 59v-
- BE Ms. Est. lat. 150, Alpha T6, 8: Various Humanistic Epigrams
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APPENDIX I
ARCHIVAL DOCUMENTS AND LITERARY SOURCES ON
VETTOR FAUSTO' S QUINQUEREME

Document 1: ASVe, Consiglio di Dieci, Parti secrete, reg. 1, fol. 31r (23 September 1525)

È stato alla presentia nostra el fidel nostro Venetian Dominus Vettor Fausto che ne ha mostrato uno modello de una galia quinquere, zoè che vuoga remi cinque per banco, qual esta tractata et conserata da li prothi nostri del Arsenal, è ben conveniente uno navilio de tanta securità al Stato nostro da mar come saria la dicta quinquere de haverne, et nel Arsenal nostro et insieme, et de retenir a' li servitii nostri dicto Dominus Vettor.

Landarà parte che per autorità de questo conseio sia ordinato ai Proveditor et Patroni nostri del Arsenal che debano deputar uno volto dove se habi ad levar la dicta quinquere, et li sia dato el modo et aiuto de farla. Preterea sia scritto al orator nostro in Roma che debi supplicare la beatissima pontificia con un gratification nostra sia contenta proveder de ducati 500 de intrada de beneficii de la relligion de Rhodi, over de altra sorte beneficii primi vacanti al dicto Dominus Vettor. Et presa sarà la presente parte sia obligato dicto Dominus Vettor de metter in vera executione la voga dela dicta quinquere et mostrarla al Proveditor, Patroni, et prothi nostri del Arsenal. Et essendo

approbata per i experti nostri sia commenzata dicta quinquere me et compita. Et sia preso che in questo mezo finochè vachino dicti beneficii sia dato al dicto Dominus Vetor per sustenation sua ducati 100 al anno quali habino ad cessar per rata come vacherano dicti beneficii, et tal provision debi commenzare dal iorno che sarà compita del tuto la dicta quinquere me et congnessuta cum vera experientia che la vuoga reussì et sii laudata et approbata. Pretea sia data licentia al dicto Dominus Vetor chel possi portar arme lui et uno fameio che sia cum lui per segurtà de la persona sua, come el ne ha supplicato per molti rispetti convenienti.

De parte _____17 _____16

De non _____7 _____ 8

Non synceri _____1 _____ 1

Nihil captum quia $\frac{3}{4}$ requiruntur

Secretum impositum

Document 2: ASVe, Consiglio di Dieci, Parti secrete, reg. 1, folios not numbered. On the reverse of the last folios there is written “Request by [Vettor] Fausto” (*Supplica del Fausto*)

Serenissimo Principe et Excellentissimi Signori.

Serenissimo Principe, vedendo io Vettor Fausto che le occupation de la Sublimità Vostra sono di sorte che non lassa che ‘l caso mio sia terminato, nè messa la parte che mi era stà promessa, credo non esser inconveniente cum questa mia scriptura redur in mente de la Sublimità Vostra et de questi Excellentissimi Signori il caso mio. Sapi, dunque, Vostra Sublimità, che già 7 anni io voluntieri ritornai in questa città et fui contento di lezer lettere greche cum la mità del salario che poteva haver da Lucchesi, Ragusei, come apar per istrumenti pubblici, non per altro se non per monstrar alla Sublimità Vostra quelli che tutto il tempo de la vita mia cum molti travagli, pericoli, et longa fatica per il mondo haveva acquistato, perchè praticando cum marinari de diverse nation, zoè Cathelani, Provenzali, Normandi, Biscaini, Zenovesi, et altri, et havendo cercato tutte quasi le marine de Spagna, Francia, Italia et altre, parlando cum diversi capitanei, et tra li altri Piero Navaro, Pier Jam, el Biassa, el Gobo Dalmatin, el Doria, et cum li primi prothi de Napoli, Genoa, et che già sono da Pisa, tandem è ritrovato che la galia grande et presta qual era la quinquereme che usavano romani ne le guerre, sì per la sua voluntà come perchè la poteva star sul mar ad ogni fortuna et tempo ruzo, seria signora de la marina et bateria ogni altro legno; il modello de la qual galia havendolo facto de mia man secondo le misure ritrovate ne li libri greci antiquissimi, io venni in

