Récréations Mathématiques (1624) A Study on its Authorship, Sources and Influence

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ABSTRACT

In 1624 a small octavo was published in the French university town Pont-à-Mousson. It was the first time a reference was made to 'recreational mathematics' in the title of a book. This work is pivotal in the history of science and mathematics. It brings together two sixteenth-century traditions, mercantile arithmetic and natural magic, and creates two new ones: recreational mathematics and popular science. The booklet did not abound in new ideas. Several of the recreational problems treated, can be traced back to Babylonian, Greek and Hindu sources and the infatuation with mechanical contrivances dates from Hero of Alexandria. But the fact that the book stands on the crossroad of traditions, its popularity with the natural philosophers of the seventeenth century and its complex history makes it a grateful subject for study. Some of the complexities about the numerous editions and confusing claims about its authorship will be clarified. The author's direct sources will be exposed. The arithmetical and combinatorial problems were copied from Bachet, problems on practical geometry from Jean Errard. Salomon de Caus was the source of inspiration for problems on perspective, mechanical devices and fountains. Several problems were recipies by Alexis of Piemont from the classic book by Ruscelli. The book was influencial on early seventeenth-century natural philosophers such as Descartes, Mersenne and Leibniz.

THE BOOK WAS ORIGINALLY PUBLISHED IN 1624 by Jean Appier Hanzelet, the master engraver and printer for the university of Pont-à-Mousson, under the title *Recreation mathematicqve, composee de plusieurs problemes plaisants et facetievx, En faict d'Arithmeticque, Geometrie, Mechanicque, Opticque, et autres parties de ces belles sciences*[1]. The frontispiece mentions no name of an author but the dedication is signed H. van Etten[2].

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This study is based on my thesis for a postgraduate degree in History and Philosophy of Science at Ghent University, and revised and extented with an FWO research grant. I am grateful for helpful comments on a draft of this paper by Saskia Willaert, Xabier Docampo Rey and Olivier Thill.

[1] I will hence use the modern spelling *Récréations mathématiques* to refer to the original work. The plural 'récréations' was used starting with the 1628 edition.

[2] [Leurechon], *Recreation Mathematique*, F. Aii^{v} (Pont-à-Mousson: Jean Appier Hanzelet, 1624). Although I will challenge the authorship of Leurechon, I will refer to the editions by [Leurechon] to be compatible with most bibliographical references and library catalogues.

The first English edition of 1633 uses the name Henry van Etten[3]. The arms on the frontispiece are prominently present and have been attributed to Lambert Verreycken to which the book is dedicated[4]. From the dedication we learn that van Etten was a student at the local university where he took “pleasure in certain problems no less ingenious than recreative”[5].

The original edition contains 16 introductory pages and 141 numbered pages treating 91 problems. The dating of the edition has been the basis of much controversy. Some still question its very existence today. The first bibliographic reference to the work was given in 1643 by Alegambe in an early bibliography of Jesuits[6]. Adding to later confusion, the title of the book was listed in Latin as *Hilaria mathematica ex variis geometriae, mechanicae, cosmographiae, opticae et aliarum hujus modi artium problematis contenta*[7]. Although this is not the title of a published book and Alegambe explicitly stated the book was written in French (”Editit Gallice”), the reference has unfortunately been reproduced ever since. Dom Calmet in his *Histoire de Lorraine* gives the French title of the 1624 edition[8], without pagination and reproduces Alegambe’s latin reference to the place name and printer. Beaupré duplicates the entry of Calmet and gives a

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[3] [Leurechon], *Mathematicall recreations. Or a collection of sundrie problemes, extracted out of the ancient and moderne philosophers, as secrets in nature, and experiments in arithmeticke, geometrie, cosmographie, horolographie, astronomie, navigation, musicke, opticks, architecture, staticke, machanicks, chimestrie, waterworkes, fireworks, &c. ... Most of which were written first in Greeke and Latine, lately compiled in French, by Henry Van Etten Gent. And now delivered in the English tongue, with the examinations, corrections, and augmentations*. (London : By T. Cotes, for Richard Hawkins, dwelling in Chancery Lane, neere the Rowles, 1633). The first name Henry is puzzling as there is abolutely no reference in the original work to a first name Henri, Hendrik or Henry. This is one of several indications that the translator was knowledgeable about the history of the original work. The Wing STC (10558.5) uses Hendrik van Etten for the author. Other catalogues, such as the one from British Library, describes ‘van Etten’ as a pseudonym for Leurechon.

[4] The dedication concludes with: “Your most humble and obedient Nephew and Servant, H. Van Etten”, [Leurechon], *Mathematicall recreations* (1633), F. A4., meaning that van Etten was the nephew of Lambert Verreycken. Cornelis de Waard, who edited the Mersenne correspondence, refers several times to the book and is responsible for a mistake which is often repeated. Taking van Etten as nephew of Leurechon: “L’auteur de cet ouvrage anonyme était le P. Leurechon; le neveu de celui-ci H. van Etten, en avait assuré la publication”, Cornelius de Waard, *Correspondance du Père Marin Mersenne, religieux minime. Publiée par Mme Paul Tannery, éditée et annotée par Cornelis De Waard, avec la collaboration de René Pintard* [then] *Armand Beaulieu*. 17 vols., (Beauchesne, [then] CNRS, 1932-1988). Vol. I, p. 236. Olivier Thill pointed me to this reference.

[5] [Leurechon] , *Mathematicall recreations* (1633), F. A4.

[6] Philippe Alegambe, Laevinus Torrentius and cardinalis Antonio Barberini, *Bibliotheca scriptorum Societatis Iesu / post excusum anno M.DC.VIII. catalogum R. P. Petri Ribadeneirae ... Nunc hoc nouo apparatu librorum ad annum ... M.DC.XLII. editorum concinnata ... Accedit catalogus religiosorum Societatis Iesu, qui ... interempti sunt*, (Antwerp : Ioannem Meursium, 1643). I found this in Trevor Hall, *Old Conjuring Books. A bibliographical and historical study with a supplementary check-list*. (London: Duckworth, 1972). Hall has inspected Alegambe’s 1643 edition but apparently not the much expanded entry on Leurechon in the second edition written after Leurechon’ s death in 1670.

[7] Alegambe’s translation is suspect: the original title does not mention *cosmographie*, and starts with *arithmetique*, which was not translated. He could have found the reference in an intermediate source.

[8] Augustin Calmet, *Histoire de Lorraine qui comprend ce qui s'est passé de plus mémorable dans l'Archevêché de Tréves, & dans les Evêchés de Metz, Toul & Verdun, depuis l'entrée de Jules César dans les Gaules, jusqu'à la cession de la Lorraine, arrivée en 1737, inclusivement. Avec les piéces justificatives à la fin. Le tout enrichi de cartes géographiques, de plans de villes & d'églises*. 7 vols., (Nancy : A. Leseure, 1745-57), Tome IV *La Bibliothèque Lorraine*, p. 585.

description of the 1626 Pont-à-Mousson edition[9]. In the extensive bibliography of Jesuit authors by de Backer several editions are described but 1624 is not listed[10]. Later a copy must have been found because a complete description with the correct pagination (131 p.) and some quotations, appears in the supplement of 1872[11]. Deblaye was the first to dedicate a complete study to the *Récréations Mathématiques*[12]. In an overview of the editions, he "corrects" Calmet's French title of the 1624 edition and states this should be *Hilaria mathematica*. In a biography and a comprehensive description of works printed by father and son Appier, the otherwise well-informed Favier does not list the 1624 edition at all[13]. Trevor Hall[14] found the 1624 edition listed in a catalogue of the library of le Duc de la Vallière[15]. Now, three copies are known to exist. The catalogue of books on mathematics and physics of the seventeenth century at the University of Liège in Belgium lists no less than 13 French and 3 Dutch editions[16]. I have been able to inspect most of them, including the 1624 edition. Unfortunately the frontispiece of this copy has been teared out and replaced by a manual reconstruction. Although the pagination confirms the early descriptions, the missing front page could not remove all doubt about the existance of the 1624 edition. Fortunately, I have recently seen a complete copy in the Mediathèque of Bar-le-Duc, described by Ronsin[17]. This book is in poor condition, with dog-earing, dark stains and a faded cover page, but it clearly states M.DC.XXIV. on the frontispiece, which definitly settles the issue about its existence (see figure 1).

[9] M. Beaupré, *Recherches Historiques et Bibliographiques sur les Commencements de L'Impimerie en Lorraine, et sur ses Progrès Jusqu'à la fin du XIIe Siècle* (Saint-Nicolas-de-Port : P. Trenel, 1845), pp. 578-579.

[10] Augustin de Backer, *Bibliothèque des écrivains de la Compagnie de Jésus ou Notice bibliographiques*. Par Augustin de Backer; avec la collaboration d'Alois de Backer et de Charles Sommervogel. 3 vols. + supplement (Liège: De Backer, 1869), pp. 371-2.

[11] de Backer, *Bibliothèque des écrivains de la Compagnie de Jésus*, column 2302-3. This is overlooked in a study on the authorship by Jacques Voignier, "Who was the author of *Recreation Mathematique* (1624)?" *The Perennial Mystics*, 1991, 9, pp 5-48. Voignier gives the subsequent edition of *Bibliothèque des écrivains de la Compagnie de Jésus* by Carlos Sommervogel (Brussels and Paris, 1893) as the first complete reference.

[12] A. Deblaye "Étude sur la récréation mathématique du P. Jean Leurechon, Jésuite". *Mémoire de la Société philotechnique de Pont-à-Mousson*, 1874, 171-183.

[13] Justin France Favier, "Jean Appier et J. Appier dit Hanzelet. Graveurs Lorrains du XVIIe siecle". *Mémoires de la Société d'archéologie lorraine et du Musée historique lorrain*. 1890, Troisième série, XVIIIe volume, pp. 321-363.

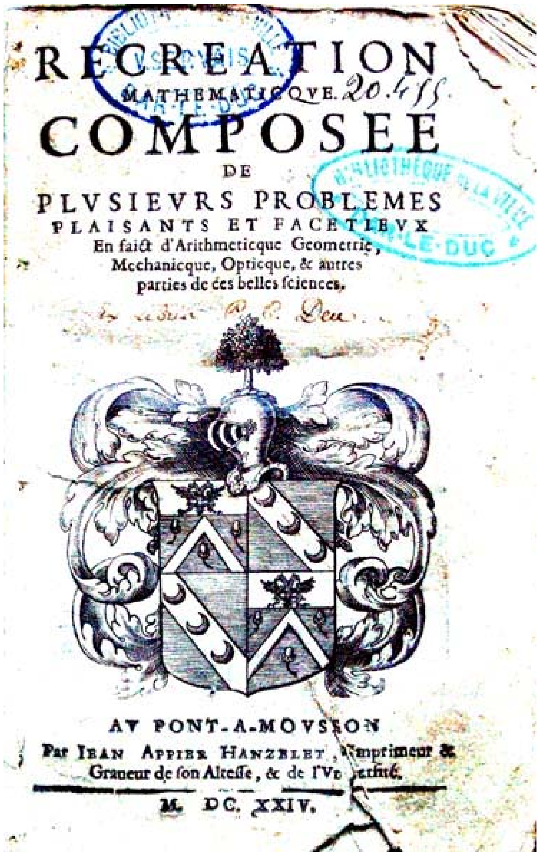
[14] Hall, *Old Conjuring Books*, p. 112.

[15] Guillaume Debure, *Catalogue des livres de la bibliotheque de feu M. le duc de La Valliere. Premiere partie, contenant les manuscrits, les premieres éditions, les livres imprimés sur vélin & sur grand papier, ...* 3 vols. (Paris: Chez Guillaume de Bure fils aîné, 1783).

[16] Elisabeth Sauvenier-Goffin (1961) *Les sciences mathématiques et physiques a travers le fonds ancien de la Bibliothèque de L'Université de Liège*. Dieuxième Partie ; Les XVIIe et XVIIIe siècles. Bibliotheca Universitas Leodiensis, No 13, (Liège: George Michiels, 1961). Librarian Carmelia Opsomer of Liège University pointed me to this catalogue and was most helpful to locate the several editions.

[17] Albert Ronsin (1984) *Répertoire bibliographique des livres imprimés en France au XVIIe siècle, Tome X, Lorraine-Trois Evêchés, Bar-le-Duc, Champ-le-Duc, Clairlieu-lèz-Nancy, Epinal, Metz, Mirecourt, Nancy, Plombières, Pont-à-Mousson, Saint-Dié, Saint-Mihiel, Saint-Nicolas-de-Port, Toul, Verdun, Vic-sur-Seille, Ville-sur-Illon.* Bibliotheca bibliographica Aureliana (Baden-Baden: Valentin Koerner, 1984) nr. 169, p. 183.

The first edition was followed in 1626 by a second one, again printed by Hanzelet, in which three pages were added with two questions related to problem 91[18].



An identical edition was printed again in 1629 by Gaspard Bernard. Also in 1626, but now in Paris, the book was published twice, once by Rolet Boutonné, with exactly the same paging as the Pont-à-Mousson edition, and the other by Jean Moreau and Guillaume Loyson, including 13 extra pages of notes by D.A.L.G. (i.e. Claude Mydorge[19]).
Further notes were added in 1627 by D. H. P. E. M. (i.e. Denis Henrion[20]) in a Boutonné publication, followed by an edition of Anthoine Robinot. In 1628, two major parts are added to a publication by Charles Osmont at Rouen and all references to van Etten and Verreycken are removed. The second part, with separate numbering adds 45 problems, similar in nature to the first part, but adding nothing on arithmetic. From the separate address to the reader it is suggested that the

***Figure 1**: Frontispiece of the rare first edition of 1624 (Bibliothèque Municipal, Bar-le-Duc)*.

[18] For a complete description of all editions see Voignier "Who was the author" and David Singmaster, *The bibliography of some recreational mathematics books.* 4th edition. School of Computing, Information Systems and Mathematics, (London: South Bank University, 2002), unpublished. David Singmaster kindly sent me an electronic copy.
[19] It has been conjectured by Henri Brocard in *Analyse d'autographes et autres écrits de Girard Desargues (1593-1662)*, (Bar-le-Duc: de Facdouel, 1913), that D.A.L.G. stands for Des Argues, Lyonnais, Géometre (Girard Desargues 1591-1661). This theory is cited in Adam and Tannery, *Oeuvres de Descartes*, 12 vols. and supllement, (Paris: Vrin, 1964-1974), XI, p. 718. However, G. Eneström in "Girard Desargues und D.A.L.G. " *Biblioteca Mathematica* (3) 14 (1914), pp. 253-258, convincingly refutes this thesis by showing that Mydorge used the D.A.L.G. acronym before in a book: Claude Mydorge, [L']*usage de l'un et l'autre astrolabe particulier et universel. Expliqué tant en la declaration de leurs parties, qu'exposition fidelle & facile de leur practique en astronomie & geometrie. Le tout accomodé aux petits traictez de la sphere, de l'astrolabe, & du quarré geometrique de Dominique Jacquinot... par mesme moyen corrigez, augmentez, & remis en meilleur ordre. D.A.L.G.* (Paris, Jean Moreau, 1625). Although we do not know the meaning of the acronym, I do not see any reason to doubt the authorship of Mydorge. From 1630 onwards several editions appear with Mydorge's name on the title page together with a preface referring to his previous notes, signed D.A.L.G.
[20] Earlier, Henrion published a book using the D.H.P.E.M. acronym on the frontpage and signed the dedication with his own name: D[enis or Didier] Henrion, *Deux cens questions ingénieuses et récréatives extraictes et tirées des oeuvres mathématiques de Valentin Menher,... avec quelques annotations de Michel Coignet... le tout corrigé, recueilly et mis en cet ordre, par D. H. P. E. M.* (Paris. 1620). The acronym may stand for Denis Henrion Professeur En Mathématiques. Henrion, using the acronym D.H.P.E.M. referred to his own works as Henrion, which was uncommon at that time.

second part is from a different author[21]. However, no name of an author is mentioned in the introduction, nor in the six pages of notes at the end. Hall attributes the second part to Henrion and Mydorge but gives no arguments for this theory[22]. Father Mersenne is mentioned in problem 42 on melting metals, which could lead to the direction of Mydorge, but I believe the conclusion is unwarranted. The preface by the publisher Boutonné in the 1630 edition reveals that Mydorge's earlier notes on the first part were used by Jean Moreau without his consent: "Et comme ce n'avoit point esté son intention que telles notes fussent publiees, aussi n'ont elles pas passé sous son nom"[23]. If Mydorge would have been the author of the second part, he had more to complain about. The third part is on fireworks and of different nature than the first two. It consists of 48 numbered pages.

From 1629 to 1680, 25 more French editions followed, based on these three parts, some of them bearing the name of Claude Mydorge. In 1694 a new edition, edited by Jacques Ozanam[24] appears and later a new one by Jean-Étienne Montucla running over 20 editions to 1790 and expanding into four volumes. From 1769 Guyot took over, turning the book in a four-volume encyclopedic work called *Nouvelles récréations physiques et mathématiques*.

The original work has been translated into English, Latin and Dutch. In 1631, Nicolas Hunt published *Newe Recreations* using 30 problems from Leurechon, but this cannot be considered a translation[25]. A first faithful translation appeared as *Mathematical Recreations* in 1633, and was reissued in 1653 and 1674[26]. We can determine exactly on which edition the translation was based. It contains the three parts, so it must have been based on an edition between 1628 and 1633, excluding the 1629 Pont-à-Mousson edition, which reproduces only the first part. This leaves the 1629 and 1630 editions at Rouen and the 1630 Mydorge edition at Paris. As the English editions contain most of the *examinations* added by Mydorge, signed as D.A.L.G. in the French, there can be no doubt that it was based on the 1630 edition. However, the translator leaves out any reference to Mydorge or D.A.L.G., includes the dedication by H. van Etten to his uncle, and replaces

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[21] [Leurechon], *Récréations Mathématiques*, 1628, part 2, Ai^{v}: "Je ne me suis point, non plus que l'autheur de la premiere partie, arresté aux demonstrations,..". This can also be an attempt to deliberately mislead the reader. On a proposition concerning fountains (p. 50) the author writes "Ceste proposition (que l'autheur a voulu traicter en son 88 probleme de la premier partie) … ". This formulation is odd if there had been two different authors.

[22] Hall, *Old Conjuring Books*, p. 88.

[23] Leurechon, *Récréations Mathématiques*, 1628, part 2, F. Ai^{r}.

