articles

Mercantile arithmetic and the incunable Catalan printing. *Suma de la art de arismètica*, by Francesc Santcliment (1482)

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Resum. La publicació de l'edició facsímil, amb estudi, de la *Suma de la art de arismètica* de Francesc Santcliment (Barcelona: Pere Posa, 1482) dóna peu a reflexionar sobre l'obra. Té uns condicionants que la fan rellevant: és un exemplar únic, conté la primera aritmètica mercantil impresa a la Península Ibèrica i potser la segona publicada a Europa, fou impresa pel primer impressor català, empra la numeració aràbiga, té un recorregut bibliogràfic ben allargassat en el temps —que s'inicia amb l'inventari de l'impressor—, és escrita en català i, segons la bibliografia més recent, mostra una vinculació amb l'aritmètica occitana conservada en la tradició manuscrita. Aquestes eren aritmètiques pràctiques destinades als usos mercantils i adreçades als mercaders o a qui n'hagués de menester; s'escrivien en la llengua de la terra i en un estil planer per exigència d'una classe mercantil cada vegada més puixant, que en general no sabia llatí i volia tenir coneixements pràctics; empraven la numeració indoaràbiga i els algoritmes de càlcul; substituïen l'àbac pel llapis i el paper, i compartien la vocació pedagògica i didàctica dels textos pràctics. El seu objectiu era ben distant del de l'aritmètica teòrica que s'impartia a les universitats. El sistema matemàtic basat en els numerals indis de posició s'havia anat introduint a Europa a partir de traduccions de treballs àrabs. En aquest sentit, la impremta no innovà, però, en canvi, es convertí en testimoni viu de la vida comercial del moment i d'una part dels coneixements matemàtics orals o manuscrits, a l'estandardització dels quals contribuí tant formalment com visualment. S'estableix un paral·lelisme amb un altre incunable, la *Compilatió[n] de arismética sobre la arte mercantívol,* atribuït a la impremta de Saragossa, al taller de Pau Hurus i a l'any 1486, i escrit en un castellà que palesa la influència catalana i aragonesa, pertanyent, segons el colofó, a «Franciso Sanclimente».

Paraules clau: Francesc Santcliment · *Suma de la art de arismètica. Summa de l'art d'arismètica* · incunables científics catalans · aritmètiques mercantils europees al segle XV · aritmètica pràctica al segle XV

Abstract. Publication of the facsimile edition of the *Suma de la art de arismètica* by Francesc Santcliment (Barcelona: Pere Posa, 1482) and a study of the work gives us occasion to reflect upon its idiosyncrasies: it is a singular copy; it contains the first commercial arithmetic printed on the Iberian Peninsula and, perhaps, the second published in Europe; it was printed by the first Catalan printer; it employs Arabic numeration; it spans a very long bibliographic course in terms of time–beginning with the inventory done by its printer; it is written in Catalan; and, according to the most recent bibliography, it shows a connection to the Occitanian arithmetic preserved in the handwritten tradition. These arithmetics were practical, intended for commercial use, and were addressed at merchants or others who might need them. They were written in the vernacular and in a simple style at the request of an ever-rising merchant class that, in general, did not know Latin and wanted to gain practical skills. They employed Hindu-Arabic numerals and calculation algorithms, substituted the abacus for pencil and paper, and shared the pedagogic and didactic line of the practical texts. Their objective was quite far from that of the theoretical arithmetic taught at universities. The mathematical system based upon Hindu positional numerals had been introduced into Europe through the translations of works in Arabic. In this sense, typography was not innovative. It did, however, convert the commercial life of the moment into a living testimony, as well as a part of the oral and handwritten mathematical knowledge, the standardization of which it contributed to, both formally and visually. A parallel can be drawn between this work and another incunabulum, the *Compilatió[n] de arismética sobre la arte mercantívol*, attributed to the typographical workshop of Paulus de Konstanz (Hurus) in Zaragoza and to the year 1486. This work was written in a Spanish that shows Catalan and Aragonese influences and belongs to "Franciso Sanclimente," according to the colophon.

Keywords: Francesc Santcliment · *Suma de l'art de arismètica. Summa de l'art d'arismètica* · Catalan scientific incunabula · European mercantile arithmetic in the 15th century · Practical arithmetic in the 15th century

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Introduction

The *Biblioteca de Catalunya* (Library of Catalonia) in Barcelona recently published a facsimile edition of one of its most valuable incunabula, accompanied by a complementary volume that studies the edition's history and the copy itself. Published in 1482, the incunable is, apparently, the only extant copy of Francesc Santcliment's *Suma de la Art de Arismètica*, printed in Catalan in Barcelona by Pere Posa, the first Catalan printer [1]. It is, without a doubt, the first commercial arithmetic printed in the Iberian Peninsula and, possibly, the second printed in Europe. However, before we proceed with an analysis of the work, and in order to place both the edition and the original text in the proper context, it is necessary to provide a historical background.

Printing reached Barcelona around 1473. There is no real certainty as to the identity of the first printed book to appear in Barcelona, the date that the event took place, the effect it had, or the reading public's reaction to the invention. What is known is that the first dated book printed in Barcelona was an edition of the *Rudimenta grammatices*. Its author, Niccolò Perotti, was an Italian humanist who wrote an innovative grammar for teaching Latin that, in its examples, paid great attention to the vernacular. The colophon was dated December 12, 1475, and indicated the names of the printers, Johannes de Salzburga and Paulus de Konstanz (Hurus). According to the colophon, a copy of this very work–in an Italian edition–was found on the beach in Barcelona amongst the remains of pirates' booty. The secretary to King John II, Joan Peiró, who knew Latin and had studied in Lazio, took it upon himself, along with a few friends, to print it. Considering its content and the great public success that both the author and the work had obtained in other lands, this was a fairly logical step. This fact is of interest because it is precisely in the colophon of the Barcelona edition that the work's printing is justified, as it claims that by teaching Latin "els rudes es tornaran cultivats." Extrapolating upon these words, it could be stated that the publication of the volume implied a recognition of the role of printing in the dissemination of knowledge.

This anecdotal fact aside, it is believed that this text was probably not the first to be printed in Barcelona; rather, it was surely preceded, among others, by Leonardo Aretino's Latin translation of Aristotle's *Ethica ad Nicomachum. Oeconomia. Politica*, which is undated and has been questionably attributed to Botel, von Holtz, and Planck in 1473. Moreover, there is documentation leading to the conclusion that texts were indeed published prior to the extant ones.

What is important is that Catalonia was involved early on and quite actively in the new mode of disseminating the written word, and thus in this innovative route to the spread of ideas, and in new ways of reading. Initially, the typographers were Germans forced to search out new horizons after the conflicts in Mainz in 1462. Until Pere Posa, no Catalan printer is known, even though there were professional booksellers. To the list of Botel, von Holtz, Planck, Johannes de Salzburga, Paulus de Konstanz (Hurus), Spindeler, Peter Brunus, Gherlinc, Rosenbach, Luschner, and the Castilian Diego de Gumiel, we must add the name of Barcelona's first printer, Pere Posa, along with that of the Catalan printer Pere Miquel.

It is difficult to identify the dynamics that drove certain texts to becoming typographic works, while others were in the hands of scribes and yet others remained in the realm of the spoken word. Printed and handwritten texts coexisted, each maintaining distinct circuits of distribution. A study between them should not be interpreted in terms of either an abrupt break or continuity, but as a shared existence marked by an evolution that would eventually lead to their separation formally, quantitatively, and economically. In some cases, printing fused all three aspects: the oral, handwritten, and printed word. This was the case in arithmetic knowledge of a mercantile nature, which was conveyed through commercial arithmetic incunabula.

An overview on mathematical texts

Based on a very schematic and accepted synopsis of specialized publications of the time, those dealing with mathematics focused on four different activities: theoretical treatises, arithmetical abacuses, algorithms (as procedures for calculation), and computations [2]. The elemental, algorithmic arithmetic written in Latin was addressed to the academic reader [3], whereas those more interested in learning how to calculate than in the concept of the abstract number, i.e., merchants, their apprentices, and other such users, relied on practical arithmetics that engaged in a dialogue with the user in his own tongue and in an unaffected style. The use of the vernacular was a response to the impulses of an emerging social class that, overall, did not know Latin and demanded access to practical knowledge.

Printing incorporated the production of these very pragmatic texts, which to a certain extent would become a generic typology. However, this remains a source of discussion, because concepts evolve with time, materials develop within a continuum of imprecise delimitation, and the classification of the various types of manuals fluctuates. Not everyone considers practical arithmetics as an established document. There are those who include trade manuals in this category while others exclude practical arithmetics that expand upon their specific, expected content with other materials, even though this progression proves to be a constant until the end of the century. It should be kept in mind that the tools that merchants or apprentices had within their reach were not limited solely to arithmetics. For example, in Barcelona, they relied on information supplied by the "taula de canvi" and by political proposals. The Barcelona courts (1480–1481) had, among other activities, promoted some of mercantile character. Also available to the merchant class was knowledge handed down from the previous generation, as well as account books, tariff lists, trade manuals, and standard texts such as the *Consulate of the Sea*.