Collegio presenti tutti quelli Excellentissimi Signori cum tutti li prothi di l'Arsenal vostro, et lo apresentai dicto modello, et li dissi che tal galia haveva queste condition: che la potea portar uno pezo di artellaria de 15 et più miara ultra li altri sui, la prova che butando 100 libre di ferro cum tanta polvere sempre quanto balla per la sua debita longeza saria sufiziente a ruinar senza periculo suo ogni possente navilio; et per esser assai grande la potria star a ferro, et far le volte in mar dove stesseno altri grossi legni; seria etiam de incredibel avantazo a la battaglia da mar. Item, per la sua bona fortuna, et conveniente numero di remi, la provezaria et andaria almanco a par a par cum le gagliarde sotil. Tutte queste condition io promissi che haveria la dicta galia. Li prothi, veramente, di la Sublimità Vostra havendo voluto veder le misure sue et quelle ben considerar, disseno che li faria gli effecti sopraditti et seria presta, se io li metesse la voga tal che tutti li remi operassino, confessano non lo saper far loro. Allora io me ofersi di far talmente che quelli vederiano che 'l quinto remo vogeria meglio di quel che fa al presente il terzo, cum questo che la Sublimità Vostra pur facesse haver dal Pontefice, per esser cosa di comun utile a la Christianità, beneficii per ducati 500 de intrada de la Religion de Rodi over altri; et fra questo mezo mi desse provision di ducati 150 a l'anno. Dove per la Sublimità Vostra et per quelli Excellentissimi Signori fu monstrata grandissima promptezza di voler meter tal parte; tamen nulla fin hora vedo esser stà facto. Al presente, veramente, intendendo che la Sublimità Vostra desiderosa di haver legni di tal sorte che possino bater le barze de corsari di ponente, vol far nave cum tanta sua spesa, item li offero la sopraditta galia quinquereme che farà tutti li effecti sopradicti; il che niuna di le galie de la Sublimità Vostra li po' far nè sotil nè

bastardetta per esser piccola, nè grossa nè bastarda per non poter montar a vento col provizar. Et dico volerli monstrar in actual voga come 5 homeni insieme vogeranno meglio tutti 5 che non fanno al presente li tre di le galie sotil; et se la dicta non sarà laudata da li pratici, et che cum l'occhio la Sublimità Vostra non vedi l'effecto che li prometto, non voglio haver niente. Et per parlarli ancor più chiaramente, quando el si guardi a spesa prima che si fazi el corpo de la ditta galia, quella me dii una bastarda del suo Arsenal, et lassi che io la conzi a mio modo, et li meti la voga secundo la sua portata per esser bassa in pontal. Vostra Sublimità vederà quanto avantazo sarà da quella a le altre ancora che la non sia proportionata; per il che si potrà comprender quel che seria la quinquere cum tutte le sue proportion, remetendo poi facta galia a description di Vostra Sublimità disminuir il premio parendoli che l'artificio nol meritasse; il qual spero li parerà meravigliosamente grande et bello. Queste, Serenissimo Principe et Excellentissimi Signori, son le cose che un vostro servitor ha zercato per il mondo, et cum l'adiuto di le scripture antique de greci et da romani tandem ha trovato, et le apresenta a la Sublimità Vostra, le qual saranno de grandissima reputation, beneficio, et segurtà de questa amplissima città. Quella adunque non fazi che 'l pari, che, questi Excellentissimi Signori li quali portano il vanto et laude appresso tutto il mondo di li più sapientissimi et peritissimi de la guerra da mar, non si habino dignato di voler veder et haver servitor di tanta importantia che un suo povero servitor li ha apresentato, perchè certo poche tal galie sarian suficiente a ruinar ogni potente armata de inimici; suplicando reverentemente, che quando li piacque de exaudirmi la si

degni far che io cum uno famiglio possiamo portar arme per li respecti che potesseno
esser notissimi alla Sublimità Vostra.

Document 3: ASVe, Consiglio di Dieci, Parti secrete, reg. 1, fol. 62r (23 May 1526)

Che la supplication de Dominus Victor Fausto hora lecta continente la oblation de far la gallia quinquere me sia remessa al collegio nostro qual possi venir cum le opinion sue al conseio nostro de pregadi per deliberare quanto li parera, exceptuando perhò el darli licentia de le arme per esser cosa spectante a' questo conseio.

De parte _____10 _____ 9

Volunt che la oblation de Dominus Vetor Fausto sia acceptata et che li sia data la commodità el domanda per far la gallia quinquere me, et visto reussir per experientia quanto el se offerisse, li sia usata quella recognition parerà a' questo conseio.