[24] Jacques Ozanam, *Recreations Mathématiques et Physiques, qui contiennent Plusieurs Problêmes d'Arithmétique, de Géometrie, d'Optique, de Gnomonique, de Cosmographie, de Mécanique, de Pyrotechnie, & de Physique. Avec un Traité nouveau des Horloges Elémentaires, ...* 2 vols., (Paris: Jean Jombert, 1694). For a complete bibliography of the editions by Jacques Ozanam and the English translations, see David Singmaster, *The bibliography*, pp. 25-34.

[25] *Newe recreations* is frequently used, but is actually the title on the second page. The correct reference is Nicolas Hunt, *Iudiciary exercises, or Practicall conclusions Whereby any one of meane capacitie, may readily and infallibly finde out the Christian names of men and women, their titles of honour, ages, offices, trades or callings of life, places of birth, houses of residence appertaining to scholars, either in the vniversities of Oxford or Cambridge, or the Innes of Court and Chauncerie. With many other things both pleasant and profitable. By Nicolas Hunt Master of Arts*. (London : Printed by Aug. Math[hewes] for Luke Faune and are to be sold at the great noth [sic] doore of Saint Pauls, 1631).

[26] [Leurechon], *Mathematical Recreations*. The Wing STC lists the 1653 edition under William Oughtred (London: William Leake) and the 1674 edition under Leurechon (London: Wiliam Leake and John Leake).

the foreword by his own. The van Etten dedication is not included in the Mydorge edition, so the translator has also used a previous edition from Pont-à-Mousson or Lyon, in an attempt to rehabilitate van Etten as the original author. There is no indication in the book who was responsible for the translation. The British Library catalogue lists the books with "now delivered in the English tongue with the Examinations, Corrections and Augmentations [by William Oughtred]". The 1653 and 1674 editions have a 16-page part on "The description and use of the double Horizontall Dyall, Invented and written by William Oughtred", with a separate title page added at the end. The addition of this part is repeated on the front page which gives the false impression that William Oughtred was responsible for the translation. However, this is very unlikely as Hall has persuasively shown[27]. The English Short Title Catalogue adds Francis Malthus as a possible translator. Malthus indeed is the most plausible candidate for the translation. My belief is based on some details in the third part on fireworks. In 1629 Malthus published a work on fireworks, with some basic arithmetic, geometry and a part on fortifications, in the same year in French in Paris and English in London[28]. Malthus relied heavily on the same source as the author of *Récréations Mathématiques*[29]. The strongest support for Malthus as the translator is the fact that he added some copper plate illustrations from his own book which are not in the French source[30].

The Dutch editions have been translated by Wynant van Westen, organ player and mathematician from the city of Nijmegen. A bibliographic search located seven editions published between 1636 and 1673 in Arnhem and later Amsterdam[31]. The first Dutch

[27] Hall, *Old Conjuring Books*, p. 92-98.

[28] Francis Malthus, *A treatise of artificial fire-vvorks both for vvarres and recreation with divers pleasant geometricall obseruations, fortifications, and arithmeticall examples. In fauour of mathematicall students. Newly written in French, and Englished by the authour Tho*: [sic] *Malthus*, (London: Printed [by W. Jones] for Richard Havvkins, and are to be sold at his shop in Chancerie lane neere to Serieants Inne, 1629), and Francis Malthus, *Traité des fevx artificiels povr la gverre, et povr la recreation : avec plusieurs belles obseruations, abbregez de geometrie, fortifications & exemples d'arithmetique, en faueur des nouueaux étudians és mathématiques / par le sieur F.D.M.*, (Paris: Chez Pierre Bvillemot, au Palais, en la galerie des prisonniers, Paris, 1629). Reprinted in 1632, 1633, 1650 and 1661.

[29] Jean Appier Hanzelet and Francois Thybourel, *Recueil de plusieurs machines Militaires, et feux Artificiels pour la Guerre, et Recreation. Avec l'Alphabet de Tritemius, par laquelle chacun qui sçait escrire peut promptement composer congruement en latin. Aussi le moyen d'escrire la nuict a son amy absent. De la diligence de Iean Appier dit Hanzelet Calcographe et de Francois Thybourel. M*[e] *Chyrurg*[ie]*n*. (Au Pont-a-Mousson, Par Charles Marchant, Imprimeur de S.A., 1620). More about this in section 5. Malthus complains in the foreword that Robert Norton used seven plates from Thybourel's book without acknowledgments. I compared Robert Norton, *The gunner shevving the vvhole practise of artillerie: vvith all the appurtenances therevnto belonging. Together with the making of extra-ordinary artificiall fireworkes, as well for pleasure and triumphes, as for warre and seruice. VVritten by Robert Norton, one of his Maiesties gunners and enginiers*. (London: Printed by A[ugustine] M[athewes] for Humphrey Robinson, and are to be sold at the three Pidgeons in Paules-Churchyard, 1628) with Hanzelet and Thybourel, 1620, but could not find any common illustrations. Norton's plates have both German and French text, Hanzelet's plates only French.

[30] E.g., [Leurechon], *Mathematicall Recreations*, 1633, p. 255, Figure F is taken from Malthus, *A treatise of artificial fire-vvorks*, 1629, p. 93.

[31] Previous bibliographies have been incomplete or wrong. The 1662-3 and 1671-2 editions have added to the confusion with different years of publication on the front pages of the different parts. The 1636 is not listed in William L. Schaaf, and David Singmaster, *Books on Recreational Mathematics. A Supplement to the Lists in William L. Schaaf's A Bibliography of Recreational Mathematics. Collected by William L. Schaaf; typed and annotated by David Singmaster*. (London: School of Computing, Information Systems

translation is a literal translation of an early edition containing the 91 problems from the first part without the additional questions from the 1626 Pont-à-Mousson edition or the van Etten dedication. Van Westen reproduces the woodcuts from the French edition including the original numbering, which does not correspond with his own. An in depth comparison of the illustrations suggest that the first Dutch translation is based on the 1627 Lyon edition. Subsequent editions from 1641 include also the second and third part. The Latin translation, known as *Thaumaturgus mathematicus*, is from Caspar Ens and was published in Munich in 1636 and 1651, to be followed by a Venice edition in 1706[32]. Problems from the second part are included but not the third part on fireworks. Singmaster identified additional problems from Alcuin's ninth-century *Propositiones ad Acuendos Juvenes*[33].
Finally there is a German book called *Deliciae Physico-Mathematica*, from 1636 by Daniel Schwenter[34] which is sometimes described as a translation of *Récréations Mathématiques*[35]. Singmaster completely rejects this attribution as "quite wrong"[36]. Indeed Schwenter's book cannot be considered a sheer translation, but closer comparison reveals a systematic treatment of the problems from *Récréations Mathématiques*. Almost 100 problems can be matched between the two works. Schwenter refers to the author as "der Frankösischen Authoris" or "Parisischen Professoris" and never uses the name van Etten or Leurechon. The book he calls the "Frankösisches Büchlein" or "Tractalein". A problem of *Récréations Mathématiques* is usually referred to as "aus dem Frankosen". The original sources of *Deliciae Physico-Mathematica* were not unnoticed by Harsdörffer who cites Mydorge, the Latin edition by Caspar Ens (1636), the Dutch edition by Wynant van Westen (1641) and even the *Pyrotechnie* of Jean Appier Hanzelet (1630 edition)[37].

3. About the authorship

Almost all library catalogues list Jean Leurechon as the author of the first editions of *Récréations Mathématiques* while there is not a single indication in the book to support this. As usual in such cases it is very hard to trace the original source for the attribution. Dom Calmet[38] and the *Bibliographie Universelle*[39], give no explanation and take it for

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and Mathematics, South Bank University, 1992) and Singmaster, *The bibliography*. Singmaster mistakenly lists Arnhem 1641 as the first edition, and gives two entries for the same book of weduw' Loots-Man, Amsterdam 1673, while there is only one.

[32] Caspar (or Gaspard) Ens, *Thaumaturgus Mathematicus, Id est, Admirabilium Effectorum e Mathematicarum Disciplinarum Fontibus Profluentium Sylloge.* (Cologne: Constantinus Münich, 1636).

[33] Singmaster, *The bibliography*, p. 22.

[34] Daniel Schwenter, *Deliciae Physico-Mathematicae oder Mathemat- und Philosophische Erquickstunden*, (Nürnberg, in Verlegung Jeremiae Dümlers, 1636). This work was expanded to two and later three volumes by Georg Philip Harsdörffer (ed.), (Nürnberg: Jeremiae Dümler, 1651-1653), and reprinted in 1677 and 1692.

[35] According to Wilhelm Ahrens in *Mathematische Unterhaltungen und Spiele*, 2 vols. (Leipzig, Teubner, 1901), Gaspar Schott in 1657 was responsible for this claim, as cited in Singmaster, *The bibliography*, p. 33.

[36] Singmaster, *The bibliography*, p. 33.

[37] E.g. Mydorge's 1638 edition in Harsdörffer, *Deliciae Physico-Mathematicae*, 1653, p. 410.

[38] Calmet, *La Bibliothèque Lorraine*.

[39] Louis Gabriel Michaud *Biographie universelle ancienne et moderne: histoire par ordre alphabétique de la vie publique et privée de tous les hommes...*, 85 vols. Tome vingt-quatrième, [Leibniz-Llywelyn] / publ. sous la dir. de M. Michaud ; ouvrage réd. par une société de gens de lettres et de savants, (Paris: Delagrave, c. 1858).

granted. De Backer writes: “It is recognised since long that, despite the dedication signed by Van Etten at the beginning of the book, it is father Leurechon with a modesty equalling his merits, permitted one of his students to take the honor”[40], but gives no source for this noble gesture. However, de Backer, as well as Deblaye and Hoefer, copied the sentence literally from Beaupré[41]. Thanks to the research of Trevor Hall we now know that it was the fellow jesuit father Philippe Alegambe who first stated that Leurechon was the author of *Récréations Mathématiques*. Alegambe took responsibility for a new edition of the *Bibliotheca Scriptorum Societatus Jesu*, originally started by Pedro de Ribadeneira in 1602[42]. Published in 1643[43], the new catalogue gives a short biography of Jean Leurechon and lists seven titles including the *Récréations Mathématiques* of 1624. He provides no further explanation and does not mention van Etten. A later edition, published after Leurechon’s death adds biographical material but repeats the seven titles and gives no further information about the claim[44]. This is the only evidence we have about the claimed authorship of Leurechon. None of the bio/bibliographies published since then sheds any new light or adds any evidence for the supposed authorship. A recent study by Antonella Romano on Jesuit mathematics divulges several new facts on Leurechon and provides a year-by-year listing of his professional activities in Pont-à-Mousson, Reims and Mons[45]. However, the authorship of *Récréations Mathématiques* remains unquestioned. Only Hall concludes “that Leurechon had little or nothing to do with the original compilation of *Récréation mathématique*, and that the first edition was in fact the work of van Etten, as the dedication would lead us to

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[40] De Backer, *Bibliothèque des écrivains*, p. 731, the translation is mine.

[41] This certainly was a favorite quotation, compare:
Deblaye, “Étude sur la récréation mathématique”: “Est-ce le nom d’un des élèves de l’auteur de le Père, par une modestie qui le rehausse autant que son mérite, a-t-il permis que celui-ci s’en appropriât l’honneur.”, p. 176.
Ferdinand Hoefer, (1862) *Nouvelle biographie générale: depuis les temps les plus reculés jusqu'à 1850-60* ... XXXI-XXXII, Leu-Maldeghem / (Paris, Firmin Didot frères, 1862) p. 10: “Ce livre ... est du jésuite Leurechon, qui, par une modestie égale à son mérite, permit qu’un de ses élèves s’en appropriat l’honneur.” (cited in Hall, *Old Conjuring Books*, p. 101).
Beaupré, *Récherches Historiques*: “Il est reconnu depuis long-temps que ce livre, quoique précédé d’une épître dédicatoire signée Van Etten, est du jésuite Leurechon, qui, par une modestie égale à son mérite, a permis qu’un des ses élèves s’en appropriât l’honeur”, p. 379.

[42] Pedro de Ribadeneyra, (Father S.J.) *Illustrium scriptorum religionis Societatis Jesu catalogus*. Auctore P. Petro Ribadeneira, (Antwerp: apud J. Moretum, 1608), cited in Hall, *Old Conjuring Books*, p. 107.

[43] Alegambe, *Bibliotheca scriptorum Societatis Iesu*, 1643.

[44] Philippe Alegambe, *Bibliotheca scriptorum Societatis Iesu*. Opus inchoatum a R. P. Petro Ribadeneira Eiusdem Societatis Theologo, anno salutis 1602. Continuatum a R. P. Philippo Alegambe ... usque ad annum 1642. Recognitum, & productum ad annum iubilaei M.DC.LXXV. A Nathanaele Sotuello... (Rome: ex typographia Iacobi Antonij de Lazzaris Varesij, 1676). XXXVI, pp 487-8.

[45] Antonella Romano, *La Contre-Réforme mathématique : constitution et diffusion d'une culture mathématique Jésuite à la Renaissance (1540-1640)*. (Rome: Ecole française de Rome, 1999), pp. 489-90. A recent study on Jesuits in Belgium list some sources which fills some of the gaps in Romano’s chronological tables. From 1649 till 1655 Leurechon was part of the *Missio Castrensis* in Brussels, which indicates he was then an army chaplain. This is described in the *Catalogus primus ac secundus personorem* at the Belgian state archives (Rijksarchief). He is further listed in the *Admissi in Societatem ante Divisionem Provinciae Beligiciae*, a manuscript stored at the Collegium Maximum in Louvain, and the *Album novitiorum* vol. II, 69, at the Royal Library in Brussels. Leurechon’s presence in Brussels at that time is further confirmed by Geert Vanpaemel who studied the correspondance of royal cosmographer Michel van Langren (personal communication).

believe"[46]. To substantiate this claim he had to establish that van Etten was not just a pseudonym, as often stated, but a person that really existed and was related to Lambert Verreycken. Hall succeeded to some degree as he was able to trace a relationship between the van Etten and Verreycken families to a point of finding evidence of the marriage between Christophe van Etten and a daughter of Louis Verreycken[47]. More details can now be added. As shown in figure 2 and 3, the arms used on the title page of the first editions are indeed from Verreycken. Lambert was the latest child of Louis Verrycken in a family of ten. He must have been born after 1609 and is known to have died in 1629 as a captain in the siege of s'Hertogenbosch (in French: Bois-le-Duc)[48]. His oldest sister Marie (born Dec. 1586) married Christophe van Etten. H. van Etten must have been their child and was several years senior than Lambert. I did not find any evidence to corroborate the name Hendrik or Henri, as a son of Christophe.

***Figure 2** The arms printed on the title page of the first two Pont-à-Mousson editions. Courtesy of the Liège University Library*.

***Figure 3** The arms of Louis-François Verreycken, the oldest brother of Lambert Verreycken*[49].

In 1991 Jacques Voignier published the results of his study on the book in an obscure periodical called *The Perennial Mystics*. He challenges the claim of Hall that van Etten is the real author and bases his argument on the Jesuit

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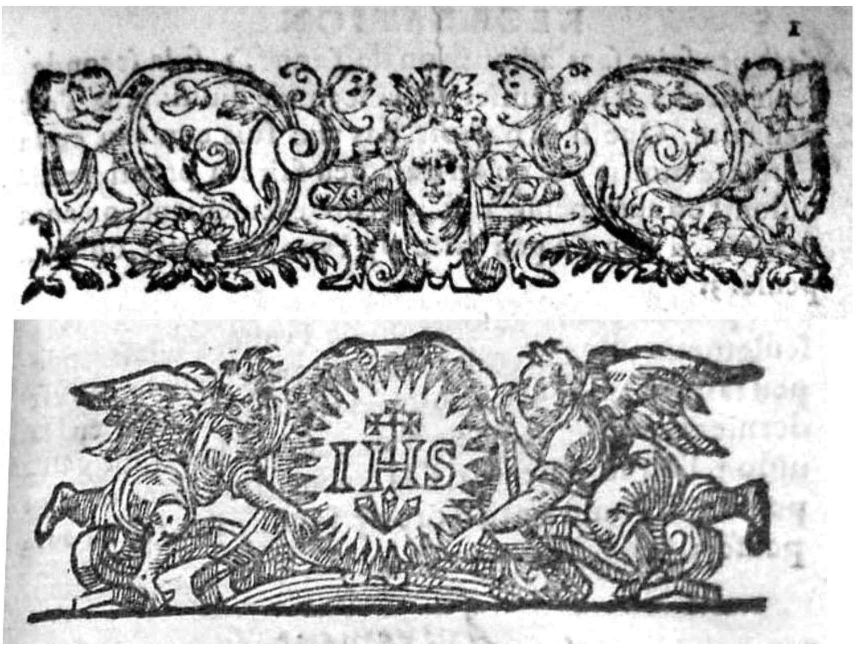
[46] Hall, *Old Conjuring Books*, p. 118.

[47] Eugène De Seyn, *Dictionnaire historique et géographique des communes belges: histoire, géographie, archéologie, topographie, hypsométrie, administration, industrie, commerce etc*. 2 vols. (Bruxelles: A. Bieleveld, 1924-5), Vol. I, p. 154, cited in Hall, *Old Conjuring Books*, 104.

[48] Jacques Salomon François Joseph Léon de Herckenrode, *Nobiliaire des Pays-Bas et du Comté de Bourgogne / R. De Vegiano, seigneur d'Hovel; et neuf de ses suppléments, rédigés et classés en un seul ouvrage, par familles et d'après un système alphabétique et méthodique*. 2 vols. (Gent: Gyselynck, 1862, 1865), Vol II, p. 1988. Guillaume Le Blond, *The military engineer: or, a treatise on the attack and defence of all kinds of fortified places* (London : printed for J. Nourse, 1759), writes: „Verreycken, a captain in the Spanish service, fell by a cannon-ball" p. 129.

[49] From Baron Ryckman de Betz, *Armorial général de la noblesse belge, orné des armoiries figurées dans les lettres patentes originales / précédé d'un historique et d'une préface du vicomte Charles Terlinden,* (Liège: Dessain, 1942).

emblem on the first numbered page of the second edition. No printer would dare to use the jesuit emblem if not asked to do so by a jesuit. While Alegambe was writing his *Bibliotheca scriptorum* in 1643, Leurechon was still alive and, knowing that he taught mathematics at the University of Pont-à-Mousson, “there was no longer doubt about the authorship problem”[50]. This argument can be contested. Several anonymous books published around that time in Pont-à-Mousson carried the IHS-emblem. One needs to show that at least one of them is not from a Jesuit. But there is an easier way: the 1624 copy, which Voignier has not seen, does not include the emblem! Only the 1626 edition used the IHS-emblem as shown in figure 4. Alegambe lists precisely the 1624 edition which does not contain any reference to Jesuits and still atributes the work to Leurechon.