In relation to the chronology, and to appreciate the contrasts, we must keep in mind that Euclid's *Elementa geometriae* was published for the first time in Latin in 1482 (Venetiis: Erhardus Ratdolt) [4]. In the preface to that edition, Ratdolt commented

on the fact that there were so few books on mathematics in print. In 1484, in Venice, he himself would publish the mercantile arithmetic by Pietro Borghi [5]. The first edition of Boethius' *Arithmetica* would not be published until 1488 (Augustae: Erhardus Ratdolt); however, that would not hinder the 1472 publication of Sacrobosco's *Sphaera mundi*, for example.

By including these texts in its bibliographic heritage, printing reproduced what in earlier times was a common scientific practice transmitted through oral tradition and manuscripts. Accordingly, and in this particular field, printing was perhaps not innovative, but–paradoxically–became living testimony of the commercial life of the moment and, indeed, a part of the mathematical knowledge, contributing to its standardization both formally and visually. The uniformity of the typographic canons would imply a step forward, away from the personalization of handwritten works.

The first known printed commercial arithmetic, the *Arte dell'abbaco*, whose author remains unknown, was printed in Treviso in 1478 [6]. Two have survived from 1482: the first from Germany and dated 17 May [7], published by Ulrich Wagner, and the second, Santcliment's arithmetic [8]. Having no further evidence of Santcliment's chronological background other than the year, it is difficult to determine which work precedes the other. In 1483, on 15 April, the same printer that brought the above-mentioned German incunable to light published a new commercial arithmetic without any indication of the author's name, although later it would be attributed to Wagner [9]: the renowned *Rechenbüchlein*. In 1484, Ratdolt published *Arithmetica*, by Pietro Borghi, in Venice [10]. The 1486 printing of an incunable with no typographic indications has been attributed to Paulus de Konstanz's printing in Zaragoza. Beginning with the words *Compilatió*[*n*] *de arismética sobre la arte mercantívol* and, in the colophon, indicating Santcliment as its author, it was imprecisely considered the Spanish translation or adaptation of the Catalan incunable [11]. Liepzig, in 1489, saw the work *Rechnung auf alle Kaufmannschaft*, by Johann Widman, brought to light [12]. In Florence, in 1491, Filippo Calandri's *Aritmetica* would be published [13]. Pellos authored the *Compendion de lo abaco* in Occitan [14], with variants from Nice, which was published in Turin [15] in 1492. In 1494, the *Summa de arithmetica, geometria, proportioni et proportionalità*, by Luca Pacioli, was published in Venice [16], a work that would set a new standard, due to its conception, encyclopedic character (it included geometry as well), and incorporation of the first printed treatise on accounting.

In addition to the above-mentioned incunabula on practical arithmetic, copies of other editions have come to us, some of them created very soon after the printing of their respective originals, indeed, prior to 1500. These include the work of Borghi, with editions from 1488 [17] and 1491 [18], and of Widman, with an edition from 1500 [19]. Given the current lack of agreement, it is necessary to reconsider whether the German edition from 1483 attributed to Wagner is a second edition, after that from 1482, or a new commercial arithmetic. The work by Pacioli was reedited in 1523 by the same printer [20].

Thus, we move from the year 1478 to the year 1494. In the series of extant arithmetics between these two dates, the main referent tends to be the commercial one, although not exclusively. There is, however, a constant within the practical texts: their pedagogical and didactic vocation. Only some of them complement the text with illustrations; only some are printed with a dedication; none are written in Latin. Two of them, Santcliment's and Pacioli's indicate the character of "summa" in the title. This denotation refers to the reach of the content treated: the *Suma* of Santcliment is limited to arithmetic while Pacioli's *Summa* includes geometry. The incunable attributed to the printing in Zaragoza is characterized as a "compilation", whereas the work by Pellos is a "compendium." The author, if noted at all, is mentioned in different ways. In some works, the author appears as such and also as the compiler. The Borghi work (1484) begins with the words, "Qui comenza la nobel opera de arithmethica ne la qual se tracta tute cosse a mercantia pertinente facta & compilata p[er] Piero Borgi da Veniesia" [21] ([a²r.]). Pellos (1492) recognizes, in verse, "complida es la opera ordenada he condida/per noble Francés Pellos, citadin de Nisa/[...]" (fol. 80v.). The title of the incunable attributed to Zaragoza begins, as mentioned above, with the word "compilation," which gives the implicit impression of an assemblage of materials extracted from other sources. A bit further on, however, it is termed a "compendium" and the colophon ends with the denomination "summa." The arithmetic is defined as a "compendious art or science." It seems evident, therefore, that these texts, more than original creative works, were adaptations, guided by pragmatism and by pre-established models. Determining the origin of the material is extremely difficult because the works do not make any mention of their sources. Creative input is limited to concrete aspects.

Suma de la art de arismètica, by Francesc Santcliment

The Santcliment work is an arithmetic aimed at students and at those who need to learn the skills covered by it. It is conceived as a tool for performing numerical calculations in conjunction with commercial activities. It is written in a concise and clear style, with neither citations nor references to the learned world, nor to that of astrology or magic. Notwithstanding, some of the problems laid out are situated within the framework of a prior tradition, different from that of commercial tradition.

The arithmetic devised by Santcliment and printed by Posa is described in a number of catalogs and reference works over a wide chronological range. Each one offers revelations that, together, help to situate the original edition, the copy that we possess, and other copies that at some point were located but that have long been missing. Some address the bibliographic aspect–with incursions into the bibliography, which is specialized in science and mathematics–while others give concrete analyses within their studies on Renaissance mathematics. If we are to gauge the bibliographic landscape, the first indication we have regarding the Santcliment, "Arismètica de Sant Climent," is in the inventory created by the hand of Pere Posa [22] of the books he owned and stored in his shop and home. The Santcliment was "on the shelves out front, entering the shop."

Pere Posa did not state whether he had only one copy or if there were more. The document was written 2 March 1506. Two months later, he dictated his will. By 5 June, he had died and his last will was published [23].

The description of the arithmetic in its most formal aspect makes it evident that it is a work carefully printed on paper and on size 4°, with pages marked a-r⁸. Its 136 pages are not numbered and there is no set number of lines per sheet. It is written in Gothic characters of a single size [24]. There is no register; neither are there catchwords or illustrations. There are lower-case letters in the spaces meant for initials that were never incorporated. Many paragraphs are separated from one another with a double space, although it is not standard practice. The text is fully justified, with incidental clauses for the mathematical operations. Throughout the text, numbers tend to be written between dots. Although it may be claimed that this is the first Catalan incunable to employ Arabic numerals [25], there is room for doubt. On 22 August of that same year, Pere Posa himself printed Llull's *Arbor scientiae* [26] in which Arabic numerals were used within the text and for sheet numbering (Fig. 1).

There are two filigrees on the paper. One is a straight-on view of an ox's head, including nose, eyes, and protruding tongue. It corresponds to the earlier quaternions that bear the

signature *m*. The other, of a hand and a flower, corresponds to later quaternions. The latter differs from the hand and flower on the first flyleaf, which was likely added to the copy at a later date.

The first initial, the lead-in letter of the incipit next to the printed lower-case text, is in red as are the two pilcrows on the same page. The small lines of the arithmetic operations were also drawn in red after the text was printed. In a very few cases, the drawing was omitted. Some numerals were also written in red [27], as were some of the horizontal lines of the fractions and other relational signs, the circles and semicircles used to make certain quantities stand out, as well as other indicators. A red horizontal line was also used to underline. Some of the red ink writings have percolated onto the contiguous page. Handwritten corrections and additions can be found in the text. On the back flyleaf, there is a handwritten note, possibly a *probatio pennae* or the start of a letter that is partially erased and scratched out.

The copy, which bears humidity- and oxidation-related stains, ink stains, and bookworm holes, is bound in parchment. The cover still bears the remains of ribbons that acted as an enclosure. On the back cover, numerical notes can be made out, written inversely to the direction one would expect. The spine is reinforced on the inside by a fragment of written text, possibly on vellum.

Much about the author is still unknown. We know what the text and the bibliography tell, namely, that which he himself makes known through the text, and that which is implied in reference works, bibliographies, documentation, and critical studies. Nevertheless, there is a degree of uncertainty. The text presents the author as a teacher in Barcelona, but other places are also evidently part of his surroundings. Other, indirect bits of evidence are also conveyed, including a connection to "lo mestre Ràpita, en aquesta e en les altres arts e en sacra theologia meritíssimo laureat", and another related to "lo honorable en Jachme Serra olim mestre de la seca de Perpi[n]yà" (r⁷v.). Some of the evidence establishes a direct link with the author of the Spanish text or, not so directly, with the translator responsible for the Catalan of *Flors de virtut*. As of today, all of this remains conjecture.