De parte _____ 10 _____10

De non _____ 8

Non synceri _____1 _____10

APPENDIX II

GLOSSARY OF VENETIAN NAVAL AND NAUTICAL TERMS¹

(* terms used in the *Misure di vascelli*, fols. 5r-6v)

Legend:

fem. = feminine form
loc. = locution
masc. = masculine form
n. = noun
pl. = plural form
sing. = singular form
v. = verb

A

Acciurmar/azzurmare: v. To provide a ship with crew.

Achordamento: n. sing. masc. Rigging. See also *Chorda*.

Agugliotto: n. sing. masc., pl. *agugliotti*. Pintle. See also *Cancaro*.

Alboro/albero: n. sing. masc., pl. *albori/alberi*. Mast.

Alboro di mezo: n. sing. masc. Main mast.

Alboro di proda: n. sing. masc. Mizzen mast. See also *Alboro di trinchetto*.

Alboro di trinchetto: n. sing. masc. Mizzen mast. See also *Alboro di proda*.

Alzana: n. sing. fem., pl. *alzane*. Cable used to tow small boats.

¹ This Glossary is based mostly on archival research conducted by the author and on Jal, A. 1848. *Glossaire nautique. Répertoire polyglotte de termes de marine anciens et modernes*. Paris: Firmin Didot Frères.

Amainare: v. To furl a sail.

Amante: n. sing. masc., pl. *amanti*. Thick rope used to hang the yard.

Amarra: n. sing. fem., pl. *amarre*. Mooring cable.

Ampolletta: n. sing. fem., pl. *ampollette*. Sand clock.

Anccura: n. sing. fem., pl. *anccure*. Anchor.

Anchino: n. sing. masc., pl. *anchini*. Ropes used to fasten the yard to the mast.

Anco/ancho: n. sing. masc. See *Anchino*.

Antenna: n. sing. fem., pl. *antenne*. Yard.

Apostizzo/aposticcio: n. sing. masc. See *Postizzo*.

Armiraio: n. sing. masc. Admiral.

* *Asta*: n. sing. fem., pl. *aste*. Wooden rods placed vertically at the extremities of the *carena* (or baseline). Usually followed by the terms *da poppa* (sternpost) or *da prora/prova* (stem).

B

Bachalare/baccalare: n. sing. masc., pl. *bachalari/baccalari*. Outrigger knee.

Banco/bancho: n. sing. masc., pl. *banchi*. Rower's bench.

* *Bocca*: n. sing. fem. The maximum breadth of a ship taken at the midship frame.

Bruscha: n. sign. fem. Wooden stick or gauge on which the increments generated by geometric progression were marked.

Buonevoglie: n. pl. masc. Volunteer rowers.

C

* *Calcagnol*: n. sing. masc., pl. *calcagnoli*. The gripe placed at the forward and after extremities of the keel (see *Colomba*).

Calcese: n. sing. masc., pl. *calcesi*. Crow's nest.

Cancaro/Ghanghero: n. sing. masc., pl. *cancare/gangheri*. Pintle.

* *Campo*: n. sing. masc., pl. *campi*. Room and space; location for frame placement.

* *Cao*: n. sing. masc., pl. *cai*. Literally meaning head, but denoting a terminus point in measurements.

* *Cao de sesto*: n. sing. masc. Location of the last molded frame.

Carena: n. sing. fem. Wooden timbers on which the shipwright placed the keel and built the ship. In manuscripts, the *carena* is referred to as the base line.

Collo de la lata: n. sing. masc., pl. *colli de le latte*. Upward curving extension of the deck beam that supports the outrigger knee (see *Bachalare*).

* *Corba*: n. sing. fem., pl. *corbe*. Floor timber of a frame (see: *Madiere*).

Corba codiera: n. sing. fem. The last molded frame.

Corba di mezo: n. sing. fem. The midship frame.

Corsia: n. sing. fem. Central gangway.

* *Costado*: n. sing. masc. Skeletonwork of a ship, frames.

Coverta/coperta: n. sing. fem. Deck.

Cugno: n. sing. masc. Wedge, also known as *schagion*. It is one of the geometrical methods used in designing the narrowing and rising of a ship's frame. It is better known as the "incremental triangle." See *Scagion*.

D

* *Dedo*: sing. masc., pl. *deda*. Fingerbreadth. It corresponds to 1/6 of a foot (*deda grosso*, big fingerbreadth), or to 1/14 of a foot (*deda sottile*, small fingerbreadth) (see: *Piede*).

F

* *Ferir*: n. sing. masc. The distance between the last molded frame and the endpost.