Emblem
1624 edition,
Fol. B1^{r}.

Emblem
1626 edition,
Fol. B1^{r}.

Figure 4a and b: *The emblems used in the 1624 and 1626 editions of* Recreation Mathematique (*Courtesy of the Liège University Library)*.

But there is more: a copper plate used for a sun dial, currently at the Lorraine Museum in Nancy, is signed by Hanzelet and uses the IHS emblem[51]. In addition to IHS also MA appears on the plates. An iconographical explanation for the signs is that Jesus symbolizes the sun, and Maria the day. IHS was a general monogram for Jesus (IHESUS), as MA is for Maria, and could therefore be used without intentional reference to the Jesuits[52]. Other copper plates by

[50] Voignier, “Who was the author”, p. 21.
[51] A comprehensive description of the sun dial is given in Léon Germain and Ch. Millot, “Tables d'horloges solaires gravées par Jean Appier Hanzelet”. *Mém. de la Soc. d'arch. lor*., Troisième série, XVIIIe volume, 1892, 321-363, pp. 374-412.
[52] Germain and Millot, “Tables d'horloges solaires”, pp. 387-90.

Hanzelet used the IHS emblem for this purpose[53]. The fact that Hanzelet used the IHS monogram on other occasions, refutes Voignier's arguments for the tacit authorship of Leurechon.

Jean Appier Hanzelet as the author of Récréations Mathématiques

As there are no arguments except for the authority of Alegambe to substantiate the authorship of Jean Leurechon, I will propose the most palpable alternative: Jean Appier dit Hanzelet. The printer/engraver was the son of Jean Appier, an engineer who worked on the fortifications of Nancy under Charles III[54]. The son "dit Hanzelet", to differentiate his name from his father's, was born on 15 Nov 1596 and died in 1647. His first engravings to be published in a book appeared in 1619. In 1620 he published a book together with Thybourel on military machines and fireworks[55]. He is described as "Maître d'Artillerie de S.A. Lorraine"[56] and master of fireworks for the city of Nancy. From 1623 to 1628 he is the official printer of the university of Pont-à-Mousson. His license is retracted and Hanzelet is fined 50 francs for printing a book by Hordal without his consent[57]. Hanzelet can be considered as the real author of *Récréations Mathématiques* for several reasons. In the foreword to the reader, the author gives "five or six words of advice worthwile before proceeding"[58]. The fifth word is as follows[59]:

> I have used copper plate engravings for the most needed illustrations to clarify some propositions. I have done so rather than using the more expedient woodcuts where they could have been put on their proper place; nonetheless, using numbering to overcome this minor inconvenience.

This is clearly the word of the master engraver Jean Appier Hanzelet and not of a Jesuit mathematician or his 20-year old student. Indeed subsequent editions, starting with 1627 Lyon edition had the woodcut illustrations inside the text. A notable exception is the

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[53] Justin France Favier, "Harangues des Etudiants de Pont-à-Mousson au duc de Lorraine Henri II, 1614", *Mémoires de la Société d'archéologie lorraine*, Troisième série, XVIIIe volume, 1892, 321-363, describes a copper plate by Hanzelet using the monogram, p. 250.
[54] This biographical data is from the only biography on Jean Appier I am aware of: Favier, "Jean Appier".
[55] Hanzelet and Thybourel, *Recueil de plusieurs machines*. Given his credentials there is little doubt that the first five parts on artillery and fireworks are by Hanzelet. The surgeon Thybourel could have contributed with the sixth and seventh book on secret writing. The separate title pages list Thybourel first, but the frontispiece of the book puts Hanzelet first. In the 1630 the book is issued again without Thybourel's name: *La Pyrotechnie de Hanzelet, lorrain, où sont representez les plus rares et plus appreuvez secrets des machines et des feux artificiels propres pour assiéger, battre, surprendre et deffendre toutes places. Préface du général...A.* [André] *Beaufre*, (Pont-à-Mousson: I. et G. Bernard, 1630).
[56] Dom Calmet, *La Bibliothèque Lorraine*, p. 474.
[57] Jean Hordal, *Mella apum romanarum. Authore Joanne hordal I. U. doctore... Almae Universitatis Pontimussanae ordinario professore...* (Pontimussi: apud J. Appier Hanzel, 1628).
[58] In the Pont-à-Mousson editions, the Rouen editions and the Mydorge editions (except point VI). This foreword is not translated into Latin, or Dutch, but does appear in the English edition with the exception of the quoted citation. The reason that this important quote has been overlooked by many, might be because it only appears in these early editions.
[59] [Leurechon], *Récréations Mathématiques*, 1624: "I'ay faict graver en taille douce les figures plus necessaires pour l'eclarcissement de quelques propositions, et iaçoit qu'il eut esté plus expedient de les imprimer en taille de bois, pour les mettre chacune n son propre lieu: neantmoins le renvoys des nombres, suppleera à cette incommodité qui n'est pas grande." F. [VI], my translation.

1626 Paris edition which has the copper plate illustrations from Hanzelet pasted inside the text. Apparently this process was not feasible in Hanzelet's workshop. This rather technical defense for the use of copper plates instead of wood cuts is likely to be one from the printer engraver himself.

In the same foreword the author reveals his sources for the arithmetical problems: "Gemma Frisius, Forcadel, Ville-franche [de la Roche] et Gaspard Bachet"[60]. Favier cites sources describing Hanzelet as "mathématicien et graveur"[61], which makes it likely that he was acquainted with these popular works of the sixteenth and early seventeenth century and that he himself, possibly with the aid of a young student at Pont-à-Mousson compiled the propositions.

Finally, there is the expanded edition of 1628, adding two parts to an already succesful work. Several 'problems' from the second part and the complete third part have previously been published by Hanzelet in his *Recueil de plusieurs machines* of 1620. In the third book he describes several contrivances to lift a heavy canon by one or two persons[62]. In *Récréations Mathématiques*, Hanzelet expands on this and gives also an illustrating of the lever[63]. While the inclusion of a treaty on fireworks in a book on recreational mathematics might seem a little odd to some, the fact that Hanzelet is the author makes it fit together. The third part is a literal reproduction of the fifth book of *Receuil de plusiers machines militaires* of 1620, with a chapter added at the beginning (*La maniere de faire poudre à Canon*) and one at the end (*Admirable invention de faire une fuzee qui s'allumera dedans l'eau*). The 15 chapters in between have the same title and mostly the same text as the *Receuil*. All the copper plate illustrations from 1620 are included as wood cuts, with the addition of a new one in the last chapter. Why would Hanzelet allow his book and precious illustrations from 1620 to be used if he was not involved? If he still would have held his printing license in 1628 he very likely would have printed the book himself, but now he had to make an agreement with Charles Osmont to get the book on the market. Expanding an already succesful work with a section, using previous work available, makes perfect sense.

4. Sources of the mathematical problems: Bachet and his predecessors

One third, or more precisely 31 problems in *Récréations Mathématiques* are on arithmetical and combinatorial recreations. With a few exceptions, the direct source of all these problem can be attributed with poise to *Problemes plaisants* by Claude Bachet[64].

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[60] [Leurechon], *Récréations Mathématiques*, 1624 and 1626, F. Aiii^{v}; Rouen, 1628 F. Aii^{v}. Several commentators claim that the author does not acknowledge his sources. Those have clearly not seen the early editions. The English translator leaves out this passage and replaces the genuine sources by a preposterous long list of Greek philosophers, medieval and renaissance authors to end with (ironically so) Tyberill [Thybourel].

[61] Favier, "Jean Appier", p. 323.

[62] Also described in Norton, *The Gunner*, pp. 118-9, and in Buonaiuto Lorini, *Le fortificationi*, (Venice: Presso Francesco Rampazetto, 1609), p. 211, with similar illustrations.

[63] [Leurechon], *Récréations Mathématiques*, 1628, Part II, p. 38.

[64] Claude Gaspar Bachet, *Problemes plaisans et delectables, qui se font par les nombres partie recueillis de divers autheurs, & inventez de nouveau, avec leur demonstration* (Lyon : Pierre Rigaud, 1612), followed by a revised and expanded edition in 1624 and editions in 1874, 1879 and 1884, with extensive notes by A. Labosne. The fifth edition of 1884 was reprinted in 1905 and 1959.

Not only is Bachet cited in the foreword, Denis Henrion also refers to Bachet in his *Nottes*[65]. More significantly, there is textual evidence. Although most of the values of the examples have been changed, several problems are almost literal literally taken from Bachet's original text:

Bachet, 1612, p. 33 (problem IV)	**[Leurechon], 1624, p. 21 (problem 24)**
Fay multiplier le nombre pensé par quel nombre que tu voudras, puis diviser le produit par quel autre que tu voudras, puis multiplier le quotient par quelque autre, et derechef multiplier, ou diviser par un autre, et ainsi tant que tu voudras.	Dictes luy qu'il multiplie le nombre pensé, par tel nombre qu'il vous plaira, puis faictes luy diviser le produit, par quel qu'autre no[m]bre que vous voudrez. Puis multiplier le quotient par quelque autre, et derechef multiplier, ou diviser par un autre, et ainsi tant qu'il vous plaira.

Ozanam was the first to point to this dependence and writes in his preface that his and other works on recreational mathematics all stem from Bachet's *Problèmes*.[66] It is likely that Ozanam contributed to the misunderstanding that recreational mathematics originated with Bachet in the beginning of the seventeenth century. Also Bachet misled his readers about the originality of his problems as he rarely mentions any of his sources[67]. Despite the new term 'recreational mathematics', it was not a seventeenth-century phenomenon. Both Bachet and Leurechon relied heavily on the traditions of mercantile arithmetic and practical geometry which spread from Italy to France from the fifteenth century. By the end of the nineteenth century several authors have shed light on the origins of the problems contained in these seventeenth-century works. Rouse Ball introduces his arithmetical recreations with problems of Bachet but points out that "several of Bachet's problems are taken from the writings of Alcuin, Pacioli di Burgo, Tartaglia and Cardan, and possibly some of them are of oriental origin, but I have made no attempt to add such references"[68]. Some years later Wilhelm Ahrens did make the attempt and was the first to give alternative sources for several problems of Bachet[69]. His *Mathematische Unterhaltungen und Spiele* could be considered as the first work on the history of recreational mathematics which took considerable care in mentioning the sources of previously published problems. The extensive studies on the history of mathematics by Cantor[70] and Günther[71] revealed a tradition of recreational problems in

[65] The so-called fourth part with a separate title page in the 1630 and 1639 editions: *Nottes svr les Recreations Mathematiqves: En la fin de diuers Problemes, seruant à l'intelligence des choses difficiles & obscures. Par D.H.P.E.M.* References to Bachet on p. 7, 9, 10, 13, 18, 20 and 22.
[66] Ozanam, *Recreations Mathématiques*, 1778, p. v : "Ce livre [Bachet, *Problemes plaisans*] est, après les problèmes de l'Anthologie grecque, le premier germe de toutes les R*écreations mathématiques* qui ont paru dans la suite, plus ou moins augmentées, & en différentes langues". The foreword was written by Montucla.
[67] There are some exceptions in Bachet, *Problemes plaisans*, 1612, [AU09]: "Cest question est proposee par Tartaglia en la premier partie, livre 16, q. 130 et encor il en propose une semblable en la q. 131 suivante.", p. 161. Also for [AU05] see p. 143-146. Both references to Tartaglia were deleted in the following editions.
[68] Walter William Rouse Ball, *Mathematical Recreations and Problems of Past and Present Time*s, (New York: MacMillan and Sons, 1892), p 1.
[69] Wilhelm Ahrens, *Mathematische Unterhaltungen und Spiele*, (Leipzig: Teubner, 1901).
[70] Mortiz Cantor, *Vorlesungen über Geschichte der Mathematik*, (Leipzig: Teubner, 1880-92; 2nd ed. 1894-1901; 3e ed. 1907; vol. 4 in 1908).

arithmetic books in the fifteenth and sixteenth centuries. Of monumental value for the history of many problems is JohannesTropfke, who gives both a chronology and a classification of recreational problems[72].

1624	Problem type	Bachet, 1612	[Leurechon], 1633 (problem, page)
1a	Divination		(E001, 1).
1b	Divination	P03	(E001, 2).
1c	Divination	P01	(E001, 3).
7	Josephus problem	Preface	(E007, 17).
8	Divination of a permutation	P22	(E008, 19).
9	Jugs and bottles	AP03	(E009, 22).
14	Crossing problem	AP04	not in the English edition
15	Crossing problem	AP04	not in the English edition
16	Divination	P18	(E014, 28).
21	Divination		(E019, 33)
24	Divination	P04	(E022, 39).
25	Divination		(E023, 40).
29	Divination	P7	(E028, 44).
30	Divination		(E029, 44).
31	Divination	P9	(E030, 46).
35	Divination	X12	(E034, 51).
36	Ring game		(E035, 52).
42	Divination	P8	(E040, 59).
43	Throwing dices	P14	(E041, 60).
51	Chinese remainder problem	P05	(E046, 69).
52	Chinese remainder problem	P06	(E047, 71).
53	Weights problem	AP05	(E048, 71).
57	Double others' money	AP08	(E052, 77).
62	Cards	P15	(E056, 83).
63	Divination of cards	P16	(E057, 84).
64	Divination of cards	P17	(E058, 86).
68	Divination of cards	P18adv	(E061, 89).
69	Selling at different amounts	P21	(E052, 90).
70	Perfect numbers		(E063, 92)
83	Arithmetical problems		(E076, 134)

[71] Siegmund Günther, *Geschichte der Mathematik*, (Leipzig: Walter de Gruyter, 1907).

[72] Tropfke went through four editions, each consisting of several volumes, published in different years and often misquoted. Johannes Tropfke, *Geschichte der Elementarmathematik in systematischer Darstellung*. Bd. 1 (1902): *Rechnen und Algebra*, Bd. 2 (1903): *Geometrie, Logarithmen, ebene Trigonometrie, Sphärik und sphärische Trigonometrie, Reihen, Zinsenzinsrechnung, Kombinatorik und Wahrscheinlichkeitsrechnung, Kettenbrüche, Stereometrie, analystische Geometrie, Kegelschnitte, Maxima und Minima*, (Leipzig: Veit & Comp., 1902-3). Johannes Tropfke, *Geschichte der Elementar-Mathematik*, Bd. I (1921): *Rechnen*, Bd II (1921): *Algemeine Arithmetik*, Bd. III (1922): *Proportionen, Gleichungen*, Bd. IV (1923): *Ebene Geometrie*, Bd. V (1923): *Ebene Trigonometrie, Sphärik und sphärische Trigonometrie*, Bd. VI (1924): *Analyse, analytische Geometrie*, Bd. VII (1924) *Stereometrie, Verzeichnisse*, (Leipzig: Walter de Gruyter, 1921-1924). Tropfke started with a third edition which was not completed before his death: Johannes Tropfke, *Geschichte der Elementar-Mathematik in systematischer Darstellung mit besonderer Berücksichtigung der Fachwörter*, Bd. I (1930): *Rechnen*, Bd. II (1933): *Algemeine Arithmetik*, Bd. III (1937): *Proportionen, Gleichungen*, Bd. IV (1940): *Ebene Geometrie*, (Leipzig: Walter de Gruyter, 1930-1940). Johannes Tropfke, *Geschichte der Elementar-Mathematik in systematischer Darstellung mit besonderer Berücksichtigung der Fachwörter*, Bd. I *Arithmetik und Algebra*, revised by Kurt Vogel, Karin Reisch and Helmuth Gericke, (Berlin: de Gruyter, 1980)

87	Geometric progressions		not in the English editions
89	Division of casks	AP09	(E086, 208)

***Table 1:** Cross reference of the arithmetical problems from Bachet with the English edition of* Recréations Mathématiques*.*

Being the author of the most important translation of the *Arithmetica* of Diophantus in the seventeenth century[73], Bachet's preoccupation with arithmetical problems should come as no surprise. But also Bachet relied heavily on previous writers. Although it is impossible to determine exactly from which authors and works Bachet found his inspiration for his *Problèmes plaisants*, an overview of possible sources is listed below. These sources provide evidence for a long-lasting tradition of recreational mathematics through the Renaissance and Middle Ages, back to Arab, Hindu and Babylonian sources.

The Columbia Algorismus [c.1350]

When selecting only one medieval source after Fibonacci's *Liber Abaci*, we should look at this vernacular manuscript as a prototype for the sort of problems common to *Récréations Mathématiques* and Bachet's work. The text is written in Italian and bears its name as part of the David Eugene Smith Mathematical Collection at Columbia University[74]. Although it is unlikely that Bachet had access to this manuscript or a related copy, the correspondance with many of the problems is significant. About half of the arithmetical and combinatorial problems of *Récréations Mathématiques* also appear in this manuscript. These are most of the number and permutation divinations, cistern problems, the two crossing problems, the ring game, the weights problems and the problems involving geometric progressions[75]. With the exception of the cistern problems and the geometric progressions, they also appear in Bachet. The *Columbia Algorismus* is only one of the 284 abacus manuscripts described in Warren van Egmond's catalogue[76]. Almost all of the other texts deal with recreational problems. Some include only a few problems as illustrations of arithmetical or algebraic rules, others exclusively list recreational problems. In any case they provide evidence of a continuous tradition of recreational mathematics throughout the Middle Ages.

[73] Claude Bachet, *Diophanti Alexandrini Arithmeticorum libri sex, et De numeris multangulis liber unus / nunc primùm graecè & latinè editi, atque absolutissimis commentariis illustrati auctore Claudio Gaspare Bacheto, Meziriaco Sebusiano, v.c.* (Lutetiae Parisiorum: Sumptibus Sebastiani Cramoisy, 1621).
[74] X511 Al. 3. For a paleographic description see Warren van Egmond, *Practical Mathematics in the Italian Renaissance. A Catalog of Italian Abbacus Manuscripts and Printed Books to 1600*, (Florence: Istituto e Museo di Storia della Scienza, Monografia no. 4, 1980), 253-4. An early study appeared in Elizabeth B. Cowley, "An Italian Mathematical Manuscript" in Christabel F. Fiske (ed.), *Vassar Medieval Studies*, (New Haven, 1923), pp. 379-405. A complete transcription was made by Kurt Vogel, *Ein italienisches Rechenbuch aus dem 14. Jahrhunded (Columbia X511 A13)*, (München: Veröffentlichungen des Forschungsinstituts des Deutschen Museums für die Geschichte der Naturwissenschaften und der Technik, 1977).
[75] For an overview of the problems see appendix B. Problems will be referred to by their number in the English editions, between square brackets.
[76] van Egmond, *Practical Mathematics*.