The text is interesting from the beginning, which is why we reproduce the incipit here [28]:

"A laor e glòria de Déu e de la humil verge Maria, mare sua, comença lo libre appel·lat Suma de la art de arismètica. Lo qual divisirem en 15 parts, ço és, en nombrar, ajustar, restar, multiplicar, dimidiar, partir, regla de tres ab diversitat de raons, companyies, cambis, barates, trencats ab totes ses 4 spècies, sou de fi ab diversitat de billons, de una e dues falses posicions, progressions e proporcions. De les quals parts ho spècies breument, emperò a fufficiència [*sic*], ací en lo present tractat parlarem (a¹r.)."

After the religious summons, the incipit gives the title the work is known by. The work has its own title and, through the title, we know that this is a summa and that it is broken up into fifteen numbered chapters. Nonetheless, the summary does
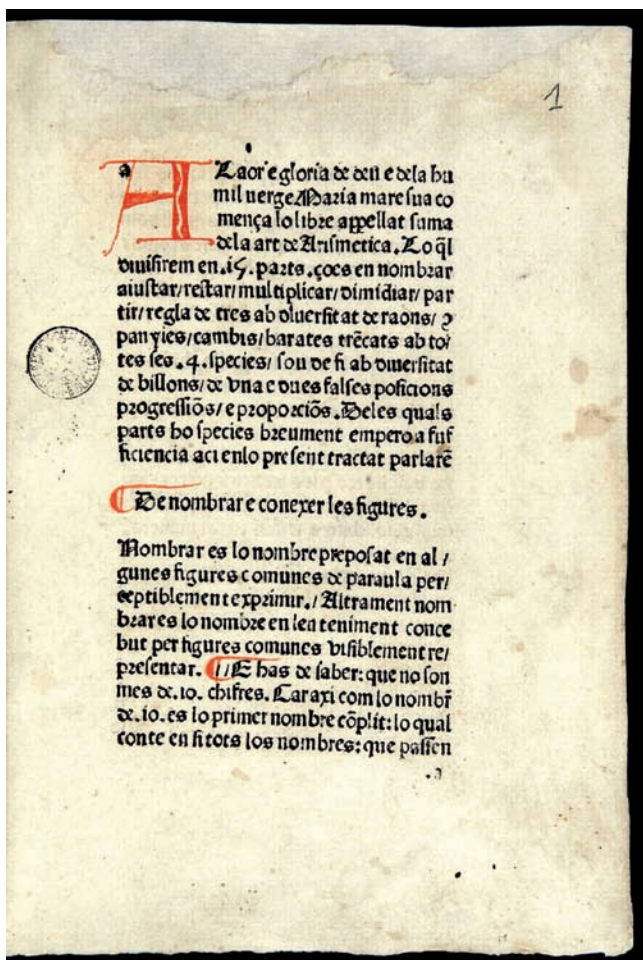

Fig. 1. The first folio, where the title of the work and a summary of its contents are indicated. It is followed by a chapter on numeration.
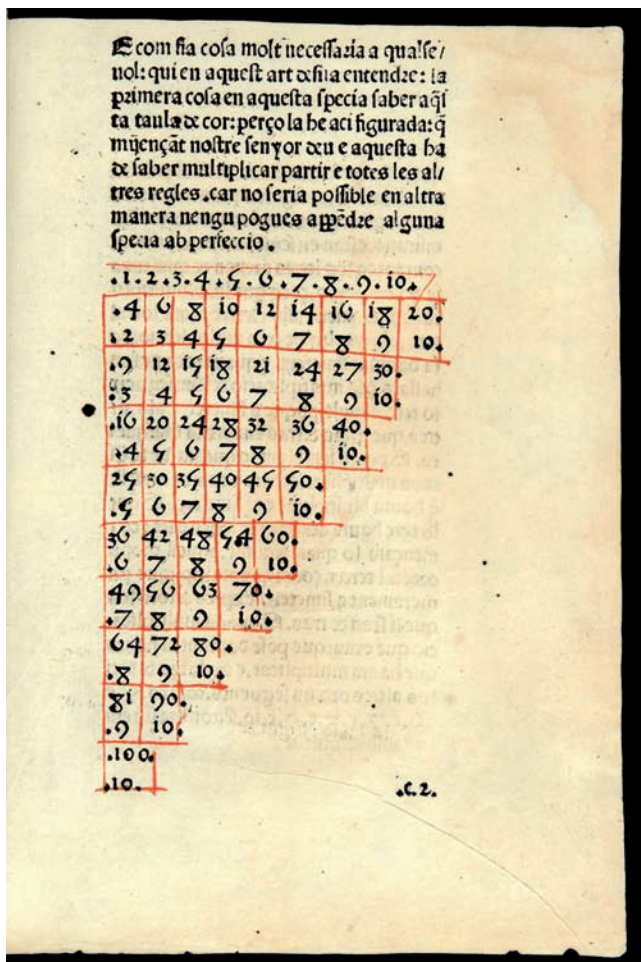
Fig. 2. Multiplication table.

Fig. 3. Multiplication: examples with a note on the use of lines, with the proof.

not correspond to the sequence of the subjects or to the numerical correlation of the parts, which are in the following order: numeration and understanding figures, addition, subtraction, multiplication, division and halving, the rule of three, fractions, partnerships, exchanges, barter, positions, fine gold and fine silver, and progressions. The thematic content ends with an unnumbered recapitulation of exercises for the general rules. Therefore, there is no chapter separately dedicated to "dimidiation," as halving is included in "division" [29], nor is there a chapter dedicated to proportions. (Figs. 2–4)

The work is meant to be methodical, descriptive, and structured. In its exposition, it starts with the introduction, followed by development of the practice, proof, summary, and an epigraph. It does not theorize, but goes straight into the practice. It intends also to be direct in its style. The teacher establishes forthright communication with his interlocutor, a second person to whom he speaks often in the imperative, whose attention he calls in an attempt to make the relationship colloquial, and to whom he presents numerous questions so that the correct interpretation of what he has explained is made evident.

A syncopated syntax is employed. Many questions are direct, with a question mark at the end. At times, the word "Answer" is introduced as a marginal note, similar to the dialogues employed in religious verses or doctrines. But the authenticity or appropriation of some constructions must be questioned:
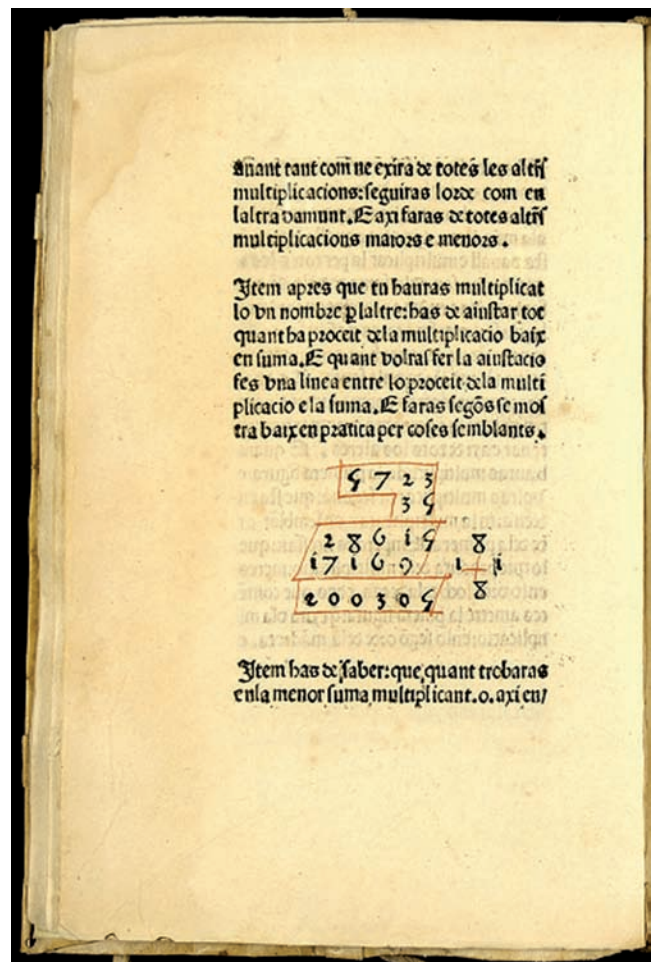
on occasion–which we exemplify with the use of the diminutive "*solet*" ("all alone") (a³r., a³v.) [30]–certain features could have arisen during copying, translation, adaptation, or a synthetic linguistic structure.