Forcame: n. pl. masc. Futtocks.

G

Giogo/gioco: n. sing. masc., pl. *gioghi/giochi*. See *Zovo*.

Gomena: n. sing. fem., pl. *gomene*. Hawser.

H

* *Hasta*: n. sing. fem., pl. *haste*. See *Asta*.

Homo da remo: n. sing. masc., pl. *homini da remo*. Rowers.

L

* *Lata*: n. sing. fem, pl. *late*. Deck beam.

M

* *Mezzaria*: n. sing. fem. Center line.

Madiere: n. sing. masc., pl. *madieri*. Frame. See also *Magiere*.

* *Magiere/magiori*: n. sing. masc., pl. *magieri/magiori*. Frame.

Maistra: n. sing. fem., pl. *maistre*. Stringer.

Mezo redondo: n. sing. masc. Half circle, better known as “half-moon.” It was one of the geometrical method employed in designing the narrowing and rising of ship’s frames.

Morello: n. sing. masc., pl. *morelli*. Gauge, measuring rod.

O

* *Oro*: sing. masc., pl. *ori*. Edge. Term used in recording ship to indicate a measurement to be taken along an edge.

P

Pala: n. sing. fem., pl. *pale*. Blade of an oar.

Palada: n. sing. fem., pl. *palade*. Stroke of the oar.

* *Palmetta*: n. sing. fem., pl. *palmette*. Distance between the yoke (*zovo*) and the post, corresponding to the foredeck and afterdeck.

Paraschossola: n. sing. fem., pl. *paraschossole*. Bilge strake.

* *Partison*: n. sing. masc. Portion of the hull consisting of the frames that are narrowed and/or raised by means of geometrical methods.

* *Passo*: n. sing. masc., pl. *passa/passi*. A measure of length corresponding to five Venetian feet.

Pavion: n. sing. masc. Scribe board for shaping the ship drawn in a 1:1 scale on the floor (*pavion*) of the mold-loft.

Pennone: n. sing. masc., pl. *pennoni*. Arm of the yard.

Piano: n. sing. masc. Flat portion of a floor timber (see *Corba*).

Piede/pie': n. sing. masc., pl. *piedi/pie'*. Foot; the basic unit of length in the Venetian mensuration system. It corresponds to 34.7735 cm.

* *Pontal*: n. sing. masc. Depth in the hold.

* *Poppa*: n. sing. fem. Stern.

* *Poselese*: n. sing. masc. A mark denoting a specific location of timbers or features. In Venetian shipbuilding manuscripts the *poselese* indicates the location of the gripe (*poselese del calcagnol*), of the futtock (*poselese del magier di bocca*), and of the turn of the bilge (*poselese della paraschossola*).

Postizzo: n. sing. masc. Outrigger.

Proda: n. sing. fem. See *Prora*.

* *Prora*: n. sing. fem. Bow.

* *Prova*: n. sing. fem. See *Prora*.

R

Ramo: n. sing. masc. Futtock.

Remo: sing. masc., pl. *remi*. Oar.

Ruota/ruoda: sing. fem., pl. *ruote/ruode*. Post.

S

Scagion: n. sing. masc. Wedge, also known as *schagion*. It is one of the geometrical methods used in designing narrowing and rising of a ship's frame. It is better known as the "incremental triangle." See *Cugno*.

Schaza/scassa: n. sing. fem., pl. *schaze/scasse*. Mast step.

Schorer del sesto: loc. The process of designing a ship's frame by moving the mold (*sesto*) so that the exact flat portion of the frame to be narrowed can be calculated.

Sentina: n. sing. fem., pl. *sentine*. Bilge pump.

* *Sesto*: n. sing. masc., pl. *sesti*. Mold.

* *Slanzo*: n. sing. masc. Rake. Refers to the overhang of the endpost.

Speron: n. sing. masc. Spur at the bow.

T

Timonera/timoniera: n. sing. fem. Rudder.

Triganto: n. sing. masc. Transom.

Trizuola: n. sing. fem., pl. *trizuole*. Rope used in a shipyard in designing the midship frame (see: *Corba di mezo*) and the mold (see: *Sesto*).

Tuola/ tola: n. sing. fem., pl. *tuole/tole*. Planks.

V

Voga: n. sing. fem. Rowing method.

Z

Zenta: sing. fem., pl. *zente*. Wale.

* *Zovo/zuovo*: n. sing. masc., pl. *zovi/zuovi*. Fore and aft yoke.