Nicolas Chuquet [1445-1488] and Estienne de la Roche

Very little is known about Chuquet, a citizen from Lyon, who deserved his fame with a single manuscript titled *Triparty en la science des nombres*, dated 1484[77]. Chuquet displays a profound knowledge of arithmetic and algebra which made this manuscript something of a rarity given the place and time in which it was conceived. Only recently it became recognized that Chuquet connects with the Italian abacus tradition through Provencial intermediaries. Chuquet himself gives little cues, but at some point criticizes a certain Bartholomy de Romans, an unknown Dominican monk. This monk authored an arithmetical treaty named *Compendy* which shares more than a few linear problems with Chuquet's text[78]. Several other Provencial authors active during that period are listed by van Egmond[79]. Franci and Toti Rigatelli have shown important structural parallels between Chuquet's approach to specific types of higher-degree equations and that of an anonymous vernacular manuscript of about 1485 in Modena[80]. The notebook of Francesco Bartoli, an Italian business man travelling between Italy and the south of France at the beginning of the fifteenth century, provides rare evidence of the transmission of recreational problems throughout Europe. In addition to arithmetic tools such as exchange and multiplication tables, the itinerary from Florence to Avignon and price lists, it contains a collection of thirty problems of the recreational sort[81]. We can assume that Bartoli was only one of the many links in the trade routes by which the tradition of recreational mathematics was passed from Italy to France and the Low Countries. Chuquet's manuscript remained largely unknown until it was published by Marre in 1880. Marre discovered that a printed work of 1520 by Estienne de la Roche, contained large fragments that were literally copied from the manuscript[82]. It appeared

[77] Transcription of the first part by Aristide Marre, "Le Triparty en la Science des Nombres par Maistre Nicolas Chuquet, Parisien d'apres le manuscrit Fond francaise n° 1346", *Bulletino di Bibliografia e di Soria della Scienze Matematiche e Fisiche*, Tomo XIII, 1880, 593-658, 693-814. The appendix which contains most of the recreational problems is partially transcribed by Aristide Marre, "Appendice au Triparty en la science des nombres de Nicolas Chuquet Parisien", *Bulletino di Bibliografia e di Soria della Scienze Matematiche e Fisiche*, Tomo XIV, 1881, 413-460. Large parts of the manuscript are translated into English by G. Flegg, C. Hay and B. Moss (eds.), *Nicolas Chuquet, Renaissance mathematician*, (Dordrecht: Reidel, 1985).

[78] Maryvonne Spiesser, "Problèmes linéaires dans le *Compendy de la practicque des nombres* de Barthélemy de Romans et Mathieu Préhoude (1471): Une approche nouvelle basée sur des sources proches du *Liber abbaci* de Léonard de Pise", *Historia Mathematica*, 27, (2000), 362-383.

[79] Warren van Egmond, "How algebra came to France" in Cynthia Hay (ed.), *Mathematics from Manuscript to Print 1300-1600*, (Oxford: Clarendon Press, 1988), pp. 127-144.

[80] Ms. Ital. 587, described in Rafaella Franci and LauraToti Rigatelli, "Towards a history of algebra from Leonardo of Pisa to Luca Pacioli", *Janus*, 72 (1985) n.1-3, pp.17-82. The resemblance is sufficient for the authors to call the manuscript "a probable ancestor of Nicolas Chuquet's Algebra", p. 48. However, Van Egmond in "How algebra came to France" writes: "The Modena manuscript was written at about the same time as the *Triparty*, but a comparison of the two works has revealed no signs of borrowing on either side" p. 138.

[81] A description of the notebook and a transcription of the problems is given by Jacques Sesiano, "Les problèmes mathématiques du Mémoriale de F. Bartoli", *Physis*, XXVI, 1, pp. 129-150.

[82] Marre, in the introduction to "Le Triparty", 1880. Estienne de la Roche, *Larismethique nouellement composee* …, (Lyon : Pour Constantin Fradin marchant & libraire, 1520). The second edition: *Larismetique & geometrie / de maistre Estienne de la Roche, dict Ville Franche, nouvellement imprimee & des faultes corrigee, a la quelle sont adioustees les Tables de divers comptes, avec leur canons calculees par Gilles Huguetan ...*, ([Lyon] : Gilles & Iaques Huguetan freres, 1538).

that de la Roche owned the manuscript after Chuquet's death and that most of the marginal gloss is by his hand. Indirectly, through the printed *Larismethique*, Chuquet's work became known in France. The correspondence of problems from Bachet and Chuquet is conspicuously high. About two thirds of the Bachet's problems that appear in *Récréations Mathématiques* can also be found in *Larismethique* or Chuquet's manuscript. It is likely that Bachet had access to de la Roche's book, but is almost impossible that he has seen the manuscript. The provenance of the manuscript was traced by Marre. After de la Roche it came into the hands of the Italian Leonardo de Villa, only to return to France, in the library of Jean-Baptiste Colbert, long after the publications of Bachet[83]. It thus remains difficult to explain how Bachet included five problems which can be found in Chuquet's manuscript but not in the *Larismethique*[84]. As these problems also appear in many sixteenth-century arithmetic books, Bachet seems to have used several written sources, or was acquainted with these problems through oral dissemination.

Luca Pacioli [1445-1517]

Pacioli is famous for his *Summa de arithmetica* published in Venice in 1494[85]. This book is one of the first printed books on mathematics. This encyclopedic work deals with many problems of arithmetic, geometry, trigonometry and algebra, which took Pacioli 20 years to collect. The work has clearly been written for practical purposes. Composed in Italian, it deals with practical problems of exchange, conversion of measures and double-entry bookkeeping. Pacioli's fame is not in proportion to his merits as a Renaissance geometer. The *Summa* is filled with large sections unscrupulously copied from manuscripts from earlier writers[86]. After working on the *Summa*, between 1496 and 1508, Pacioli compiled a text with the title *De Viribus Quantitatis*. This three-part manuscript of 618 pages is now preserved at the University Library of Bologna and has only recently been published. The first part, *Delle forze numerali cioe de Arithmetica*, contains 120 recreational problems[87].

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[83] See Marre, "Le Triparty", 1880 and Flegg, Hay and Moss, *Nicolas Chuquet*, p. 17.
[84] The Josephus problem [E007], the Chinese remainder problems [E051, E052], selling eggs at different amounts [E069] and doubling each others' money [E057].
[85] Luca Pacioli, *Summa de arithmetica geometria proportioni & proportionalita*, (Venice: Paganino de Paganini, 1494, reprinted in 1523).
[86] This has become clear during the past decades. Ettore Picutti has shown that "all the 'geometria' of the *Summa*, from the beginning on page 59v. (119 folios), is the transcription of the first 241 folios of the Codex Palatino 577", cited in Annalisa Simi and Laura Toti Rigatelli, "Some 14th and 15th Century Texts on Practical Geometry", in M. Folkerts and J.P. Hogendijk, *Vestigia mathematica*, 451-470, (Amsterdam: Rodopi, 1993), p. 463. Margaret Daly Davis, *Pierro della Francesca's Mathematical Treatises. The "Trattato d'abaco" and "Libellus de quinque corporis regularibus"*, (Ravenna: Longo Editore, 1977) has shown that 27 of the problems on regular bodies in Pacioli's *Summa* are reproduced from Piero's *Trattao d'abaco* almost word for word. Franci and Toti Rigatelli, "Towards a history of algebra", claim that a detailed study of the sources of the *Summa* would yield many suprises.
[87] A comprehensive study of Pacioli's De Viribus can be found in Amedeo Agostini, *Il De viribus quantitatis di Luca Pacioli*, (Bologna : N. Zanichelli, [1924]) and a recent transcript by Maria Garlaschi Peirani, "De viribus quantitatis, Luca Pacioli. Trascrizione di Maria Garlaschi Peirani dal Codice n. 250 della Biblioteca universitaria di Bologna. Prefazione e direzione di Augusto Marinoni", *Raccolta Vinciana*, volume XXVII, (1997). Dario Uri has pictures of the complete manuscript on-line and is in the process of doing the transcription. See http://www.uriland.it/matematica/

In his *History of mathematics*, Loria points to Pacioli as a likely source for Bachet's problems[88]. There are indeed 14 problems in Bachet's book, or about one third of the problems, that can be traced back to Pacioli. However, ten of these appear in *De Viribus*, which was not published in Bachet's time. Pacioli writes in *De Viribus* that the sort of problems he considers are alike the kind that were discussed in public schools during that time. It is possible that many of the problems in the first part of *De Viribus* were communicated within the oral tradition. Pacioli himself admits that he borrowed from Euclid, Boethius, Sacrobosco and Fibonacci. The major part of the problems that can be attributed to Pacioli are also treated in printed books that were accessible to Bachet: Cardan[89], Tartaglia[90] and Trenchant[91]. So the influence could have been indirect. One of the problems for which there seems to be no link between Pacioli and Bachet, a card divination problem [P18], could still be inspired by Pacioli's problem with coins[92]. Both problems have the character of parlour tricks and could have been part of the oral tradition. The importance of the oral tradition became clear to me when going through the card tricks of Bachet together with someone who had surprised me before with his skills in this discipline. Every problem of Bachet involving cards was immediately known to him and he started demonstrating the tricks without finishing reading Bachet's text. He could show me several variations and explain the arithmetic behind them. However, he was taught all this by friends and relatives and did not learn them from books. So, the tradition in which recreational problems and parlour tricks were communicated before the age of printing continues to be part of our culture. It was a remarkable experience to see some of Pacioli and Bachet's problems still practiced today.

Francesco di Leonardo Ghaligai [?-1536]

Ghaligai is a lesser know mathematician who earned a living by given arithmetic lessons in Florence[93]. His school's curriculum was directed towards boys aged eleven to fourteen and took two years to complete. The lessons were divided into seven parts or *muta*, covering subjects typically found in the arithmetic books of the early sixteenth century.

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88 Gino Loria, *Storia delle matematiche dall'alba della civiltà al secolo xix*, (Milan: U. Hoepli, 1950), pp. 439-44.

89 Girolamo Cardano, *Practica arithmetice, & mensurandi singularis in qua que preter alias continentur, versa pagina demonstrabit* ... (Milan: Imprimebat impensis Bernardini Calusci, 1539).

90 Niccolò Tartaglia, *General trattato di numeri et misure*, 6 vols. in 3, (Vinegia, 1556-30).

91 Jean Trenchant, *L'aritmetique / de Iean Trenchant, departie en trois liures. Ensemble vn petit discours des changes. Auec l'art de calculer aux getons.* (Lyon, Jean Pillehotte, 1578), reprinted in 1602, 1612, 1618, and 1631.

92 Pacioli, c 1500, problem 84 "A saper trovare una moneta fra 16 pensata o vero tocata con bel modo et facile". The most comprehensive historical overview of recreational problems is David Singmaster, *Sources in Recreational Mathematics, An Annotated Bibliography*. Eighth Preliminary Edition, (unpublished, electronic copy from the author, 2004). However Singmaster does not mention any sources for this type of problem between 1494 and 1631 in section 7.Q.

93 For biographical data on Ghaligai and the context of abacus schools, see Guillaume Libri, *Histoire des sciences mathématiques en Italie depuis la renaissance des lettres jusqu'à la fin du dix-septième siècle*, 4 vols., (Paris : J. Renouard et cle, 1838-41), vol. II, p. 25 and vol III, pp. 145-6; R. A. Goldthwaite, "Schools and Teachers of Commercial Arithmetic in Renaissance Florence", *Journal of European Economic History*, vol. 1, (1972-73), pp. 418-433; and Frank J. Swetz, *Capitalism and arithmetic : the new math of the 15th century, including the full text of the Treviso arithmetic of 1478, translated by David Eugene Smith*, (La Salle: Open Court, 1987), pp. 22-24.

After some or all *muta*, the boys would become apprentices with merchants and apply their arithmetical knowledge for commercial purposes. Some continued the study of arithmetic became *maestri d'abbaco* following the example of their master. Solving recreational problems by arithmetical and algebraic methods were an integral part of the curriculum. Ghaligai published his *Summa de arithmetica* in 1521 in Florence. This book, written in Italian, is now very rare. It was reprinted in 1548 and 1552 as *Pratica d'arithmetica.* The book is divided into 13 chapters, treating practical subjects such as money exchange, the rules of fellowship and barter, as well as algebra and the works of Fibonacci and Euclid. Chapters 9 and 13 contain several recreational problems. Eight problems from Bachet correspond with those by Ghaligai[94]. As there are alternative sources for each of these problems, it is unlikely that Ghaligai was a direct source for Bachet or Leurechon.

Girolamo Cardano [1501-1576]

We know more about Cardan's life than some of his contemporaries, mostly because he wrote an autobiography (Cardan 1643)[95]. He was a brilliant, critical, unconventional and controversial man. In his younger years he played chess, dice and card games for money, a practice that earned him good living thanks to his knowledge of probabilities. He studied and practiced medicine but did not succeed in obtaining a post lecturing medicine until 1552. From 1539 onwards he wrote many books on mathematics, the most famous being *Ars Magna* in 1545. However, it is his first book, the *Practica arithmetice et mensurandi singularis* of 1539, that is of most interest to us. Although the *Practica arithmetice* contains many recreational problems, only ten of Bachet's problems can be traced back to Cardan. Bachet was acquainted with the *Practica arithmetice,* as he cites the work in his translation of Diophantus[96]. The problems in common with the *Practica arithmetice* are classics such as the Josephus problem [P23], the river crossing problem [AU04], a legacy problem [AU07], three men doubling each others' money [AU08], and the problem with the three jugs [AU03]. All these problems are also known from Chuquet's *Triparty*. Most likely Bachet knew these problems even before having read Cardan, and it would be doubtful to claim that he consciously copied them from the *Practica arithmetice*.

Niccolo Fontana Tartaglia [1499-1557]

Niccolo Fontana is better known by his nickname Tartaglia, the stammerer, a condition he was left with after his head was being cut with a sword when the French captured Brescia. Tartaglia was a very capable mathematician with a special interest in arithmetic and algebra. He achieved fame by his method of solving cubic equations, which led to a bitter fight with Cardan who published the method in his *Ars Magna* and extended Tartaglia's procedure to the quartic. Tartaglia published the first Italian translation of Euclid's *Elements* and Latin editions of Archimedes. His *Nova Scientia* was an important

[94] Problems [P02, P03, P04, P24, AU01, AU03, AU07, AP02]

[95] Girolamo Cardano, *De propria vita liber,* written in 1575, but only published in the next century (Paris: I. Villey, 1643, and in Amsterdam: Joannes Ravesteinius, 1654) and in the *Opera omnia,* (Lyon: Sumptibus Ioannis Antonii Huguetan, & Marci Antonii Ravaud, 1663). Translated into English by Jean Stoner, *The book of my life (De vita propria liber) by Jerome Cardan*, (New York: E.P. Dutton & co, 1930).

[96] Bachet, *Diophanti Alexandrini Arithmeticorum*, p 10. He also cites Tartaglia here.

contribution to the mathematics of ballistics[97]. The three volumes of *General Trattato* contain many arithmetical problems that have inspired Bachet[98]. We can compare fourteen problems or one third of *Problemes plaisants* directly to Tartaglia. The fact that Bachet referred twice to Tartaglia in the first edition and that seven problems have exactly the same values makes it very likely that Bachet has read Tartaglia and copied problems from him[99]. Possibly, Bachet used the more accessible French translation of Guillaume Gosselin[100].

Gemma Frisius [1508-1555]

Regnier Gemma was born in Friesland which gave him his nickname Gemma Frisius. He lived most of his time in what is now Belgium. He studied at the University of Louvain where he later became a private teacher, teaching both medicine and mathematics. He published several books on cosmology and astronomy, but is best known for his work on arithmetic. His *Arithmeticae Practicae Methodis Facilis* of 1540 became the most reprinted Latin arithmetic book of the sixteenth century. Van Ortroy gives a complete overview of all editions of the works of Frisius[101]. With no less than 64 editions between 1540 and 1595, this was the most popular Latin book on arithmetic. As a Latin work, it was mostly used for teaching at the universities through Europe and was of less practical use for merchants and craftsmen. As Bachet mentioned Frisius in the first edition, it is possible that several problems can be attributed directly to the *Arithmeticae Practicae*[102]. Because of its popularity and the large number of editions, there can be little doubt that Bachet consulted the book. Frisius gives throughout the book examples and problems with recreational value[103]. Most are given as examples for rules and deal with division, sharing, cistern and mixing problems. We also find some classical recreational problems

[97] Niccolò Tartaglia, *Nova scientia inventa da Nicolo Tartalea*, (Venice: Stephano da Sabio, 1537).
[98] Niccolò Tartaglia, *La prima [-sesta] parte del General trattato di numeri, et misure*, (Venice: Curtio Troiano dei Nauò, 1556-[1560]).
[99] Problems with the same values are: [P03, P06, AU05, AU07, AU08, AU09, AU10]
[100] Guillaume Gosselin, *L'Arithmetique de Nicolas Tartaglia Brescian* (Paris: Gilles Beys, 1578). I consulted a copy of this translation in the British Library. Apparently, Gosselin did not translate the complete *General Trattato*. If all 14 problems that Bachet borrowed from Tartaglia are contained within Gosselin's translation, this would provide some support for the thesis. However, I have not been able to verify this. According to *EEBO*, Gosselin's translation in French was used by John Tapp (1613, 1621) for an English version: John Tapp, *The path-vvay to knovvledge containing the whole art of arithmeticke, both in whole numbers and fractions; with the extraction of roots; as also a briefe introduction or entrance into the art of cossicke numbers, with many pleasant questions wrought thereby. Digested into a plaine and easie methode by way of dialogue, for the better vnderstanding of the learners thereof. Wherewith is also adioyned a briefe order for the keeping of marchants bookes of accompts, by way of debitor and creditor*, (London : Printed by Th: Purfoot, for Tho: Pauier, 1613). Also published in 1621 without any changes. However, sampling about twenty problems from the 1621 edition, Tapp seems to use different values and ratio's for all problems compared.
[101] Fernand van Ortroy, *Bio-bibliographie de Gemma Frisius, fondateur de l'école belge de géographie de son fils Corneille et de ses neveux les Arsenius*, (Bruxelles, M. Lamertin, 1920). I came accross two editions not included by van Ortroy: Wittemberg, G. Rhau (heirs), 1552, and Leipzig: Johannes Rhamba, 1562.
[102] Bachet, *Problemes plaisants*, problem V, p 37-45, [P06]. He also mentioned Tartaglia and Forcadel in relation to this problem. Pierre Forcadel translated the *Arithmetica Practica* into French, *L'Arithmétique de Gemme Phrison,* (Anvers : Jean Bellere, 1582), but did not contribute much to its contents.
[103] Frisius is underrepresented in David Singmaster, *Sources*. Frisius is mentioned only twice: the cistern problem in 7.H and divination of a permutation in 7.AO.

such as the posthumous twins and the hound and hare problem. However, it is only at the end of the book that he adds three problems in which he refers to its recreational aspect. All three problems are reproduced quite literally by Bachet[104]. The problem of weights is the best known: What is the *minimum number* of weights (which can be placed on either side of a balance) needed to weigh any number of pounds from 1 to 40. An alternative modern formulation of the problem is to find optimal denominations for coins or banknotes[105].