The difficulty or the benefit of what is taught is commented upon. The author is a pedagogue who is thorough in the progression of learning, simplifying or expounding as he sees fit. He only includes what he considers important in the manual. Santcliment builds upon experience and chooses algorithms that he considers the best and most useful for each case. His pragmatism forces him to be concise. Therefore, he gives only one model for multiplication and one for division. It also forces him to explain his methodology or to resort to popular sayings and grammar, as in his exposition of two false positions: "E per ço les podem acomparar al dit vulgar que diu: si vols saber veritat, digues falsia, o per semblant al dit del gramàtich qui diu que dues negacions fan una affirmació" (p⁷r.). (Fig. 5)

He begins by addressing the concept of numbers and explaining the positional value of zero or "digit of nothing" (a¹v.) [31], an exposition that, from the start, sets the work apart from Boethius. He considers 1 to be just another natural number. Apart from the whole numbers, there are numerical sets of tens and hundreds. He then introduces the algorithms of calculation and the four rules, the latter in the order that we learn them today: addition, subtraction, multiplication, and division (and
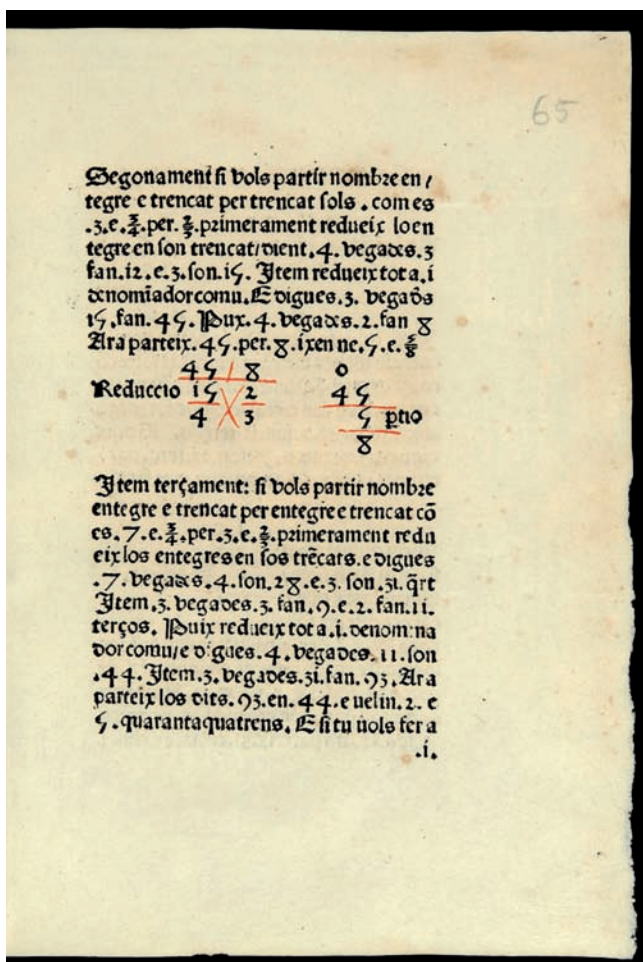
Fig. 4. Fractions: division of a mixed number by a whole number and division of two mixed numbers. Example of the first.

Fig. 5. False positions method, "by which through two falsehoods, the truth is subtly found".

halving) [32]. These are completed with the appropriate exercises and the suggestion to check the work with the inverse operation. It should be noted that the example used for addition contains more than two quantities and that the multiplication table is displayed in the form of a triangle. Both multiplication and division are limited to one system. Negative values are not covered.

The examples [33] further elucidate the definitions, as the teaching of arithmetic cannot be achieved without exercises. Notational symbols of algebraic language do not yet appear in the text and so, for this function, the corresponding words are used. The author does, however, indicate which lines are necessary to configure the various operations; with some exceptions, these were added in red ink after the copy's printing. He also believed that the reading of large quantities, formed by triplet groupings, is made easier by separation of the numerals in groups of three, but the printed text only shows the slanted line in the example. In the fractions, the notation is printed.

The operations utilize the units of weight, length, and the coins of Barcelona, whose mint he refers to when stating the value. The relationship of the Catalan coin to those from other regions (Aragon, Perpignan, Valencia, Milan, Pisa) is given. This information makes it possible to draw inferences about the author's environment and the audience for which he had conce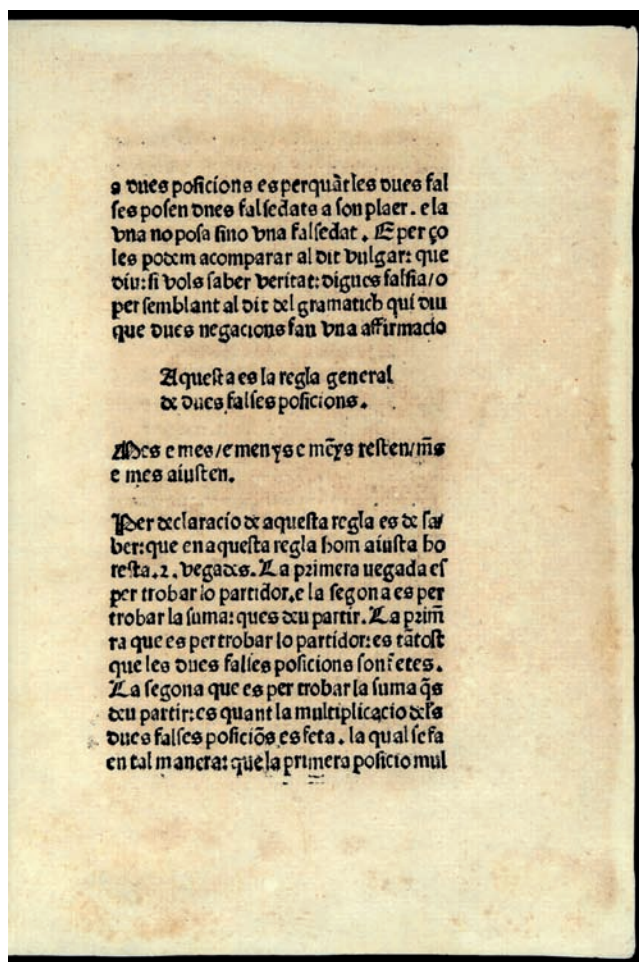ived the work. Examples of the operations are given in a system of coins of account or in real coins. The relationship between the two was fixed by the ruling power. In bartering, the change in the value of "cash" money is mentioned, as is the idea of "fair" bartering. In addition, although the value of the coinage at the moment was given, the author warns the students of its fluctuations and differences in its worth.

The rule of three is applied to problems of money, scrap, and weights and measures–or rather, of coins and measures (length, soil weight, and volume). He introduces the variant of time in the rule of three with coins and with the inclusion of fractions. Fractions take up the most extensive section of the book and have a broad field of application to the topics noted up to this point. The practice of how to reach a common denominator is taught, as is, without referring to them as such, determination of the least common multiple and the greatest common divisor. This part of the text distinguishes the work from other texts offering a method for the division of fractions [34].

A section is dedicated to operations that can also be solved using the rule of three: in the rule of partnership, in exchanges and in barter, in positions, the rule of alloys, and in progressions. The work ends with a recapitulation of the general rules through a specific series of problems. The answers are given without explaining the process, a practice considered quite common and found in other arithmetic texts. The omission of a certain point is also considered acceptable if it is thought that

the user is already aware of it or, perhaps, in the hope that a personal conversation will take place between professor and pupil, or that the matter is addressed in other documents such as accounting manuals or commercial treatises.

What better way to describe the end of the work than with a reproduction of its colophon:

"Per mitjà del divinal adjutori fonch acabada la suma present sobre l'art de arismètica per mi, Francesch Sanctcliment, en la insigna ciutat de Barcelona [a] aquella ensenyant, jatsia no ab aquell stilat scriure que entre·ls doctes és acustumat mas bé satisfet a la fervor de aquells qui de tal art ignorants tenen desig sien adoctrinats tant quant la flaquesa de la mia intel·ligència m'à consentit. La qual suma fonch regoneguda per lo reverent mestre Ràpita en aquesta e en les altres arts e en sacra theologia meritíssimo laureat e per lo honorable en Jachme Serra, olim mestre de la seca de Perpinyà. E si res en orde e modo de dir bo en aquella serà trobat, al donador de gràcia Déu eternal sia referit. E lo que ab defalliment e no ab aquella allegància e orde a tal art pertanyent serà posat sia referit al poch saber que en mi té loch pregant-los qui més de mi hi sabran tals erres ab amor corregesquen sotsmetent-me humilment a lur correcció, e per satisfacció de tants treballs los prech per caritat per mi a Déu pregar vullen.

Estampada fon la present obra en Barcelona per Pere Posa prevere en l'any mil quatre-cents vytanta-dos. (r^7v.-r^8r.)." (Fig. 6)

Thus, the colophon contains a justification for the printing of the work, even though it does so in a conventional manner [35]. In contrast with the responsibility, perhaps moral, implied in making a work public, it offers the virtue of humility, a desire that is *ad captandam benevolentiam*. The work is written to meet the needs of students, rather than the learned–thus, in the language of the land–and under the supervision of someone considered superior in rank, such as a distinguished ecclesiastic or perhaps a professional in the field [36]. This oversight guarantees acknowledgement of the value of the work. Corrections are welcome and gratefully accepted. The text's public usefulness will take precedence over any wish of the author to gain recognition.

Many of the exercises in the volume were formulated in a similar way in texts from other cultural areas. This is where the difficulty in determining a common root arises. For example, many texts had reached the step preceding symbolic algebra that would come to rule the resolution of the equations.