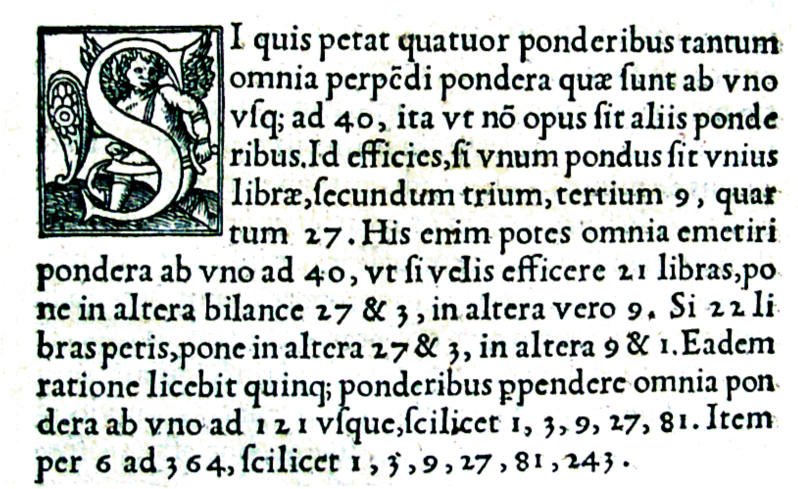
SI quis petat quatuor ponderibus tantum omnia perpēdi pondera quæ ſunt ab vno vſq; ad 40, ita vt nō opus ſit aliis ponderibus. Id efficies, ſi vnum pondus ſit vnius libræ, ſecundum trium, tertium 9, quartum 27. His enim potes omnia emetiri pondera ab vno ad 40, vt ſi velis efficere 21 libras, pone in altera bilance 27 & 3, in altera vero 9. Si 22 libras petis, pone in altera 27 & 3, in altera 9 & 1. Eadem ratione licebit quinq; ponderibus ppendere omnia pondera ab vno ad 121 vſque, ſcilicet 1, 3, 9, 27, 81. Item per 6 ad 364, ſcilicet 1, 3, 9, 27, 81, 243.

Figure 5: *The weights problem from the first edition of Frisius'* Arithmeticae Practicae *(1540) (Courtesy of the Ghent University Library)*.

With combinations of weights of 1, 3, 9 and 27 pounds, it is possible to weigh any integral number up to 40. The four weights are within a geometrical progression of third powers[106]. Frisius extends this to 121 and 364 with five and six weights respectively (see figure 5). Bachet gives the same solutions for 4, 5 and 6 weights as given by Frisius. So the problem which is known today as "Bachet's weights problems" could be named more adequately. This and another form of the problem also appears in Pacioli's and Tartaglia's books as someone who has to pay a rent using five cups of gold. Frisius, in turn, could have found it in the Flemish arithmetic books of van Hoecke[107]. A second problem, the divination of a permutation [P25, E008], consists of three persons selecting three things and a number of coins for finding out which person had selected what. In the 1612 and 1624 editions Bachet criticises Forcadel for the erroneous method he gives for the four person version. This refers to Forcadel's note and the end of his translation of Frisius *Arithmeticae Practicae*[108]. The reference to Forcadel was subsequently deleted by

[104] Divination of a number [P03], divination of a permutation [P25] and the weights problem [AU05].
[105] L. Van Hove, "Optimal denominations for coins and bank notes: in defense of the principle of least effort", *Journal of Money, Credit, and Banking*, Vol. 33, (4), November 2001, pp. 1015-1021, argues that these are two different kinds of problems and other criteria apply for choosing money denominations.
[106] If the weights can be placed on one side of the balance only, the solution is with successive powers of two.
[107] Gielis van Hoecke, *Een sonderlinghe boeck in dye edel conste Arithmetica, met veel schoone perfecte regulen* …, (Antwerp: Symon Cock, 1537).
[108] Forcadel, *L'Arithmétique*, p 118.

Labosne, the editor of the third and following editions, who refers instead to Diego Palomino[109]. It is quite possible that Bachet copied all three problems from Frisius and most likely consulted Forcadel's French version of 1582 as well as Forcadel's *Arithmetique*[110].

Problems on practical geometry

The geometrical problems in *Récréation Mathematiques*, are also founded within a Renaissance tradition, known as practical geometry. Practical geometry deals with subjects such as measurement of distances, plane figures and solids, surveying, triangulation, fortification and gunnery. The best known works are Fibonacci's *Practica Geometriae* from 1220 and the second part of Pacioli's *Summa*. Recent historical studies reveal a continuous development in practical geometry during these three centuries[111]. However, if we are looking for direct sources for our author, we do not have to delve into this vast literature. Some works of the early seventeenth century show close resemblance with the geometrical problems from *Récréation Mathematiques*. In France and the low countries books on civil engineering were closely intertwined with mathematics. A prime example is Simon Stevin who published on fortification, hydraulic engineering and mill construction as well as on arithmetic and algebra[112]. In France, Claude Flamand, an engineer serving for the Duke of Wirtemberg, published several books treating these subjects within the Italian tradition of practical geometry[113]. But especially Jean Errard, an engineer for the Duke of Lorraine, brought the Italian tradition to France. It is known that Errard studied the art of geometry and fortification in Italy[114]. He translated the first nine books of Euclid's *Elements*, and published books on mathematical instruments, practical geometry and fortification[115]. Denis Henrion used, edited and republished his

[109] Bachet 1884, "Nous ferons remarquer qu'avant Bachet, Diego Palomino avait examiné la question de 4 objects avec 4 personnes ; il en donne une solution fort ingénieuse", p 134. Labosne also refers to Palomino when commenting on Bachet's method for constructing magic squares. Singmaster, *Sources* gives the reference to Jacobo Palomino, *Liber de mutatione aeris in quo assidua et mirabilis mutationis temporum historia cum suis caussis enarratur* (Madrid: 1599).

[110] Forcadel's *L'Arithmétique* of 1556 already treates the same problem.

[111] For a good overview see Simi and Rigatelli, "Practical Geometry". The authors describe five manuscripts containing problems we also find in *Récréation Mathématiques*.

[112] Simon Stevin, *De Sterctenbouwing* (Leiden: Franciscus van Ravelenghien, 1594), *De Haven-vinding*, (Leiden: Christophorus van Ravelenghien, 1599), *L'arithmetique*, (Leiden: Christoffel Plantijn, 1585).

[113] Claude Flamand, *La guide des fortifications et conduitte millitaire pour bien se fortifier et deffendre*, (Montbéliard: Jacques Foillet, 1597) reprinted in 1611, German edition in 1612, *Les mathematicqves et geometrie departies en six livres contenant ce qu'est le plus necessaire, pour l'utilité de la vie humaine*, (Montbelliard: Jacques Foillet, [1611]), *La practique et usage d'arpenter et mesurer toutes superficies de terre*, (Montbéliard, Jacques Foillet, [1611])

[114] J. Balteau (ed.), *Dictionnaire de Biographie Française*, (Paris: Librairie Letouzey et Ané, 1933). A bibliography of the works of Errard is given by Marcel Lallement and Alfred Boinette, *Jean Errard de Bar-le-Duc, premier ingénieur du très chrestien roy de France et de Navarre Henry IV. Sa vie, ses oeuvres, sa fortification*, (Paris, E. Thorin, 1884).

[115] Jean Errard, *Les six premiers livres des elemens d'Euclide*, (Paris: 1598), *Les neuf premiers livres des elemens d'Euclide*, (Paris: G. Avvray, 1605), *Le premier livre des instruments mathématiques*, (Nancy, J. Janson, 1584), *La géométrie et pratique générale d'icelle*, (Paris: Le Clerc, 1594), second edition: Paris: Chez Guillaume Auuray, 1602, third in 1619. *La fortification reduicte en art et demonstrée*, (Paris, 1600), second edition in 1604, other editions by his nephew Alexis in 1617 and 1622. The *Bibliographie Universelle* and many other sources wrongly list Errard as the first to write on fortification in France, Michaud, Tome 13, c. 580.

works without contributing much to its contents[116]. Several problems from the first as well as of the second book of *Récréations Mathématiques* can be directly related to the works of Jean Errard. There is little doubt that 'problems' such as the measurement of heights [E104] and triangles with rectangular angles [E097] stem from Errard's work on geometry. Probably the most convincing evidence is a section in his third book on geometry explaining how to distinguish two globes of the same form and weight, the one made of gold and the other one of lead [E042]. Errard gives a somewhat clumsy construction, illustrated in figure 6, using a compass fixed at D, a needle EK and a counterweight G. The intention is to place the counterweight at the right spot K to balance the whole. If the same is done with the other globe with a slightly different size, the distance of the counterweight will be different.

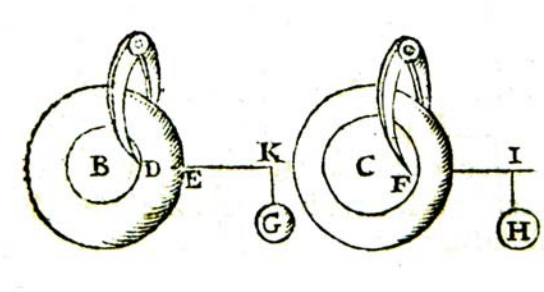

***Figure 6** From Errard,* Géometrie*, 1620, p. 210*
(Courtesy of Ghent University Library)

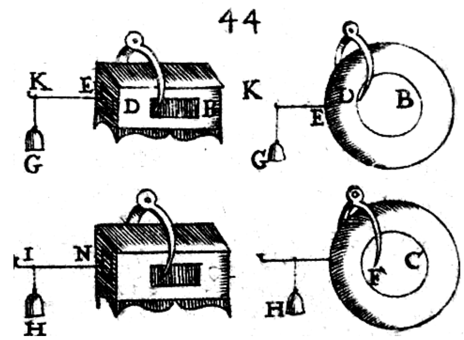

***Figure 7** [Leurechon], 1626, pp. 40-41*
(Courtesy of Liège University Library)

In the original editions of the *Récréations Mathématiques* two problems are given that relate to Errard. Problem 44 gives an implausible version with boxes, which is later criticized by Henrion. Problem 45 gives the exact version of Errard with a mirrored version of the woodcut. There is a misprint in Errard's figure (or text) because he compares the distances *EK* versus *FN*. However, his figure shows *I* instead of *N* and the letter *F* should be placed at the outside of the globe. In *Récréations Mathématiques* the figure is not only reproduced, but the French text also refers to the point *N*, although the letter does not appear in the picture. The English edition merges the two problems and deletes the reference to *N*.

6. Magic recipes

Esotericism might serve the new philosophy as effectively as it had served the old [117]

As shown above, recreational mathematics in the seventeenth century are founded on a century old tradition of scholastic and mercantile arithmetical problems. But there is a

[116] Denis Henrion, *Collection, ou, Recueil de divers traictez mathematiques : a sçavoir, d'arithmetique, d'algebre, de la solution de divers problemes & questions, tant geometriques, qu'astronomiques ...* (Paris: Chez Abraham Pacard, 1621), and *Memoires mathematiques, recueillis et dressez en faveur de la noblesse françoise*, (Paris: Fleury Bourriquant, 1623-7) contain large fragments of the texts on geometry and fortification by Jean Errard, which is not always properly acknowledged by Henrion.
[117] William Eamon, *Science and the Secrets of Nature. Books of secrets in Medieval and Early Modern Culture*. (Princeton: Princeton Univ. Press,.1994), p 318.

second line of descent which is equally important for the philosophy of science of early seventeenth century. Recreational mathematics are also founded on the evolution from the knowledge of secrets to public knowledge. We should explain first some further differences between Bachet's book and recreational mathematics starting with *Récréations Mathématiques*. In addition to the questions and experiments in cosmology, optics, perspective, mechanics, statics and other subjects, we have listed, it also included 'problems' we would now rather call parlour tricks. Such as: "How to breake a staffe which is laid upon glasses full of water, without breaking the glasse, spilling the water, or upon two reeds or strawes without breaking them" and "how three staves, knives, or likebodies may be conceaved to hang in the aire, without being supported by any thing, but themselves"[118]. The motivation to include such 'problems' could only be the wonder about nature's hidden forces which suddenly could be imitated in the privacy of the *salons*. The use of these forces for human gain provided those people with this knowledge considerable power and distinction.

Roger Bacon was one of the first to propagate the importance of the enquiry of the secrets of nature for a scientific understanding of natural phenomena[119]. Bacon was deeply influenced by the *Secretum Secretorum*, a translation of the Arabic *Kitab sirr al-asrar*, wich was originally attributed to Aristotle[120]. This encyclopaedic work was a compilation of practical wisdom and recipes such as "Of thynges that fatteth the body" and "Of goodnesse & harme that cometh of wyne". The longer version also included subjects as diverse as astrology, numerology and medicine. Lynn Thorndike called the *Secretum Secretorum* "the most popular book of the Middle Ages"[121]. William Eamon uses it as a starting point for his overview of books on secrets and magic recipes during the first centuries of printing[122]. Although not stated by Eamon himself, one could distinguish three stages of evolution in the centuries-long history of these books: books on magic and recipes, books on conjuring tricks and rarities and popular science books. Though risking over simplification, this distinction is helpful in that it shows the influence of magic recipes on *Récréations Mathématiques*.

Magic books

One should not be misled by the present-day connotations of the term 'magic'. Mechanics and machines were considered magical in the Hermetic tradition until well into the seventeenth century[123]. *Mathematicall Magick* of 1648 deals primarily with balances, wedges, levers, pulleys, wheels, catapults, automata and inevitably, perpetual motion. Citing Agrippa,Wilkins explains the title of his book as follows:[124]

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[118] Problems [E004] and [E006], and subsequent quotations are taken from the English translation of 1633.
[119] In the sixth part of his *Opus Majus*, Bacon 1266.
[120] E.g. Robert Copland, *Thus endeth the secrete of secretes of Arystotle w' the gouernayle of prynces and euery maner of estate with rules of helthe for body and soule very prouffytable for euery man, and also veray good to teche chyldren to lerne to rede Englysshe*, ([London] : Imprynted by Robert Copland at Londo[n] in the flete-strete at the sygne of the Rose garla[n]de, 1528).
[121] Lynn Thorndike, *History of Magic and Experimental Science*, 8 vols., 2nd ed., (New York: Columbia University Press, 1923-58), vol. II, p. 267.
[122] Eamon, *Science and the Secrets of Nature*, pp. 45-53.
[123] Frances Yates, "The Hermetic Tradition in Renaissance Science", in Charles S. Singleton (ed) *Art, Science and History in the Renaissance*, (Baltimore: John Hopkins Press, 1967), pp. 259-60.
[124] Wilkins, 1648, foreword to the reader. Despite the title, there is not much mathematics in this book.

> This whole discourse I call Mathematicall Magick, because the art of such mechanical inventions as are here chiefly insisted upon, hath been formerly so styled; and in allusion to vulgar opinion, which doth commonly attribute as such strange operations unto the power of Magick.

Magnetism was considered an occult power during the Middle Ages and most of the Renaissance. The medicinal effect of plants and herbs were beyond the explanatory power of scholastic natural philosophy. Astrological medicine was an accepted medical practice in the fifteenth and sixteenth centuries[125]. Prescriptions were based on the relation between planets and body parts. Charles Singer shows in *From Magic to Science* how magic played a major role in the dissemination of knowledge about medicinal plants and herbs: “Of all forms of cultural influence it is magic that passes most easily and most rapidly from people to people”[126]. The quest for magic recipes could be considered as the quest for a general understanding of the occult forces of nature. What distinguished someone like Galileo from the compilers of magic recipes in the fifteenth and sixteenth centuries is the method of enquiry and the criteria for truth. Experimenters and practitioners of magic were not concerned about theory. On the contrary, practical and proven experience could be trusted more than dubious theories. Also, an operational definition of truth was adopted. It was not important to know why specific recipes worked, but successfully applying them was the aim. Because only the initiated could be trusted, the knowledge of magic recipes was kept secret. The secrecy varied with the subject of exploration. Astronomy was quite open in its methods, alchemy, was the most secret of all *Scientia Experimentalis*. In “What is the nature of Magick”, Della Porta gives a definition[127]:

> There are two sorts of Magick; the one is infamous, and unhappy, because it has to do with foul Spirits, and consists of incantations and wicked curiosity; and this is called Sorcery; an art which all learned and good men detest; neither is it able to yield any truth of reason or nature, but stands merely upon fancies and imaginations, such as vanish presently away, and leave nothing behind them (…). The other Magick is natural; which all excellent wise men do admit and embrace, and worship with great applause; neither is there any thing more highly esteemed, or better thought of, by men of learning.

So, the enquiry into the forces of nature should look at natural influences, not the supernatural ones. And the investigation of the natural forces required serious study and experimentation. Agrippa, in his definition of magic, goes one step further and uses natural magic in explaining the effects that are caused by the forces of nature[128]:

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[125] Frances Yates, *Giordano Bruno and the Hermetic Tradition*, (Chicago: University of Chicago Press, 1964), p. 62.
[126] Charles Joseph Singer, *From Magic to Science. Essays on the scientific twilight*, (London: Ernest Benn, 1928), Dover edition, 1958, p. 135.
[127] Giambattista Della Porta, *Magiae naturalis libri XX in quibus scientiarum naturalium divitiae et deliciae demonstrantur*, (Naples: 1589), Book I, chapter II. From the English translation, *Natural magick by John Baptista Porta*, (London: John Wright, 1669), pp. 1-2.
[128] Agrippa von Nettesheim, [Heirich Cornelius], *Agrippae de occulta philosophia liber I,*. (Paris: Christian de Wechel, 1531). From the English translation by John French, *Three books of occult philosophy, written*

> Magick is a aculty of wonderfull vertue, full of most high mysteries, containing the most profound contemplation of most secret things, together with the nature, power, quality substance, and vertues thereof, as also the knowledge of whole nature, and it doth instruct us concerning the differing, and agreement of things amongst themselves, whence it produceth its wonderfull effects, by uniting the virtues of things through the application of them one to the other.

To be able to comprehend and explain, the “Professors of Magic”, as Agrippa called them, should be qualified in the three faculties of natural magic: natural philosophy, mathematics and theology. “Natural Philosophy teacheth the nature of those things which are in the world, searching and enquiring into their causes, effects.”[129]. By including natural philosophy within natural magic and insisting upon causal explanations for the forces of nature, Agrippa went beyond the ambitions of many compilers of magic recipes. However, explanations were often limited to the determination of attracting and opposing forces such as sympathy and antipathy. One looked at virtues of stones and herbs, the attracting powers of magnets and remarkable properties of lenses and burning glasses, and how they could be used for human gain. In the fifteenth and sixteenth century, magic was indistinguishable from experimental science. Its aims were the same of those of the natural philosophers of the seventeenth century. What had changed over this period were the methods and the criteria for truth.

While the secrets should be kept for the initiated, the advancements in printing in the sixteenth century provided some with growing business opportunities in selling these secrets in the form of books with all sorts of recipes. Eamon gives an overview of the hundreds of books and editions that were eagerly bought by a growing audience. One successful “vendor of secrets” was the barber surgeon Leonardo Fioravanti (1518-1588) whose books such as *Del compendio dei secreti rationali* went through many editions and were translated into several languages.[130]

The most successful compiler and publisher of secrets was Girolamo Ruscelli (d. ca. 1565). He published *De' secreti del Alessio Piemontese* or Alexis of Piemont, which was his own pseudonym. Many editions of the book appeared since the first edition of 1538 and it was translated into Latin, Dutch, French, German and English[131]. Most of his

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by Henry Cornelius Agrippa, of Nettesheim, counseller to Charles the Fifth, Emperor of Germany: and judge of the Prerogative Court. Translated out of the Latin into the English tongue, (London: Printed by R.W. for Gregory Moule, 1650), pp. 2-3.

[129] Ibid, p. 3.

[130] In English: Leonardo Fioravanti, *A ioyfull iewell Contayning aswell such excellent orders, preseruatiues and precious practises for the plague, as also such meruelous medcins for diuers maladies, as hitherto haue not beene published in the English tung. First made and written in the Italian tung by the famous, and learned knight and doctor M. Leonardo Fiorouantie, of his owne ingenious inuentions. And now for the carefull commoditie of his natiue countrey, translated out of the Italian by TH,* (London: [By J. Allde] for William Wright, 1582) and many more editions up till the late 17th century.

[131] In French: Girolamo Ruscelli, *Les secrets du reverend signevr Alexis Piemontois Traduit d’Italien en françois*, (Antwerp: Cristoffel Plantin, 1557). In Dutch, translated from the French : Girolamo Ruscelli, *De secreten van den eerweerdighen heere Alexis Piemontois : inhoudende seer excellente ende wel gheapprobeerde remedien, teghen veel-derhande cranckheden, wonden ende andere accidenten, met de*

recipes deal with practical cures and ailments in daily life such as “To take markes or ringworms out of the body”[132], “To get any things out of eares that is gotten in”[133] and the high incidence “When one pisseth against his will”[134]. Through the more than 1000 recipes peculiar similarities with some of Leurechon’s “problems” can be discovered:

[Leurechon], *Récréations Mathématiques*, **1628**	**Ruscelli,** *The secrets of Alexis*, **1615**
Faire tenir une chandelier allumé dans l’eau, qui durera trois fois plus qu’elle ne seroit. (Part II, Probl. 37, p. 64)	How to make candles that cannot be put out, (ff 125r-125v)
Faire en sorte que le vin le plus fumeux et mal-faisant, ne pourra envuyer et ne nuyra pas mesme à un malade. (Part II, Probl. 38, p. 65)	To take away the flavour of the mouldinesse or putrifications of the wine, (f. 130r)
Tenir du vin frais comme s’il estoit enfermé dans une cave, au plus chaud de l’Esté, sans glace ou neige, le portant mesme exposé au Soleil à l’arçon de la selle. (Part II, Probl. 40, p. 67)	Wine to keepe it sweet all the yeare. (f. 129r).
Fair fondre tout metal promptement, (Part II, Probl. 42, p. 69)	How to melt mettall perfectly (ff. 254v-255v)
Tremper le Fer ou l’Acier et lui donner une incroyable dureté. (Part II, Probl. 43, p. 70)	To harden Iron or Steele (f. 123v) To make any instrument of steel hard and sharpe (f. 242v)
Faire prendre couleur d’Ebene à toute sorte de bois, pourveu qu’il soit bien poly, en sorte qu’on s’y pourra tromper. (Part II, Probl. 44, p. 72).	To counterfeit the black woode called Hebenus or Hebenum, and to make it as faire as the naturall Hebene. (f. 83v)

The fact that problems of the second part of *Récréations Mathématiques* share title and solution with Ruscelli’s recipes leaves little doubt about the author’s sources. Also the style of presenting is very similar. The entries are typically quite short. After a brief description of the problem, a solution or recipe is presented, often without any explanation at all. The early editions of the book are thus remarkably similar to sixteenth century books with magic recipes.

An other kind of problems is borrowed from the vast quantity of books within the magical tradition which deal with mechanical contrivances. Most of the renaissance

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maniere te van distilleren, perfumeren, confituren maken, te verwen, coleuren ende gieten / uut den Françoise overgheset, (Antwerp: Cristoffel Plantijn, 1561), many editions from 1561. In English: Ruscelli, *The secrets of Alexis containing many excellent remedies against diuers diseases, wounds, and other accidents : with the maner to make* [brace] *distillations, parfumes, confitures, dyings, colours, fusions and meltings : a worke well approued, very necessarie for euery ma*[n]. *Translated out of French into English by William Ward*, (London : Printed by William Stansby for Richard Meighen and Thomas Iones, and are to be sold at their sh[op] with-out Temple-barre vnder S. Clements Church, 1565), In German: many editions, Girolamo Ruscelli, *Kunstbuch deß wolerfaren Herren Alexij Pedemontani von mancherley nutzlichen unnd bewerten Secreten oder Künsten*, (Basel : Peter Perna, 1569).

[132] Ruscelli, *The secrets*, p. 160.

[133] Ruscelli, *The secrets*, p. 186.

[134] Ruscelli, *The secrets*, p. 215, 242, 277.

books on this subject rely heavily on Hero of Alexandria's *Pneumatica* and *Mechanica*[135]. Both Cardan in his *De subtilitate*, as Della Porta in *Magia Naturalis* discuss several problems from the *Pneumatica*. As these works share several problems with *Récréations Mathématiques* both could have been the source for our author[136]. However, there is a remarkable concordance with a work by de Caus published some years before[137]. In this book, de Caus describes the principles underlying fountains, levers, pulleys and cogwheels. These principles stem from Hero's works and are presented by propositions and collaries: air can be easily compacted, but not water (Prop. 1), water cannot flow out of a vessel if no air can come in (Prop. 2), if air is pressed in a vessel with water and you open a cistern, the water will come out by force (Prop. 5) the principle of the syphon (Prop. 10) and, the inverted syphon (Prop. 11). It becomes clear from the exceptionally detailled drawings that de Caus has put these principles into practice in an ingenious way which contributed to its desired effects.

[Leurechon], ***Récréations Mathématiques*****, 1628**	**De Caus,** ***New and rare inventions,*** **1659**
Faire une pompe dont la force sera merveilleuse, pour le grand poids d'eau que un homme seul pourra lever. Probl. 25, p. 46.	There can be no vacuity, (Prop. 4, p. 3).
Par le moyen d'une cisterne, faire sortir continuellement l'eau d'un puits, sans force et sans le ministere d'aucun pompe. Probl. 26, p. 48.	The water runs equally by the means of a syphon, if the end by which the water of the said syphon ascends doth only touch the superficies of the water of another vessel, (Prop. 11, p. 7).
Faire une fontaine boüillante, qui jettera son eau fort haut. Probl. 27, p. 50 (Figure 6)	Plate VI, p. 20, Figure 5.
Vider toute l'eau d'une cisterne, par le moyen d'un syphon qui aura mouvement de luy-	Of another kind of syphon: and how the air may be drawn forth by the means of

135 Guillaume Schmidt, *Heronis Alexandrini opera quae supersunt omnia, Volumen I, Pneumatica et automata*, (Leipzig, B. G. Teubner, 1899-1900). For a good overview on the influence of Hero's *Pneumatica* in the Renaissance and the natural philosophers of the seventeenth century see Marie Boas, "Hero's Pneumatica: A Study of Its Transmission and Influence" *Isis*, Vol. 40, No. 1. (Feb., 1949), pp. 38-48.

136 It looks like the first part had already borrowed several problems from de Caus, such as the deceitful balance (problem 54), the water dial (problem 85) and a general treatment of fountains (problem 88). However, these are probably taken from earlier sources. Della Porta is mentioned in [Leurechon] 1624, 107. The author seems to have read de Caus only after publication in 1624.

137 Salomon de Caus, *Les raisons des forces mouvantes, avec diverses machines tant utiles que puissantes, auxquelles sont adjoints plusieurs dessings de grotes & fontaines*, (Francfort : en la boutique de J. Norton, 1615). A digital copy of this book is on-line at http://cnum.cnam.fr/fSYN/FDA1.html. The book was reprinted in Paris in 1624. Later, Salomon's younger brother Isaac used much of the contents and the plates for a book of his own, entitled *Nouvelle invention de lever l'eau : plus hault que sa source avec quelques machines mouantes par le moyen de l'eau et un discours de la conduit d'ycelle*, printed in London and translated in English as, de Caus, *New and rare inventions of water-works shewing the easiest waies to raise water higher then the spring by which invention the perpetual motion is proposed : many hard labours performed : and varieties of notions and sounds produced : a work both usefull profitable and delightfull for all sorts of people / first written in French by Isaak de Caus ... and now translated into English by John Leak*, (London: Printed by Joseph Moxon, 1659). I have used the translation of the English version.

mesme. Probl. 28, p. 52.	another vessel, (Prop. 11, p. 7).
Trouver l’invention de Syringuer un petit filet d’eau fort haut, par un mouvement authomatique, en sorte qu’un pot d’eau durera plus d’une heure. Prob. 29, p. 54.	The water cannot enter into a vessel, but there must come forth as much aire except the water be sent in by force, (Prop. 2, p. 2).
Fair un Ciment dur comme marbre qui resistera à l’air et à l’eau sans iamais se dissoudre. (Part I, Probl. 68, p. 68.)	The manner to make a cement, to cement glasses to the vessal, so as the air may not come forth, (p. 24).

***Table 2:** A comparision of problems in the work of De Caus on machinery and fountains with those of* Récréations Mathématiques*.*

A convincing example of De Caus’ mark on the treatment of hydraulics and fountains in *Récréations Mathématiques* is given in figures 8 and 9. De Caus describes this ‘machine’ using one of several methods to design fountains. In this case the contrivance is based on the principle of heating to raise the inside pressure, discussed as theorem V. However, the reader of *Récréations Mathématiques* is completely at a loss, because the author forgot to mention that you have to heat the container.

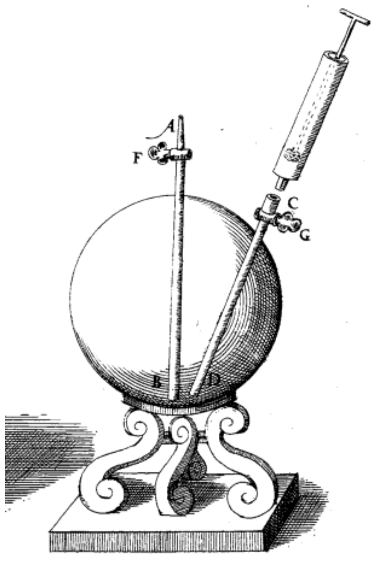

***Figure 8:** de Caus, New and rare inventions, 1659, F. 18^r. A similar picture is in the 1615 French edition.*

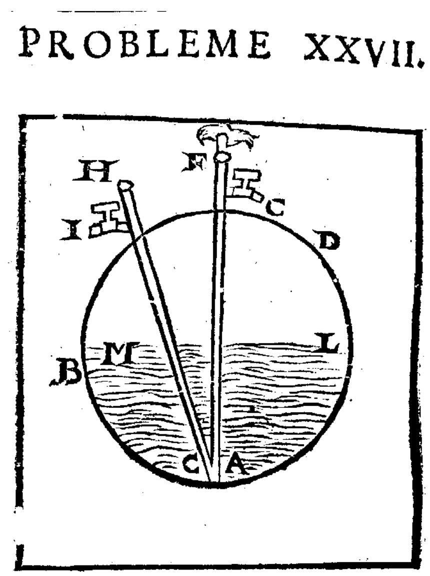

***Figure 9:** [Leurechon], 1639, Part II, p. 46,* (*Courtesy of the Ghent University Library)*.

An earlier book by de Caus on perspective[138] is the likely source of problem 18, described in the English edition as: “How to make statues, letters, bowles or other things which are placed in the side of a high building, to be seene below from an equall bignesse”[139]. The problem is treated recurrently in the Renaissance; de Caus himself

[138] Salomon De Caus, *La perspectiue, auec la raison des ombres et miroirs Par Salomon de Caus ingenieur du serenissime Prince de Galles, dedie a son altesse*. (Londres : [printed by Richard Field (London), and J. Mommart (Brussels)] chez [i.e. for] Robert Barker. Imprimeur du Roy de la grande Bretaigne, 1611).
[139] [Leurechon], *Mathematicall recreations*, p. 243.

refers to Durer's *Geometry*. However, in this case the plates used in both works are very similar and the accompanying text is almost an exact copy[140].

Conjuring books

Eamon describes the importance of the Renaissance patronage system and its recuperation of the secrets of nature[141]:

> In a world dominated by courts, princely patronage not only provided monetary support to cultural activity, it was also a mechanism for fashioning social identities. To belong to a court, even to a minor one, was to share in the prestige that went with rendering service to an overlord. Honor - that is, the praise and recognition of a prince - was the reward of servitude and the engine of courtly ambition.

A display of curiosity and virtuosity contributed to the praise and recognition of the patrons, and that what was literally done. Exotic specimens of wonder consisting of strange and grotesque oddities were exhibited in cabinets of curiosities (*Cabinet de Curiosités, Rariteitencabinetten* or *Wunderkammern*). The cabinets wanted to surprise, impress, amuse its audience rather than to stimulate their scientific interest and educate them, as museums and popular science books later would do.

The next logical step in delighting the audience was to turn the artefacts of magic into real performances. The new practitioners of magic use sleight of hand techniques, parlour tricks or conjuring for amusement and make no claim of supernatural powers. The sixteenth century saw the start of a new tradition of conjuring practices in which techniques and tricks were compiled into popular works diverging from the books on magic recipes. Evans, Hall, Heyl and Toole Stott present bibliographic data and overviews of three centuries of such conjuring books[142]. Books on magic recipes continued to be published well into the eighteenth century, but the recreational mathematics books fit better within the new evolution. One of the first books on conjuring to appear in the English language was *Naturall and Artificiall Conclusions* of Thomas Hill, reprinted more than a few times way in the seventeenth century[143]. It shares several conjuring tricks with *Récréations Mathématiques*, probably going back to the same Italian origin: "To make a light or candle to endure burning without goyng out",

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140 [Leurechon], *Récréations Mathématiques*, 1628, Part II, pp. 31-2 : "Soit la muraille donnée GHIK, contre laquelle on veut ecrire..", de Caus, *La perspectiue,* 36v : " Soit une muraille droicte marquée BCDE, contre laquelle il faut faire plusieurs escritures.. ".

141 Eamon, *Science and the Secrets of Nature*, pp. 223-4.

142 Henry Ridgely Evans, *Some Rare Old Books on Conjuring and Magic of the sixteenth, the seventeenth, and the eighteenth century,* (Kenton: International Brotherhood of Magicians, 1943). Trevor Henry Hall, *A Bibliography of Books on Conjuring in English from 1580 to 1850*, (Lepton: Palmyra Press,. 1957). Edgar Heyl, (1964) *Cues for collectors*, (Chicago: Ireland Magic Co., 1964). Raymond Toole Stott, *A bibliography of English conjuring, 1569-1876*. 2 vols, (Derby: Harpur and Sons, 1976-8). These limited editions have become as rare as the books they are dealing with. Hall's *Bibliography* was originally printed on 500 copies, the first 250 signed and numbered by the author. The revised and expanded 1972 edition was published on 1000 numbered and signed copies.

143 Thomas Hill, *A briefe and pleasaunt treatise, intituled, Naturall and artificiall conclusions: written first by sundrie scholers of the Vniuersitie of Padua in Italie, at the instant request of one Barthelmewe a Tuscane: and now Englished by Thomas Hill Londoned* [sic], *as well for the commoditie of sundrie artificers, as for the matters of pleasure, to recreate wittes at vacant tymes,* (London : By Ihon Kyngston, for Abraham Kitson, 1581).

"To make a candle burn in water", "How to make to make quanters of wood to hang so fast together that thei cannot be shaken a sunder without braking" (the three knives), and "How to cut an Apple into many peeces, without harming of the skinne or paryng"[144]. Hall places recreational mathematics within this new tradition of conjuring and gives a comprehensive bibliography and biography. Apart from the three English editions of *Mathematical Recreations* he also includes the editions of Hunt, Ozanam mentioned above, and Hooper[145]. Hooper's first volume contains mathematical problems card tricks, and some mechanical contrivances such as a wind-powered carriage; the second volume describes experiments in optics and acoustics as well as projects such as the construction of a pipe organ; the third contains experiments on magnetism and electricity, many drawn from Priestley[146]; and the fourth is on pneumatics, hydraulics, and pyrotechnics, including chemical experiments. Many of the "recreations" are parlour tricks; others are instructive demonstrations that might be called experiments in popular science.
Typical problems of *Récréations Mathématiques* that fall under parlour tricks and conjuring practices are:

- To make a sticke stand upon the tipp of ones finger, without falling. [E010]
- To make three knives hang and move upon the point of the needle. [E012]
- How is it that a man in one and the same time, may have his head upward, and his feet upward, being in one and the same place. [E024]
- Of a deceitfull balance which being empty seemes to be just, because it hangs in equilibrio: notwithstanding putting 12 pound in one balance, and 11 in the other it will remaine equilibrio. [E049]
- To heave or lift up a bottle with a straw. [E050]

Bachet's card tricks broadly fall into this same category, although they are treated arithmetically.