Influences of the work

A variety of unique elements must be considered in determining the influences on this work. Language is one of them, not only in the definitions, which are driven by a synthetic linguistic structure and by a culture highly based on memory (some definitions from other texts resemble those of this text significantly). Another is the writing of the incipits and colophons, conveyed
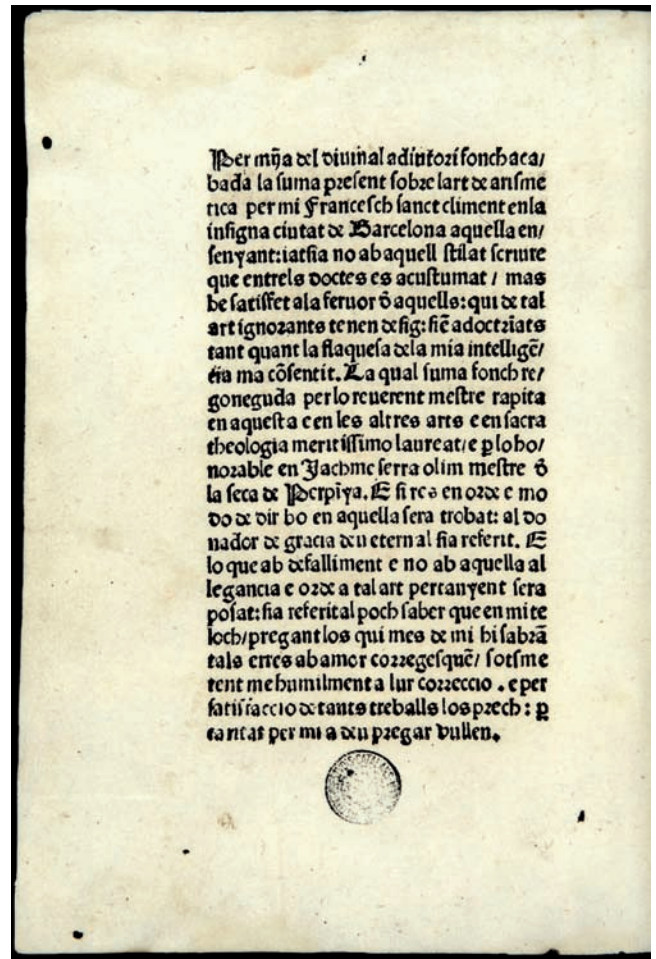

Fig. 6. Colophon: beginning.

through manuscripts and collected by printing activity. And then there is the discourse itself (the words at the beginning and the end, as well as the idiolect of the author recall the Treviso text and earlier manuscripts.) Essentially, the content should be considered. The content varied from one manual to the next.

The most recent bibliography links the Santcliment printed by Posa to the Occitanian arithmetic preserved in the handwritten tradition [37]. Of all the Occitanian mathematical manuscripts from the mid 15th century, one stands out [38]. Written in Pamiers on an undetermined date [39], in Occitan [40], it could have been the source for both the *Suma* by Santcliment and the *Compendion de lo abaco* by Pellos [41], should there not exist a common prior source [42]. Proof of this would be obtained from a comparison between the Santcliment and the Occitanian manuscript since, in certain fragments, there is a strict correspondence to the Santcliment text [43], such as the inclusion of position and "remotion" [44] within the false position method.

The Santcliment work provides us with much more information than merely a collection of dry arithmetical facts. Between the lines, a wealth of additional economic and commercial insight is hidden: data on commercial customs, goods undergoing transaction (pepper, saffron, cinnamon, honey, sugar, skeins of silk, mutton), coins, weights and measures, quotations and pricing, barter conditions, the value of the market, the exchange surcharge, the rules regulating interest. This is com-

plemented by extraordinarily valuable information on language, numismatics, and the social backdrop. Regardless of whether the treatise reflects the reality of the time or whether its priority is practical arithmetic, it offers us a slice of life at the time of its authorship. It uses Catalan as a scientific language and as the colloquial language, shying away from an academic style. In this work, the city of Barcelona is the cynosure, a position already granted to it in other texts. It recognizes Barcelona as a market to be dealt with.

However, the story of Santcliment does not end here. In the colophon of the *Compilatió[n] de arismética sobre la arte mercantívol*, authorship of the work is attributed to "Franciso Sanclimente". This incunable does not bear the publisher's imprint. Notwithstanding, according to Coni and to the Cagliari University library, where the book [45] is kept, it was published in Zaragoza by Paulus de Konstanz around 1486. This attribution is referenced in *IGI* and in the *GW* database [46]. This copy had belonged to Montserrat Rosselló [47], the jurisconsult born in Cagliari to Vicent Rosselló of Mallorca and Helena Nicolau and who lived from the end of the 16th century through the first two lustrums of the 17th century. His library, enriched by the acquisition of the Canyelles library from Nater [48], reached the school of the Jesuits of Santa Croce in Cagliari along with a monetary donation and would grow with the contributions of the Jesuits. In the end, after the abolition of the Society of Jesus, this entire collection–except for a few pieces that were missing–would be passed along to the university library of Cagliari. A series of works was recovered during a reorganization of this collection in the 1940's, among them, this compilation, which at the time was identified as a Spanish translation of the *Suma* by Santcliment [49].

The recovered work, according to Coni's reference [50], had not been previously identified because it is not dated and there are no typographic indications; the inventory of Rosselló's library described it as "Francisce sanclementis co(m)pilatio arismetica in artem mercatorum 4 fol Venetijs 1501" [51], and it was bound with two later treatises: a copy of *Art y stil para scriure a totes persones de qualsevol estat que sien. E diverses maneres de comptes abreviats molt necessaris per a totes persones,* with no publisher's imprint, by Tomàs Perpinyà (printing attributed to Valencia: Cofman, circa 1511 [52]), and, from Sessa, Venice, *Libro de Abacho*, by Pietro Borghi, from 1501. All three works are related to the same thematic field.

Coni describes [53] the work quite extensively. He remarks first upon the quality of the edition and then provides a description, including the collation. He points out that the colophon is followed by a table of gold pricing. Later, in 1954, Coni himself would describe it again upon compiling the description of the incunabula preserved in the university library of Cagliari and in other Sardinian libraries [54]. Marina Romero Frías briefly reviewed it [55], in 1982, in *Gli incunaboli e le stampe cinquecentesche*, the first volume of the *Catalogo degli antichi fondi spagnoli della Biblioteca Universitaria di Cagliari*, citing the reference as *IGI.*

The Cagliari copy [56] presents handwritten annotations and other reading signs. On the upper part of folio a^2r is written, "Auctor est Franciscus Sanclemente," and below, on the same page, "Ex libris Monsserrati Rossellò". The work is currently in a single volume, covered and bound in parchment with somewhat modern bands. The current size of the sheets is 195 × 145 mm, while the justification of the text is 140 × 85 mm. The rubber stamp on a^2r reads, "Biblioteca Governativa di Cagliari." The copy is well preserved, except for a few stains.

The incipit clearly delimits the work's content when it says that it is a compilation of arithmetic about the art of commerce, divided into fourteen parts. It then turns to the Aristotelian quote conveyed by Boethius [57]. In the same line, the author refers to zero "o círculo o teca" [58] and does not consider 1 as a number, but as the beginning of other numbers [59]. Within the abacus' nomenclature [60], he speaks of natural numbers, articles, and composite numbers [61]–as did the anonymous writer in Treviso–and then goes immediately into explaining practical arithmetic.

A reading of the edition–48 pages in 4° format–makes it clear that the language in which it is written shows Aragonese features and the influence of Catalan, and that the parallelism with the Catalan incunable is not as substantial as it may be concluded from the bibliographic notes. A comparative reading of the two summaries shows that there is no strict parallelism in the subjects treated. Fractions are now omitted, while root extraction is included. On the other hand, in the development of the subjects, this text does not follow the order invoked by the incipit and covers more subjects than announced.

The text begins on folio a^2r [62]. A good part of the information is given in the incipit:

"A honor e reverentia de nuestro seynor Dios Ihesu X̄p̄o. e de la sacratíssima virgen María su madre. Comiença la compilatió[n] de arismética sobre la arte mercantívol. En la qual consistirán 14 partes que són: numerar, sumar, restar, multiplicar, pratir [*sic*] e reductiones de monedas, regla de ters [*sic*], companyes, cambios & baratas, fin de oro & fin de plata & rahizes quadradas & cúbicas, las quales partes o especias brevemente empero a sufficientia en el presente compendio se tractará.

[T]³odas las cosas que del principio del mundo fasta oy procieron an estado formadas a razón e causa de los números. Por donde se vehe que en todo lugar o parte del mundo que hayan conoscimiento es la arte de contar. Et esta scientia compendiosa fue sacada por un philósofo que se llamava Algus de donde le dezimos algorismus. Et es algorismus arte compendiosa por figuras falladas por los arábigos (a^2r.)."