Popular science

As the presentation and dissemination of popular knowledge about the forces of nature evolved from magic recipes to conjuring and parlour tricks, it continued to advance to popular science during the next centuries. Books on recreational mathematics in the first half of the seventeenth century were the prototypes of the new popular science books. There was an evolution both in the choice of subjects as in the mode of presentation.
In his choice of new subjects, our author was inspired by Giambattista Della Porta's *Magiae Naturalis*[147]. Della Porta was a typical figure from the Italian renaissance who

[144] The trick with the three knives is reported by Pacioli's *DeViribus Quantitatis* Part 2, Cap.CXXXV: "De acozzare 3 tagli de coltelli in siemi". Most of the 140 problems in the second part *Della virtu et forza lineale et geometria* are conjuring tricks.

[145] William Hooper, *Rational Recreations, In Which The Principles Of Numbers And Natural Philosophy Are Clearly And Copiously Elucidated, By A Series Of Easy, Entertaining, Interesting Experiments, Among Which Are All Those Commonly Performed With The Cards*. (London: Printed for L. Davis, 1774).

[146] Joseph Priestley, *The history and present state of electricity, with original experiments*, (London: Printed for J. Dodsley, J. Johnson and B. Davenport, 1767).

[147] The rare, first and lesser know edition consisted of only four books: Giambattista Della Porta, *Magiæ naturalis, siue de miraculis rerum naturalium libri IIII*. / Io. Baptista Porta Neapolitano auctore (Naples: Apvd Matthiam Cancer, 1558). The *Magiae Naturalis* must have been popular from the start as it was translated shortly after in Italian (1560), French (1565) and Dutch (1566). The expanded edition, Giambattista Della Porta, *Magiae naturalis libri XX in quibus scientiarum naturalium divitiae et deliciae*

exemplifies the transition from magic influences to scientific enquiry. He combined a considerable breadth of learning and a deep interest in natural phenomena with a childish fascination with the occult. Although it had an important influence on natural philosophers such as Francis Bacon, the *Magiae Naturalis* is not considered a serious book. It contains subjects such as “how creatures, made drunk, may be caught with the hand”[148], “the best soaps for women”[149] and the intriguing “how to generate pretty little dogs to play with”[150]. However, Della Porta also did publish serious studies on coding and decoding[151], the classification of plants[152], refraction of light[153], physiognomy and astrology[154], distillation[155], meteorology[156] and pneumatics[157]. The *Magiae Naturalis* fits within the tradition of magic recipes but contains the results of the more serious experiments from Della Porta, Cardan and Daniello Barbaro. Within the literature of history of science, the *Magiae Naturalis* is best known for his optics and more specifically for the first citation of the use of a lens in the aperture of the *camera obscura*. The description of the *camera obscura* [E002], the spectacles of pleasure [E066], the experiments with burning glasses [E075], concave glasses [E077] and the optical illusions [E080, E081] in *Récréations Mathématiques* all come from book XVII of the *Magiae Naturalis*. Optical illusions have been classic in the literature on magic books since the *Secreti Alberti* but starting with della Porta, the subject is treated quite differently. We can read how different shapes of ‘glasses’ are used to produce the illusionary effects, about the differences between concave and convex glasses, the principles of the biconvex lens, the reversal of the image and the focusing effect of burning glasses. Here we witness the transition of parlour tricks to popular science. Other

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demonstrantur. (Naples: Apud Horatium Saluianum, 1589), consisted of twenty books and went through at least twelve editions in Latin, four in Italian, seven in French, two in German and two in English (1658, 1669). I used the second English edition: Giambattista Della Porta, *Natural magick by John Baptista Porta, a Neapolitane. In twenty books*. (London: Printed for John Wright next to the sign of the Globe in Little-Britain, 1669).

[148] Della Porta, *Magiae Naturalis*, 1669, Bk XV, Ch. VIII.

[149] Ibid, Bk IX, Ch. XVI.

[150] Ibid, Bk II, Ch. VII.

[151] Giambattista Della Porta, *De furtivis Literarum Notis vulgo, De ziferis Libri IIII* – (Naples: Apud Ioa. Mariam Scotum, 1563).

[152] Giambattista Della Porta, *Phytognomonica, octo libris contenta: in quibus nova, facillimaque affertur methodus, qua plantarum, animalium, metallorum, rerum denique omnium ex prima extimae faciei inspectione quivis abditas vires assequatur: accedunt ad haec confirmanda infinita propemodum selectiora infinita propemodum selectiora secreta . . .Nunc primum ab innumeris mendis, quibus passim Neapolitana editio scatebat, vindicata*, (Frankfurt: Apud Joannem Weehelum & Petrum Fischerum consortes, 1591).

[153] Giambattista Della Porta, *de Refractione optices parte libri novem*, (Naples: Apud Io. Iacobum Carlinum et A. Pacem, 1593).

[154] Giambattista Della Porta, *Coelestis physiognomoniae libri sex*, (Naples: Ex typographia Io. Baptisate Subtilis, 1603).

[155] Giambattista Della Porta, *Dedistillatione lib. IX quibus certa methodo multiplici´q*[ue] *artificio, penitioribus naturae arcanis detectis, cuiuslibet mixti in propria elementa resolutio, perfectae docetur*, (Rome: Ex typographia Reu. Camerae Apostolicae, 1608).

[156] Giambattista Della Porta, *Io. Baptistae Portae Neapolitani De aeris transmvtantionibvs linbr IV : in quo opere diligenter pertractur de ijs, quae, vel ex aere, vel in aere oriuntur [meteorologion] multiplices opiniones, qua illustrantur, qua refelluntur: denum variarum causae mutationum aperiuntur*, (Rome: Apud Bartholomaeum Zannettum, 1610).

[157] Giambattista Della Porta, *Pneumaticorum libri tres : Quibus accesserunt curvilineorum elementorum libri duo*, (Naples: J.J. Carlinus, 1601).

examples of popular science experiments that we can find both in Della Porta and Leurechon are:

Della Porta (1589)	**[Leurechon] (1633)**
A description of water Hour-glasses, wherein wind or water-instruments for to show the hours are described, (Bk. XIX, Ch. IV).	Of fine and pleasant dyalls [E082 gives adescription of the water dial]
A description of Vessels casting forth water by reason of Air, (Bk. XIX, Ch. V).	Of a fine vessell which holds wine or water, being cast into it at a certain height, but being filled higher, it will runne out of its wone accord, [R038].
A vessel that shall cast forth water. How to make water ascend conveniently, (Bk. XIX, Ch. 3).	Of fountains, hydiatiques, machinecke and other experiments upon water or other liquor, [E085].
The Wonders of the Loadstone, (Bk. VII).	Of the adamant or magnes, and the needles touches therewith, [E067].
How an Instrument may be made, that we may hear by it a great way, (Bk. XX, Ch. V).	To make an instrument to helpe hearing, as Gallileus made to helpe the sight, [E059].
Artificial Fires, (Book XII).	Artificial fireworks, [Part III].

The transition from parlour tricks to popular science is also demonstrated by the need for additional explanatory notes. Magic books typically gave a recipe that “was proven by experience” without any further comments. Della Porta started to provide explanations for the mystical forces of nature. He used natural magic to explain the exceptional and unusual aspects of nature.

Our portrayal of *Récréations Mathématiques* as a work on popular science is epitomized quite well by two further examples: the thermometer and the rainbow. The invention of the thermometer is still subject to controversy. Many books and encyclopaedias list Galileo as the inventor of the water thermometer in 1603. However, Galileo’s instrument consisting of an open glass cylinder of about 40 cm, was reported not to contain a scale. Santorio Santorio in Italy, Cornelius Drebbel in Holland, and Robert Fludd in England, all developed scaled instruments for measuring temperature in the first decades of the seventeenth century. An answer to the question of the inventor of the thermometer will depend on a precise definition of the instrument itself and this is beyond the scope of this study. Interesting however is that *Récréation Mathematiques* did describe such instrument as early as 1624, provided a picture of the instrument and was the first to give it its present name: *Thermometre*[158]. The same term was subsequently used in the English translation “Of the thermometer: or an instrument to measure the degrees of heat and cold in the aire”[159]. The Latin translation of 1651 describes it as “Thermometra, sive instrumentum Drebilianum”[160], referring to Cornelius Drebbel, but the other editions do not make that reference. The author describes how a scale can be constructed by drawing a line on the cylinder and divide it into 4 degrees for physicians or 8 degrees for

[158] [Leurechon], *Récréation Mathématiques*, 1624, p. 75, plate p. 69.
[159] [Leurechon], *Mathematical Recreations*, 1633, p. 110, [E069].
[160] Ens, *Thaumaturgus*, p. 126.

philosophers[161], which in turn can be divided into smaller parts. “This way they may not onely distinguish upon what degree the water ascendeth in the morning, at midday and any other houre: but also one may know how much one day is hotter or colder than another. By marking how many degrees the water ascendeth or descendeth, one may compare the hottest and coldest dayes in a whole yeare together with these of another yeare”[162]. It is not clear what the author’s source was for the description of this new instrument. A possibility is again de Caus’ original work of 1615[163]. De Caus describes a perpetual movement machine based on a “vessel of lead or copper, about a foot and a half square, very close and soldered on every side, which shall have a pipe in the middle”[164]. Through the pipe a thread passes, holding a copper ball floating on the water. As the air expands and contracts, the water will ascend and descend, activating a trolly with the counterweight A. This moves the dial within a range numbered one to twelve. Although the principles of contraction and expansion of water were also used in *Récréations Mathématiques*, de Caus describes a different kind of instrument. It is not clear to what degree the author contributed to the conception. The original text suggests that the author had personal experience with this instrument, but a similar scaled instrument was known in Holland at the same time[165].

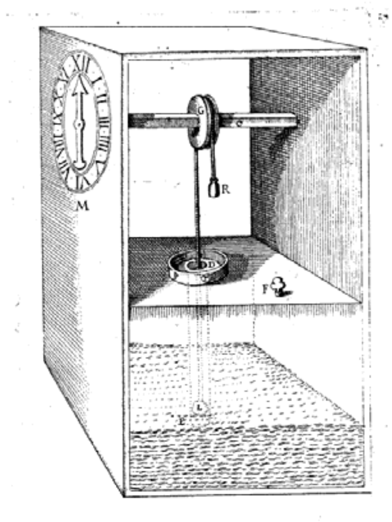

Figure 10: *An early instrument to measure temperature from de Caus, 1615, VIII.*

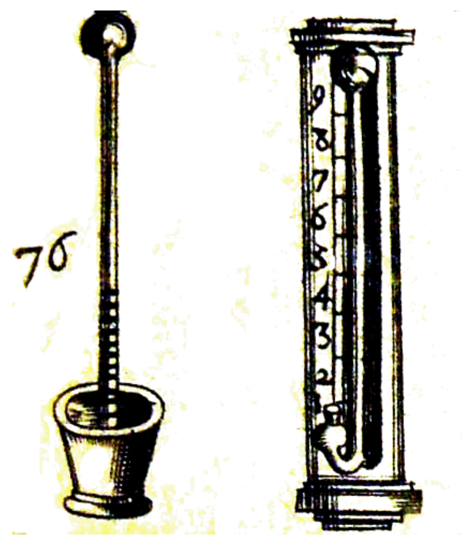

Figure 11: *The first pictures of an air thermometer and Dutch thermometer from [Leurechon], 1624, picture 76,* (*Courtesy of the Ghent University Library)*.

[161] [Leurechon], *Récréation Mathématiques*, 1624, p. 76. The English translation misprints 4 for 8, see [Leurechon], *Mathematical Recreations*, 1633, p. 112.
[162] [Leurechon], *Mathematical Recreations*, 1633, p. 112.
[163] The idea of a thermometer in de Caus, *Les raisons des forces mouvantes*, is cited by W. E. Middleton, *A history of the thermometer and its use in meteorology*, (Baltimore: Johns Hopkins Press, 1966), pp. 18-9, although he does not relate de Caus with Leurechon. Martin Barnett, “The Development of Thermometry and the Temperature Concept”, *Osiris*, Vol. 12. (1956), pp. 269-341, gives Drebbel as the source for Leurechon, but without further argumentation.
[164] de Caus, *New and rare inventions*, p. 21.
[165] Middleton, *A history of the thermometer*, p. 20.

The presentation of the principle of a thermometer is comparable in style and presentation to that of the many books on popular science published in the following centuries. It could be a quotation out of one of the many books with scientific experiments for boys and girls in the nineteenth and twentieth centuries. The construction of the thermometer device is detailed and simple enough to try it yourself. But *Récréations Mathematiques* presents is not as a sort of rarity, a curiosity meant to surprise and amuse, but as an instrument for experimental science. It can be used to observe, measure, register and compare, the basic procedures of empirical science. The same experimental spirit is displayed in the description of the rainbow. In "How to represent diverse sorts of rainebowes here below" the author praises in the most lyrical terms, our fortune to be able to witness "a thing admirable in the world, which ravishet often the eyes and the spirits of men" and describes how the rainbow "is the chiefe and principall worke of God"[166]. One could wonder how to do experiments with a rainbow, but "nothwithstanding there is left to industrie how to represent it from above, here below, though not in perfection yet in part, with the same intermixture of colours that is above". The answer is surprisingly simple: you fill your mouth with water, stand with your back to the sun and press the water through your lips. "You shall see these atomes vapours in the beames of the sunne to turne into a faire rabinbow [sic]". In his classical study of the rainbow, Carl Boyer assigns great value to this experiment and believes that *Récréations Mathématiques* was crucial for Descartes' interest in the physics of the rainbow[167]:

> It is known that this charming book had been read by Descartes with considerable care; and his emphasis on the wonder and lack of understanding of the rainbow, as well as his experimental approach to its study, may well have stemmed from the comments of Leurechon.

The *Récréations Mathematiques* reads, that despite the many years of efforts of philosophers and mathematicians to discover and explain the causes of the rainbow, all one can say is that it is related to the reflection and refraction of light[168]. Such a lack of a causal explanation was for Boyer "a challenge which Descartes could not resist"[169]. Descartes does not refer directly to the experiment of spraying water through the lips, as Duhamel would do later[170]. However, Descartes describes an experiment which could be inspired by reading *Récréations Mathématiques*. The trouble with the experiment is "all the grief that it lasteth not but soon is vanished". Thus, "to have one more stable and permanent in his colours, take a glasse full of water and expose it to the sunne, so that the rays pass through strike upon the shadowed place, you will have pleasure to see the fine forme of a rainebow by this reflection"[171].

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[166] Quotations from [Leurechon], *Mathematical Recreations*, 1633, p. 67.
[167] Carl B. Boyer, *The rainbow, from myth to mathematics*. (New York: T. Yoseloff, 1959), 1987 edition, Princeton University Press, p. 207.
[168] [Leurechon], *Récréations Mathématiques*, 1628, p 65. This comment was left out from the English translation.
[169] Boyer, *The rainbow*, p. 208.
[170] Jean Baptiste Duhamel, *De Meteoris et fossilibus libri duo*, (Paris: 1660), p. 93, 97. Reference given by Boyer, *The rainbow*, p. 229.
[171] [Leurechon], *Mathematical Recreations*, 1633, p. 68.

This could have inspired Descartes to view the glass of water as a giant water drop[172]:

> Then, knowing that these drops are round, as has been proven above, and seeing that their being larger or smaller does not change the appearance of the arc, I then took it into my head to make a very large one, the better to examine it. And for this purpose I filled a perfectly round and transparent large flask with water.

He hence initiates his geometrical analysis of the process of reflection and refraction in a water drop, which shows the value the ‘glass of water as a water drop’ metaphor.

In later editions the commentaries became more important as popular science. The notes that were added to the original text since 1627, not only clarified obscure parts and challenged ridiculous claims, but provided explanations and causes for the observed wonders. These commentaries contributed significantly to the value of these books. Mydorge’s additions on the optical problems and Henrion’s notes on the arithmetical ones, raised *Récréations Mathématiques* from a conjuring book to a work of recreational mathematics and popular science. Especially Jacques Ozanam improved the educational value of this popular work. The compilation and publication of curiosities and wonders of nature was encouraged and raised to systematic standards by the emergence of the scientific societies. The Baconian program called for the accumulation of knowledge about the natural world, the “propagation and advancement of knowledges, the improvement, and not the conservation only, of the patrimony of our ancestors; and that by opening to the understanding a different way, than hath bin known to former ages; and clearing the glass to the letting in of a more plentifull light”[173]. The Royal Society executed Bacon’s program, organised meeting on an eclectic variety of subjects and build an exotic repository with “Monstrous Works of Nature”[174]. On the continent, Leibniz who had filled manuscripts with descriptions and analyses of many of the curiosities described in *Récréations Mathématiques* had plans for “a new sort of exhibition”. Described by himself as “an odd idea”, he imagined “an Academy of Sciences” putting on display machines including “Magic Lanterns, (we might begin with these), flights, artificial meteors, all sorts of optical wonders; a representation of the heavens and stars of comets; a globe like that of Gottorp at Jena; fire-works, water fountains”[175]. Apparently

[172] René Descartes, *Oeuvres*, VI, pp. 226, English translation from Paul Olscamp; Descartes, *Discourse on Method, Optics, Geometry and Meteorology*, (Cambridge: Hackett, 2001), p. 332.

[173] Francis Bacon, O*perum moralium et civilium tomus Qui continet historiam regni Henrici Septimi, Regis Angliae. Sermones fideles, sive interiora rerum. Tractatum de sapientîa veterum. Dialogum de bello sacro. Et Novam Atlantidem. Ab ipso honoratissimo auctore, praeterquam in paucis, Latinitate donatus. Curâ & fide Guilielmi Rawley, Sacrae Theologiae Doctoris, olim dominationi suae, nunc Serenissimae Majestati Regiae, à sacris. In hoc volumine, iterum excusi, includuntur Tractatus de augmentis scientarum. Historia ventorum. Historia vitae & mortis. Adjecti sunt, in calce operis, libri duo Instaurationis magnae. Cum priuilegio*. (London: Excusum typis Edwardi Griffini, John Haviland, Bernard Norton, and John Bill; prostant ad Insignia Regia in Coemeterio D. Pauli, apud Richardum Whitakerum [and John Norton], 1628). From the Preface to the reader in the English translation: Francis Bacon, *Of the advancement and proficience of learning, or, The partitions of sciences, IX bookes written in Latin*; interpreted by Gilbert Wats, (Oxford: Printed by Leon. Lichfield .. for Rob. Young & Ed. Forrest, 1640).

[174] Thomas Spratt, *The history of the Royal Society, for the improvement of Natural Knowledge*, (London: J. Martin and J. Allestry, 1722), p. 251.

[175] Leibniz, “Drole de Pensee touchant une nouvelle sorte de Representations”, Sept. 1675. Transcription in: Ernst Gerland, “Leibnizens Nachgelassene Schriften Physikalischen, Mechanischen Und Technischen

he got the idea from an exhibition he witnessed at the river Seine in Paris, and describes "a machine for walking on water". One can have doubts about the feasibility of such "machine", but curiously a drawing of a man walking on the water, with wooden clubs attached to his feet is found in *Deliciae Physico-Mathematica*[176]. It is very likely that Leibniz got his idea for his exhibition through *Récréations Mathématiques* or Schwenter's adaption. At least, the early years of the scientific academies, bear witness of a curiosity and a taste for the strange and the exotic, not different from the first compilers of magic recipes and recreational problems. But times had changed and the procedures of enquiry had evolved to the seventeenth century standards of natural philosophers.
Hereby we concluded our study of *Récréations Mathématiques*, an occasion to sketch the historical evolution from magic recipes to recreational mathematics. The intermediate steps this evolution, magic recipes and books on conjuring, parlour tricks and cabinets of curiosities continued to be published for centuries besides each other. However, we argued that in the sixteenth century the evolution from magic books, over conjuring to popular science was a general one which not only contributed to the emergence of recreational mathematics but was part of the general evolution from natural magic to experimental science.

Inhalts" *Abhandlungen zur Geschichte der mathematischen Wissenschaften mit Einschluss ihrer Anwendungen*, XXI Heft, 1906, 256 p. Technischer Teil, Anhang 134, pp. 246-250. Translated by Philip Wiener, "Leibniz's project of a public exhibition of scientific inventions", *Journal of the History of Ideas*, Vol. 1, No. 2. (Apr., 1940), pp. 232-240.
[176] Schwenter, *Deliciae Physico-Mathematica*, p. 465.

Appendix A: The Alegambe biography of Leurechon

Ioannes Levrechon, nationes Lotharingus [Lorraine] patrie Barroducaeus [Bar-le-Duc], in dioeeesi Tullensi anno 1609 ingressus est in Societatum annum agens aetatis 18. Quatuor votorum professionem anno 1625 emisit. Docuit sexennio Philosophiam, decennio Mathematicam, Theologiam etiam tam Scholasticam, quam Moralem, sacrasquc litteras aliquot annis explicuit. Rexii Collegium Barroducaeum, et Serenissimo Duci Lotharingiae mulis annis à factis Confessionibus fuit. Vir omni genere scientiae apprime ornatus, et singulari pietatis humilatis, simplicitatis, et obedientiae ubicumque vixit, laude cummulatus. Ante ingressum in Societatum non vulgare argumentum futurae olim virtutis in ea dedit, quando inaudito à parentibus experimento probatus, ut à proposito dimoverent, perstitit immotus. Eo siquidem venit mater, ut sicam intentaret uni ex Patribus tamquam seductori, et raporti filij Pater vero filium litigando repetiturus; cum Professor esset medicinae in Universitate Mussipontana [Pont-à-Mousson], abdicavit se officio, et in Barrensem Urbem patriam suam remigravit, ut inde ad Parisiensem Curiam causam evocaret, quamuis non sine gravi offensione Serenissimi Ducis Lotharingiae; perfecitque tandem, ut decreto Serenissimi subductus Novitius è tirocinio Nancaeiano [Nancy] ad Conventum Patrum Minimorum traductus fuerit. Ibi per mensem, quasi in sequestro positus, retento tamen habitu Societatis, quem nunquam exvere voluit, et alternis ferme diebus examine iuridico à Deputatis super vocatione sua interrogatus sie fatisfecit, ut per sententiam ludicum, redditus suo iuri, ac Societati fuerit. Nanceio tamen ad vitandam ulteriorem perfecutionem parentum missus fuit ad Tornacensem Novitiatum [Tournai], et post multos annos, ita genitorem sibi, ac Societati reconciliavit, ut ab eo fuerit testtamento scriptus haeres. Hanc nimirum constantiae suae palmam retulir. Nec illiud omittendum illustre caritatis Trophaeurm quando uni ex nostris peste afflato, Sacramenta Poenitentiae, et Eucharistiae administravit. Tandem plenus dierum et bonorum operum propè octogenarius migravit ad Dominum Mussiponti die 17 Ianuarij 1670.

Editit Gallicè tacito suo nomine:

Hilaria mathematica ex variis geometriae, mechanicae, cosmographiae, opticae et aliarum hujus modi artium problematis contenta. Mussiponti apud Hanselet 1624 in 8°.

Selectae propositiones in tota sparsim mathematica propositas, in solemni festo S.S. Ignatij, et Francisci Xaverij. Mussiponti, apud Sebastianum Cramoisy 1622, in 4°.

Rationem facillimam discribendi quam plurima et omnis generis Horlogia brevissimo temore ex Opticae principijs demonstratam. Mussiponti typis Melchionis Bernardi 1618.

De cometa anni 1618. Mussiponti typis ijsdem 1618. in 8° verit Gallicè.

Epistolam R.P.N. Generalis Mutij Viteleschi, de Iubelio Societatis. Item.

Ferdinandi il. Imperatoris virtutes, Latine prius editas à P. Guilielmo Lamormaini nostro.

Appendix B: Conspectus of problems from the English editions

The 1624 and 1628 columns list the numbers of the corresponding problems in these French editions. The 1633 column gives the page numbers of the first English edition. The English edition does not include problems 14, 15, 47, 48, 49 and 66 from the original French edition.

Nr	Problem	1624	1628	1633
E1a	To finde a number thought upon	1a	1a	1
E1b	Another way to finde what number was thought upon	1b	1b	2
E1c	To finde numbers conceived upon otherwise than the former	1c	1c	3
E002	How to represent to the these which are in a chamber that which is without, or all that which passeth by	2	2	6
E003	To tell how much waighs the blow of ones fist, of a mallet or suc’s like, or resting without giving the blow.	3	3	9
E004	How to breake a staffe which is laid upon glasses full of water, without breaking the glasse, spilling the water, or upon two reeds or strawes without breaking them.	4	4	12
E005	How to make a faire geographical card in a garden plot, fit for a prince, or great personage.	5	5	14
E006	How three staves, knives, or likebodies may be conceaved to hang in the aire, without being supported by any thing, but themselves.	6	6	15
E007	How to dispose as many men, or other things in such sort that rejecting, or crafting away the 6 , 9, 10 part, unto a certaine number, there shall remaine these which you would have.	7	7	17
E008	Three things, and three persons proposed, to finde which of them hath either of these three things.	8	8	19
E009	How to part a vessell which is full of wine containing 8 pints, into equall parts, by two other vessels which contained as much as the greater vessell, as the one being 5 pints and the other 3 pints.	9	9	22
E010	To make a sticke stand upon the tipp of ones finger, without falling.	10	10	24
E011	How a milstone or other ponderositie, may be supported by a small needle without breaking or any wise bowing the same.	11	11	26
E012	To make three nives hang and move upon the point of the needle.	12	12	27
E013	To finde the weight of smoake, which exhaled of any combustible body whatsoever.	13	13	27
E014	Many things being disposed circular (or otherwise) to find which of them, anyone thinkes upon.	16	16	28
E015	How to make a dore, or a gate, which shall open on both sides.	17	17	30
E016	To shew how a ponderositie, or heavie thing may be supported upon the end of a staffe (or such like) upon a table and nothing holding or touching it.	18	18	30
E017	Of a deceitfull bowle to play withall.	19	19	32
E018	To part an apple into 2, 4 or 8 like parts, without breaking the rind.	20	20	33
E019	To find a number thought upon without asking any questions, certain operations beind done.	21	21	33
E020	How to make an uniforme, and an inflexible body, to passe through two small holes of divers formes, as one being circular and the other square, quadrangular, and triangularwise, yet so that the holes shall be exactly filled.	22	22	35
E021	How with one uniform body or such like to fill three several holes: of which the one is round, the other a just square; and the third an ovall forme.	23	23	37
E022	To finde a number thought upon after another manner, than that which is formely delivered.	24	24	39
E023	To finde out many numbers that sundry persons, or one man hath thought upon.	25	25	40

E024	How is it that a man in one and the same time, may have his head upward, and his feet upward, being in one and the same place.	26	26	41
E025	Of a ladder by which two men ascending at one time; the more they ascend the more they shall be asunder, norwithstanding one being as high as another.	27	27	42
E026	How is that a man having but a rode or pole of land; doth bragge that he may be in a right line passe from place to place above 3000 miles.	28	28	42
E027	How is that a man standing upright, and looking which way he will, he looketh true north and south.			43
E028	To tell any what number remaines after certaine operations being ended, without asking any question.	29	29	44
E029	Of the play with two several things.	30	30	45
E030	Two numbers being proposed unto two severall parties, to tell which of these numbers is taken by each of them.	31	31	46
E031	How to describe a circle that shall touch 3 points placed howsoever upon a plaine, if they be not in a right line.	32	32	47
E032	How to change a circle into a square forme.	33	33	48
E033	With one and the same compasses, and at one and the same extent, or opening, how to describe many circles concentricall, that is, greater or lesser one than another.	34	34	49
E034	Any number under 10 being thought upon, to find what numbers they were.	35	35	51
E035	Of the play with the ring.	36	36	52
E036	The play of 3, 4 or more dice.	37	37	53
E037	How to make water in a glasse seeme to boyle and sparkle.	38	38	54
E038	Of a fine vessell which holds wine or water, being cast into it at a certain height, but being filled higher, it will runne out of its wone accord.	39	39	56
E039	Of a glasse very pleasant	41	41	58
E040	If any one should hold in each hand, as many peeces of money as in the other, how to find how much there is.	42	42	59
E041	Many dices being cast, how artificially to discover the number of points that may arise.	43	43	60
E042	Two mettals as gold and silver, or other kind weighing alike, being privately placed into two boxes, to finde which of them the gold or silver is in.	44	44	62
E043	Two globes of diverse mettles (as one gold and the other copper) yet of equall weight being put into a boxe as B.G. to finde in which end the gold or copper is.	45	45	65
E044	How to represent diverse sorts of rainebowes here below.	46	46	66
E045	How that if all of the powder in the world were inlosed within a bowle of paper or glasse, and being fired on all parts, it could not breake that bowle.	50	50	68
E046	To finde a number which being divided by 2 there will remaine 1, being divided by 3 there will remaine 1, and to likewise being divided by 4, 5 or 6, there would still remaine 1; but being divided by 7, there would remaine nothing.	51	51	69
E047	One had a certaine number of crownes, and counting them by 2 and 2, there rested 1: counting them by 3 and 3, there rested 2: counting them by 4 and 4, there rested 3: counting them by 5 and 5, there rested 4: counting them by 6 and 6, there rested 5: counting them by 7 and 7, there remaines nothing: how many crownes might hee have.	52	52	71
E048	How many sorts of weights in the least manner must ther be to weigh all sorts of things betweene 1 pound and 10 pound, and so unto 121, and 364 pound.	53	53	71
E049	Of a deceitfull balance which being empty seemes to be just, because it hangs in equilibrio: notwithstanding putting 12 pound in one balance, and 11 in the other it will remaine equilibrio.	54	54	72
E050	To heave or lift up a bottle with a straw.	55	55	74
E051	How in the middel of a wood or desert, without the sight of the sunne, starres, shaddow or compasse, to find out the north or south, or the foure cardinall points of the world, east, west, etc.	56	56	75
E052	Three persons having taken counters cards, or other things, to finde how much	57	57	77

	each hath taken.			
E053	How to make a consort of musicke of many parti with one voyce, or on einstrument only.	58	58	78
E054	To make or describe an ovall forme, or that which neare resembles a paire of common compasses.	59	59	79
E055	Of a purse difficult to be opened.	60	60	80
E056	Wether it is more hard and admirable without compasses to make a perfect circle, or being made to finde out the center of it.	61	61	82
E056	Any one having taken 3 cards, to finde how many points they containe.	62	62	83
E057	Many cards placed in diverse rankes, to finde which of these cards any one had thought.	63	63	84
E058	Many cards being offered to sundry persons to finde of those cards any one thinketh upon.	64	64	86
E059	To make an instrument to helpe hearing, as Gallileus made to helpe the sight.	65	65	87
E060	Of a fine lampe which goes not out, though one carry it in one pocket: or being rouled upon the ground will still burne.	67	67	88
E061	Any one having thought a card amongst many cards, how artificially to discover it out.	68	68	89
E062	Three woman A, B, C carryed apples to a market to sell, A had 20, B 30 and C 40; they sold as many for a penny, the one as the orther; and brought home one as much money as another, how could this be.	69	69	90
E063	Of the properties of some numbers.	70	70	91
E065	Of an excellent lampe which serves or furnisheth it selfe with oyle, and burnes a long time.	71	71	95
E065	Of the play at Keyles or nine pinnes.	72	72	97
E066	Of spectacles of pleasure.	73	73	98
E067	Of the adamant or magnes, and the needles touches therewith.	74	74	99
E068	Of the properties of Aelipiles or bowles to blow the fire.	75	75	108
E069	Of the thermometer: or an instrument to measure the degrees of heat and cold in the aire.	76	76	110
E070	Of the proportion of humaine bodies of statues, of colossus or huge images, and of monstrous giants.	77	77	113
E071	Of the game at the palme, at trappe, at bowles, paile-maile and others.	78	78	122
E072	Of the game of square formes	79	79	124
E073	How to make the string of a viole sencibly shake, without any one touching it.	80	80	126
E074	Of a vessel which containes three severall kinds of liquer, all put in at one bung-hole, and drawne out at one tappe severally without mixture.	81	81	128
E075	Of burning glasses	82	82	129
E076	Containing many pleasant questions by way of arithmetic.	83	83	134
E077	Divers excellent and admirable experiments upon glasses	84	84	141
E078	How to show to one that is suspitious, what is done in another chamber or roome: notwithstanding the interpositions of the wall.	84	84	160
E079	How with a musket to strike a marke, not looking towards it, as exact as one aymed at it.			162
E080	How to make an image to be seene hangin in the aire, having his head downward.	84	84	164
E081	How to make a company of representive souldiers seeme to be a regiment, or how few in number may be multiplyed to semme to be many in number.	84	84	165
E082	Of fine and pleasant dyalls.	85	85	166
E083	Of cannons or great artilery, souldiers and others would willingly see this probleme which conatines thre or foure subtile questions: the first is how to charge a cannon without powder.	86	86	173
E084	On prodigious progression and multiplication of creatures, plants, fruites, numbers, gold, silver, etc. when they are alwayes augmented by certaine proportion.	87	87	178

E085	Of fountains, hydiatiques, machinecke and other experiments upon water or other liquor.	88	88	190
E086	On sundry questions of arithmeticke, and first of the number of sands.	89	89	208
E087	Witty suits or debates betweene Caius and Sempronius, upon the forme of figures which geometricians call isoperimeter or equall in circuit or compasse.	90	90	214
E088	Containing sundry questions in matter of cogmography.	91	91	219
E092	To finde the bissextile year, the dominical letter and the letters of the moneth.		1	222
E093	To finde the new and full moone in each moneth.		2	224
E094	To finde the latitude of a countrey.		3	225
E095	Of the climates of countries, and to finde in what climate any country is under.		4a	225
E096	Of longitude and latitude of the earth and the starres.		4b	227
E097	To make a triangle that shall have three right angles.		5	234
E098	To divide a line in as many equall parts as one will, without compasses or without seeing of it.		6	235
E099	To draw a line which shall incline to another line, yet never meete: against the axiome of parallels.		7	236
E100	To observe the variation of the compasses, or needle in any places.		9	237
E101	How to finde at any time which way the wind is in ones chamber, without going abroad.		10	238
E102	How to draw a parallell spherical line with great ease.			239
E103	To measure an inaccessible distance: as the breadt of a river with the helpe of ones hat onely.		11	240
E104	How to measure a height with two strawes or two small stickes.		12	240
E105	How to make statues, letters, bowles or other things which are placed in the side of a high building, to be seene below from an equall bignesse.		18	240
E106	How to disguise or disfigure an image, as a head or an arme, a whole body, etc, so that it hath no proportion, the eares to become long: the nose as that of a swan, the mouth as a coaches entrance, etc yet the eye placed at a certaine point will be seeme in a direct and exact proportion.		19	241
E107	How a canon after that it hath shot may be covered from the battery of the enemy.		20	244
E108	How to make a lever by which one man may alone place a cannon upon his carriage, or raise what other weight he would.		21	245
E109	How to make a clocke with one onely wheele.		22	244
E110	How by helpe of two wheeles to make a child to draw up alone a hogshead of water at a time: and being drawne up shall cast out it selfe into another vessel as one would have it.		23	245
E111	To make a ladder of cords which may be carryed in one pocket: by which one may easily mount up a wall, or tree alone.		24	248
E112	How to make a pump whose strenght is marvelous by reason of the great weight of water that is able to bring up at once, and so by continuance.		25	249
E113	How by meanes of a cisterne, to make water of a pit continually to ascend without strenght, or the assistance of any other pumpe.		26	248
E114	How out of a fountaine to cast the water very high: different from a probleme formerly delivered.		27	251
E115	How to empty the water of a cisterne by a pipe which shall have a motion of its selfe.		28	252
E116	How to squirt or spout out a great height so that one pot of water shall last a long time.		29	253
E117	How to practice excellently the reanimation of simples, in case the plants may not be transported to be replanted by reason of distance of places.		30	255
E118	How to make an infailliable perpetuall motion.		31	255
E119	Of the admirable invention of making the philosopher's tree, which one may see with his eye to grow by little and little.		32	256
E120	How to make the representation of the great world.		33	257

E121	How to make a cone, or pyramidall body move upon a table without springs or other artificial meanes, so that it shall move by the edge of the table without falling.		34	258
E122	To cleave an anvill with the blow of a pistoll.		35	258
E123	How to rost a capon carried in a budget at a saddel bow, in the space of riding 5 or 6 miles.		36	259
E124	How to make a candle burne and continue three times as long as otherwise it would.		37	259
E125	How out of a quantitie of wine to extract that which is most windy, and evill, that it hurt not a sicke person.		38	260
E126	How to make two marmouzets one of which shall light a candle, and the other put it out.		39	261
E127	How to keep wine fresh as if it were in a cellar though it were in the heate of summer, and without ice or snow, yea though it were carried at a saddles bow, and exposed to the sunne all the day.		40	262
E128	To make a cement which indureth or lasteth as marble, which resisteth ayre and water without ever disjoyning or uncemiting.		41	262
E129	How to melt mettle very quicke, yea in a shell upon little fire.		42	263
E130	How to make iron or steele exceedingly hard.		43	263
E131	To preserve fire as long as you will, imitating the inextinguable fire of Vostales.		45	264