The subjects are limited to numbering, addition, subtraction, multiplication, division (halving), reductions, the rule of three, partnerships, exchanges, barter, fine silver, fine gold, progressions, square and cubic roots, and positions. It should be noted that reductions do not appear in the text as a separate chapter, that roots appear in the text as the fourteenth part, that neither progressions (which appear in the thirteenth part), nor positions (which also appear in the fourteenth part and include the section on position and "remotion") are mentioned in the summary. In addition, the relationship of prices to different

purities continues after the half-printed/half-written colophon. Notational symbols are not printed, and lines of operations are not included. There are blank spaces for initials that never were included.

Compared to the Catalan text, this one shows significant changes from the start [63]. It mentions the philosopher Algus (a^{2}r.), gives the numerals in descending order according to the Arab model (a^{2}v.), and introduces "teca" or "círculo" as an alternative to zero. The examples and their placement within the context are different. The order of the paragraphs is inverted if the arrangement lends greater logic to the reasoning. The text is much more concise and intermediary steps have been omitted. It is also less punctuated than the Catalan text. Rarely is there a separation between paragraphs. For as much as the text signals a need to employ lines in the arithmetic applications–"es necessari [...] fazer una línea entremedias", as it states on b^{2}v–the copy does not have them.

The user to whom the work is addressed is a second person, singular or plural, referred to as the beginner. Indirect questioning is used as an active tool, always with the awareness that the language must be within reach of the reader: "[...] el simple es todo número menor de diez e éste en vulgar llamamos no[m]bre e siempre está primero", (a^{2}v.). Curiously, the figure of the "arithmetician" is introduced in the enunciation of some problems (f^{6}v.), along with those of the merchant and of the money changer.

The changes also extend to the exercises. The author employs measures and coinage from Aragon, which at one point are contrasted with those from other markets (Catalonia, Castile, Valencia, Mallorca, Sicily, Bruges, Milan, Genoa, Montpellier, and Naples). It observes the difference in value of units or coinage from one land to another: "tienes de saber por regla general que las tienes de tomar segunt en la tierra donde eres. Como agora somos en Çaragoça, cosa cierta es que un florín vale [...]" (d^{5}r.), and the fluctuation of gold coins that "puyan e baxan" (a^{8}r.).

Even though the text in this incunable is generally shorter than that in the Catalan work, complementary explanations, the completion of a paragraph, or the use of a clarifying synonym are dwelled upon in full–"Síguese la segunda specie que se llama ayustar o comunente [*sic*] sumar" (a^{3}v.). It speaks of "discreta" or "continua" progression and of "interpolata" or "intercisa" progression (e^{8}r.–v.). It does not include advanced material and does not include certain practices if beforehand an explanation has not been given. Thus, it only gives the multiplication proof by 9 because the inverse would imply knowing how to divide (b^{4}r.). It eliminates difficult proofs of little benefit to the beginner, such as the proof by 7 in addition (a^{5}r.). On the other hand, it emphasizes the advantages of other proofs, such as the rule of three involving time: "la qual es muy mucho provechosa en el arte mercantívol" (d^{3}r.).

The text's morphosyntactic, lexical, and, generally, linguistic alternations, such as the uneven writing of the incipit, are surprising. The writing of the colophon is particularly unexpected: poorly done, half-copied and half-adapted in Zaragoza, shortened, and put together somewhat hastily. It also seems curious that the printed text is suddenly interrupted in the middle of the chapter. More understandable is that the reference to the two people to whom the Catalan Santcliment text had been presented –and who, in some way, had served as guarantors– is omitted from the colophon. Thus, the colophon reads:

"Por medio de adiutorio divinal fue acabada la suma presente encima l·arte de aritimética [*sic*] por mi Franciso [*sic*] Sanclimente aquella en la insigna ciutad de Çaragoça ensenyante, iatsesia que no esté con aquel lindo estillo que entre los scientes es acostumbrado pero e satisfecho a la voluntad de aquellos que de tal arte ignorantes tienen desseo seyer adoctrinados. Et esto tanto quanto la flaqueza de mi entelligencia me a consentido. Et si algo de dizir bueno será en la presente fallado, a la infinida bondat [de] Dios omnipotente sea referido, e lo que con defalimiento será fallado a mi ignorancia sea reputado, rogando ad aquellos que más de mi saberán tales yerros con amor coreyescan [*sic*] yusmeténdome a su correción, et en satisfación [*sic*] de tantos trebaios los ruego por caridad quieran rogar a Dios por mí." (f^{7}v.–f^{8}r.).

Here begins the text that bears the title: "Síguese una suma muy útil por saber mercar oro a qualsequiere ley que sea" (f^{8}r.–v.). It continues from the grade of 24 karat to that of 12. In the photocopies that we work with, the text almost covers 16 karat purity. From the last line of the latter to the end of the 12 karat purity, the text is penned in a handwriting that imitates the Gothic. This text is the Aragon adaptation of what was mentioned in folios r^{2}r.–r^{4}r. regarding the Catalan text in relation to Catalonia.

Coda

The analysis of these two arithmetics allows us to reconsider the role of the authors, their selection of subjects and examples, their creative input, and their sources. Indeed, these texts have a common origin. As we know, the system of mathematics based on Hindu positional numerals was introduced into Europe through the translation of Arabic works. We are reminded of the figure of al-Hwārizmī (†840) and those who translated and adapted his work [64]. We are also reminded of the relevant contributions of the Catalan monasteries in the penetration of scientific Arab knowledge into Europe in the second half of the 10th century, and of the figure of Gerbert d'Aurillac, who was to become pope under the name of Sylvester II [65]. Despite the numerous gaps in extant documentation [66], Gerbert d'Aurillac is considered the creator of a type of abacus [67]. Finally, we are reminded of the figure of Leonardo of Pisa (1180–1250), also known as Fibonacci, to whom the split from the traditional system is attributed, as is the authorship of treatises on vernacular abacuses of the early Middle Ages, even though he wrote in Latin [68].

Considering the two above-mentioned incunabula, since the chapters touched upon diverge as discussed above and in their examples, should we consider the second as a translation, a version, or simply an adaptation of the first? If it were a translation, would the same author have done it? Or should we

be talking about a new arithmetic, attributed or signed by Sant-climent as well? If both texts derive from the pen of Francesc Santcliment, we would find ourselves looking at the first known author to have written or compiled two arithmetics in different languages. But this premise would raise the question how the same author could write that the number 1 is a numeral (in the Catalan text) and that it is not a numeral, but "el principio de todos los números" (in the other text), and how a terminology could be adopted–that of natural numbers, articles, and composite numbers–that harked back to earlier texts, to the Treviso, without further development of the idea. And how could it be that, in the first of the two works, all references to more theoretical treatises on algorithms are omitted while, in the second they are contemplated?

The studies undertaken do not allow for the establishment of a *stemma* for each of the extant arithmetic texts. In any case, when considered in their entirety the two treatises differ, even though they share many points of kinship. There are those who emphasize the source of the Italian arithmetic, others who champion an Occitanian transmission. A priori, it would be necessary to analyze in depth the penetration and spread of knowledge and of the cultural and commercial relations between the various territories, including the cultural and commercial presence of Catalonia and Barcelona, the relationship with Occitania, Italy, Aragon, and the kingdom of Naples and Sardinia, etc.–a long road of interrelation and exchange in the area of influence of Mediterranean commerce. The practical arithmetics printed in the 15th century must have come from a known–and expanded upon–common base of knowledge from which, in a desire for practical pedagogy, the teaching elements were extracted in accordance with the experience of the author and with the purpose of the work, in an approach that would soon establish itself beyond the professional commercial medium and give rise to new versions. Descriptive notes, common to the manuals, explained numeration as well as the calculation algorithms and their applications according to a very similar script, adapting the enunciation (also rather common) and the examples to the applications considered and to the context in which they were produced.

Notes and References

Notes

[1]   Joana Escobedo. *Un incunable científic català: la* Suma de la art de arismètica *de Francesc Santcliment*. Vol. 1: Estudi. Vol. 2: Francesc Santcliment. *Suma de la art de arismètica.* Barcelona: Pere Posa, 1482. Edició facsímil [86]. The presentational event for the work took place at the Biblioteca de Catalunya on May 21, 2008. Besides the author of the study volume and curator of the edition, it was presented by Dr. Josep Pla i Carrera, Professor of the History of Mathematics at the University of Barcelona. A new presentation was held at the University's Mathematics Department on April 29, 2009 as part of the exhibition *Parlem de llibres* included in *Matefest-Informació 2009.* Speeches were given by Dr. Pla i Carrera and Dr. Escobedo.

[2]   Smith [124], p 4-7; reproduced by Swetz [128], p 27–33. In short, and highly summarized, the theoretical treatises follow the writings of Boethius based on the translations by Nicomachus of Gerasa and Euclid. The arithmetic abacuses represent a system of calculation that used a framework for counting (up to the most evolved forms). It was substituted in some regions by algorithms while it endured in others. Algorithms are practical arithmetic operations in which an explicit series of rules is employed to solve a problem in a finite number of steps. It is a form of mathematics beholden to Algoritmus [the Latinized name of al-Hwārizmī (†840)] and his schemes, which used Hindu positional numerals, and methods of computation, known in the Latin world through the Latin translations and adaptations of the book *Algorithmi de numero indorum* by Adelard of Bath and John of Seville, among others. The computations became systems of calculation associated with the ecclesiastic calendar and were used to determine the dates of the moveable feasts.

[3]   Theoretical arithmetic was taught at the university level, inspired by Pythagoras' work, with the aim of serving as a base for Euclidian geometry (Salavert [117]*,* p 188).

[4]   *BMC* [77], V, 285; *CIE* [82], 2334; *GW* [89], 9428; Goff [87], E-113 + Supl. 1972; Klebs [98], 383-1. In particular, see *BMC* [77].

[5]   See the bibliographic references to note 11.

[6]   Treviso: [Michele Manzolo], 1478, December 10th (*GW* [89], 2674; H.C.R. [90,80,113], 1863; *IGI* [95], 906; Klebs [98], 115-1; Smith [126]; Smith [124], p 3-7). Benoit [75], after referring to this arithmetic, adds that there was "une autre trois ans plus tard à Florence" that he does not document (p 201). The Treviso arithmetic was translated into English by D.E. Smith [126] and was published by F.J. Swetz [128], p 40-175.

[7]   Ulrich Wagner [133] *Rechenbuch*. Bamberg: Petzensteiner, 1482, May 17 (C. [80], part II, vol. II, 5038; Klebs [98], 1045-1; Smith [124], p 12). Six printed pages in one single page of parchment is extant (a page proof?). There are discrepancies in the bibliography when considering whether or not the one that was published anonymously the following year, in Bamberg, could be considered as a second edition. However, lately the balance leans toward the idea that they are two different arithmetics (Hernández Esteve, [92], p 34-45). Also see note 9.

[8]   Aguiló [70], 1943; C. [80], II, vol. 1, 2568; II, vol. 2, addenda to part I, 5471, p 255; *CIE* [82], 5115; H. [90], 5471; Haebler [91], 602; Karpinski [96], 411-420; Klebs [98], 419-1; López Piñero [101], 1462; Méndez [105], 13, p 50; Palau [108], 297659; Sarton [120], p 89 and 218; Smith [124], p 375 (in the record dedicated to Maffeo Poveiano, entered as pertaining to 1582, among other editions from that year); Sosa [127], 754; Torres Amat [130], p 584; Vindel [131], I, no. 29. Nicolás Antonio [71] does not mention this work. It is clear, given the character of these notes, that the bibliographic research is not intended to be exhaustive. It should be noted that this text has been the object of monographic analyses that en-

compass both the bibliographical and scientific viewpoints. Karpinski, Hernández Esteve, Pla i Carrera, Malet, Labarthe, etc., must be mentioned.

[9]   Bamberg: Petzensteiner, 1483, April 15th (H. [90], 13713; Klebs [98], 1045-2; Smith [124], p 15). See the study, reproduction and transcription of the original in Wagner [133]. Also see note 9.

[10] Venice: Erhardus Ratdolt, 1484 (*BMC* [77], V, 289; *GW* [89], 4936; Klebs [98], 205-1; Smith [124], p 16; Smith [125]*, p 41-49; Sarton [120], p 113-114 and 159).

[11] Coni F [85]. This edition is recorded in *IGI* [95], 8656, where it is entered as Santcliment, Francesch, and under the title *Suma de arithmetica.* [Zaragoza, Paul Hurus, c. 1486]. 4°, got. A copy is found at the University of Cagliari. Toda [129] does not mention it in appendix IV of the section heading "Fuentes de la bibliografía española de Cerdeña"–"Catálogo de incunables y libros raros españoles de la Biblioteca Universitaria de Cáller" (p 58-63). It is also recorded by Sosa [127], 753.

[12] Leipzig: Conradus Kacheloffen, 1489 (*BMC* [77], III, 624; Goff [87], W-14; H.C. [90, 80], 13712; Klebs [98], 1047-1).

[13] Florence: Lorenzo Morgiani & Giovanni [di Piero] da Maganza, 1491/1492, January 1st (*BMC* [77], VI, 681; *GW* [89], 5884; Goff [87], C-34 + Supl. 1972; H.C.R. [90, 80, 113], 4234; *IGI* [95], 2352 + Supl.; Klebs [98], 236.1; Smith [124], p 47-49).

[14] In general, see *Huit siècles*... [94] as well as Beaujouan (*The Place of Nicolas Chuquet*) [74], p 81. The bibliography demonstrates the importance of the document as the oldest book printed in Occitan and of the language in which it is written as well: "[...] c'est un document irremplaçable sur la langue véhiculaire de la fin du XVe. siècle, qui à Nice accuse les traits niçois sans perdre le sentiment du classicisme linguistique occitan (reproduced by Pic [110], p 95).

[15] [Turin: Nicolò Benedetto and Jacobino Suigo, 1492, September 28] (Aguiló [70], 1944; *BMC* [77], VII, 1057; Brunet [79], IV, 475; *CIE* [82], 4409; Goff [87], P-260; *IGI* [95], 7393; Klebs [98], 740-1; R. [113], 1835; Sarton [120], p 114 and 160; Smith [124]), p 50: "29 Sept. 1492"; Vitale-Brovarone [132], p 34-36). Vitale-Brovarone, p 44 and 48, as well as Pic [110], p 96, give their interpretations of the background of printing in Turin.

[16] Lucas de Burgo Sancti Sepulchri. *Somma di aritmetica, geometria, proporzioni e proporzionalità.* Venice: Paganino de Paganinis, November 20th; November 10th 14[9]4.- Fol. Parts I-II (*BMC* [77], V, 457; *CIE* [82], 3578; Goff [87], L-315 (+ Supl. 1972); H.C. [90, 80], 4105; *IGI* [95], 7132 (+ Supl.), Klebs [98], 718-1; Smith [124], p 54). See Swetz [128], p 12-13, and Sarton [120], p 114-115, and 161.

[17] Venice: Johannes Leoviler, 1488 (*BMC* [77], V, 406; *GW* [89]*, 4937; H.C.R. [90, 80, 113], 3661; Klebs [98], 205-2; Smith [124], p 19-20).

[18] Venice: Nicolaus de Ferrariis, 1491, October 22nd (*BMC* [77], V, 507; *GW* [89], 4938; H. [90], 3662; Klebs [98],

205-3; Smith [124], p 20). The *BMC*, V, 507, notes: "A close reprint of Ratdolt's 1484 edition [...], the name of the latter in the second colophon being replaced by that of De Ferrariis [...]".

[19] Pforzheim: Thomas Anshelm, 1500 (*BMC* [77], III, 705; Klebs [98], 1047-2; Smith [124], p 36-39).

[20] Adams [69], P-8, and, for its ornamentation, Sander [118], II, 5368.

[21] See *BMC* [77], V, 289.

[22] Madurell-Rubió [102], doc. 235, p 404-415. In "Memorial dels libres que yo, Pere Posa, tinch fet lo segon de març 1506", the Santcliment appears with the no. 139 (p 406). Rubió (p 413, no. 139) gets the name of the author wrong, calling him Pedro, perhaps influenced by Haebler [91], 602, whom he cites. Vindel [131] is also cited, I, p 250.

[23] Madurell-Rubió [102], doc. 238, p 422-426.

[24] As maintained by Bohigas and Soberanas [78], 3:107/8 (no. 80, p 75-76). A description of the types used by Pere Posa, which also covers the contributions made by Haebler [91], is found in *BMC* [77], X, p 5, and plate IIs.

[25] Aguiló [70], 1943, mainly.

[26] This incunable is recorded in *BMC* [77], X, 6; *CIE* [82], 4838; Goff [87], L-383; H.C. [90, 80], 10318; Haebler [91], 381; *IGI* [95], 5898; Rogent-Duran [115], 5; Vindel [131], I, 26.

[27] Given that the folios numbered with a 2 correspond to the third leaf of the quaternion, we will ignore the printed numeration in the citations.

[28] The lexicon, morphology and syntax of the original Catalan has been respected in the text citations. In terms of orthography, the contractions have been resolved and, in agreement with modern-day Catalan, the use of capital letters added. The letters *u* and *v*, as well as the letter *s* and long ʃ have been standardized. Accents, diaereses, apostrophes, and the short dash are employed in the transcription–as is *l·l* of the textual *ll,* which nowadays is written this way. The interpunct is used to indicate elisions that currently have no graphic representation. Also in accordance with modern-day Catalan, words have been either separated or united and punctuation is used. Diaereses have not been employed when there is an **h** inserted in a word's spelling that seems to destroy the diphthong. Any symbol not directly printed in the original–whether missing, illegible, or an obvious error–is placed in square brackets.

[29] Sesiano [121], p 80, I.5, related to *Manuscrit de Pamiers*.

[30] The *Manuscrit de Pamiers* uses "*solet*" ("all alone") in the same sense.

[31] The Treviso incunable (fol. [1v.]) reads: "E la decima figura, zoe 0, se chiama cifra o vero nulla, zoe figura de nie[n]te, perchè in se nie[n]te leua ma io[n]cta a le altre figure fa crescere loro valore".

[32] Doubling and halving were common practices in the era, a reminder of a time when calculation on paper was unknown. Thus, multiplication and division by two, done many times over, seemed simpler. ([75], p 208).

[33] Errors have been detected in some exercises. (See Hernández Esteve [93], p 54 and 57, for example, or Malet's edition [119], p 33). Labarthe also takes this into consideration [99], p 7.

[34] Hernández Esteve [92], p 124.

[35] Observe the similarity with the Perpignan colophon according to Aguiló, reproduced here: "Per mija del diuinal adiutori fonch acabada la ſuma preſent per mi thomas de perpenya ciutada de Ley/da. Pregant als que mes de mi hi ſabran ab amor la corregeixquen" ([70], no. 1990. Also see no.1991). This similarity also extends to the incipit and the use of such key words as *summa*.

[36] Karpinski [96] points out, p 420, that neither are known in the history of arithmetic. Beaujouan considers it "[...] noteworthy that in the *Suma* of Barcelona, Francesch Sanct Climent states specifically that he had submitted his work both to a university teacher called Rapita and to a former Master of the Mint at Perpignan, Jachme Serra" ([74], p 79). What would be truly interesting is to know who these individuals were and why Santcliment made it explicitly known that he had them judge his work. Perhaps he intended to guarantee the quality of his text or to give it prestige or perhaps he owed a duty of a hierarchical nature. It could be conjectured that he was referring to Friar Bartomeu de la Ràpita, a monk at the convent in Balaguer and professor of sacred theology ([76], XX, p 751-752). The identity of the second person and when he undertook the task are as yet unknown.

[37] Beaujouan includes the Santcliment amongst the Occitanian arithmetics ([74], p 78). Malet [103], p 205, affirms: "El texto de la *Suma* muestra sin lugar a dudas su vinculación a la misma escuela franco-provenzal a la que pertenecen el importante manuscrito anónimo de Pamiers (c. 1435) y la aritmética de N. Chuquet (1484)." He contributes the examples to Santcliment (ed.) [119], p 63-72.

[38] Manuscrit de la Bibliothèque Nationale de France, fonds français, nouvelle adquisition, no. 4140, usually called *Manuscrit de Pamiers.*

[39] From the end of the 15th century by Karpinski-Staubach [97], p 121; around 1430, by Sesiano [121], p 79, in accordance with the denomination of the coinage that appears in the enunciation of the arithmetical problems.

[40] Beaujouan, in [74], studies the Occitanian texts and explains their influences. In relation to this handwritten text, see p 79. A broader compilation and several articles on the subject (by Cassinet [81], Guillemot [88]...) can be found in *Huit siècles de mathématiques en Occitanie* [94].

[41] Even though their opinions do not always coincide, see Cassinet [81], p 9ss., and Guillemot [88], p 105ss. and 129.

[42] Besides the *Manuscrit de Pamiers*, Cassinet [81] mentions three other handwritten texts from the 15th century, written in French, but by Provençal authors: an anonymous one, the *Kadran aux Marchans* by Jehan Certain and another by Mathieu Préhoude.

[43] Sesiano [122], notes 24 and 25, and the Santcliment edition curated by Malet [119], p 33-40 and appendix 2, p 63-72.

[44] Malet [119], in Santcliment (ed.), p 36.

[45] The lack of opportunity to analyze the original–the paper, filigrees, quaternions, bindings, etc.–but instead having had to work with photocopies means that these notes could not be sufficiently precise.

[46] Given their authority in the world of incunabula, the attribution is believed to be valid.

[47] Several biographical notes on Rosselló are compiled in Martini [104], p 3-5; Lippi [100], p 319ss.; Romero [116], p 12, etc.

[48] Toda [129], p 30, note 1. Also see the appendices from the third Part of Toda's: "La imprenta en Cerdeña": no. I–"Inventario de la imprenta de Canyelles" (p 288)–and no. II–"Nota de los libros y efectos hallados en casa de Canyelles el día de su muerte" (p 288-289).

[49] It was considered to be the second edition in Spanish of the Santcliment (Vitale-Brovarone [132], p 41). In note 57, p 41, Vitale adds, in reference to the author: "Je compte confier mes considérations à l'introduction de l'edition du texte castillan, à laquelle je participe". However, this edition has yet to see the light of day. On p 203 of Malet [103], we read: "Pocos años más tarde, sobre 1486, el mismo Santcliment publicó en Zaragoza una adaptación castellana de su libro." This claim is taken into consideration when the author's biographical profile is analyzed. Malet dedicates pages 26, 28–29 and 40–43 to this question in his Santcliment edition [119]. Salavert also calls it a "versió castellana del llibre, més reduïda," and follows Malet's biographical data ([117], p 191). Other authors have done so as well.

[50] (*Un incunabolo*), [85], p [3-4]. Folio a^2r is reproduced on the last page.

[51] "La copia dell'*inventari dela llibreria*, fatta sull'originale compilato dal Rossellò e allora esistente nel collegio gesuitico, è composta di 215 pagine in foglio: le opere a stampa, che sono circa cinque mila, restano elencate in ordine alfabetico, tenendo conto dei nomi (e, dopo, dei casati) degli autori, del titolo dei libri, del numero dei volumi, del formato, del luogo e della data dell'edizione". (Lippi [100], p 328).

[52] Cf. Palau [108], 223630.

[53] (*Un incunabolo*) [85], p [4-6].

[54] [84], p 48, no. 184. It gives the topographical register of the incunable (Inc. 235), the author (Sant Climent, Francesch), the title (*Suma de arithmetica* [in ispagnolo]) and the publisher's imprint [Zaragoza, Paul (or Hans) Hurus, c. 1486]. 4° cc. 48. Segn.: a^8-f^8, ll. 29. Tipi:1=99/G. That it is a singular copy and bears the ex libris of Montserrat Rosselló are noteworthy. On p 57 is a facsimiled reproduction of fol. a^2r.

[55] [116], p 29, no. 30.

[56] According to the photocopies available to us, handwritten annotations and signs of reading can be made out on fols. d^7v., d^8r., e^2v., f^1r ("1469" is written on the margin of

this folio) and f^{7}v. (on the margin of this folio is a hand pointing toward the colophon as a sign of reading).

[57] fol. a^{2}r. "Omnia quaecunque a primæva rerum natura constructa sunt, numerorum videntur ratione formata. Hoc enim fuit principale in animo conditoris exemplar" (Boethius, *De arithmetica libri duo*, I, 2: De substantia numeri), extracted from Migne's Latin patristics ([109], 63, col. 1083). These phrases were the incipit of texts by Johannes de Sacrobosco.

[58] fol. a^{2}v.

[59] fol. a^{3}v.

[60] Guillemot [88], p 106.

[61] fol. a^{3}v.

[62] Could folio a^1 be blank? The lexicon, morphology and syntax have been respected in the text citation. In terms of the orthography, the contractions have been resolved as have, in agreement with modern-day language, the use of capital letters. The letters *u*, *v*, *s* and long ∫ have been standardized as have the *i* and *j*. Accents and punctuation have been added. It has not been accentuated when, in a word's spelling, there is a *y* or an inserted **h** that seems to destroy the diphthong. Any symbol not directly printed in the original–should it have been missing, illegible or an obvious error–is placed in square brackets.

[63] Coni [85]; *IGI* [95], 8656.

[64] Algorism, with all that it implied in abandoning the arithmetic of Boethius, had already started to be disseminated at the beginning of the 13th century and was fairly well known from the work in verse by Alexander of Villedieu onward as well as in prose, by Johannes de Sacrobosco (who begins his text with general ideas taken from Boethius).

[65] Millás Vallicrosa [106], p 136-163; Mundó [107], p. 261ss., 427, 431, 468; Riché [114], p 27-33; Pladevall [112]; *Autour de Gerbert* [72]; Beaujouan [73]), etc. A direct source is the consultation of his *Opera mathematica* [123].

[66] *Autour de Gerbert* [72], p vii.

[67] Beaujouan [73]*, p 324, reproduces some of Richer's words (*Histoire de France*, t. II, p 63-65), according to which, "[...] confecciona, avec l'aide d'un fabricant de boucliers, un abaque, c'est-à-dire une planche aux bonnes dimensions. Ayant divisé la longueur en vingt-sept parties, il y disposa neuf "notes" capables de signifier tous les nombres". As maintained by Beaujouan -*ibidem*, p 325- "Il semble bien évident que ces symboles numéraux, ces *notae,* ce sont les chiffres que nous disons arabes. Comment alors tenter d'expliquer leur absence dans les écrits mathématiques de Gerbert? [...] Surtout, les nouveaux chiffres arabes étaient considérés comme des moyens mécaniques du calcul, non comme l'expression de nombres." The nature of Arabic numerals and their use in abacus in accordance with the decimal position system could be beholden to Gerbert's stay in Catalonia -*ibidem,* p 326.

[68] Malet [103], p 201.

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