

## Chapter 2

# Ramus and the History of Mathematics

### Introduction

Peter Ramus (Pierre de la Ramée, 1515–1572), was born in Picardy, the son of a once wealthy family, now severely impoverished. Despite his family's financial condition, Ramus gained entrance to the University of Paris, where he paid his way by working as a servant to wealthier students. Eventually he became a teacher, at various small colleges of the University – a life of academic obscurity that was ended by his publication in 1543 of two books based on his lectures to undergraduates, in which he subjected Aristotle to remorseless attack. This led to his being banned from teaching philosophy at the University (an interdict that was, in part, the work of his great opponent Jacques Charpentier, who will figure largely in these pages). In 1551 he was not only restored to philosophical teaching but even elevated to a regius professorship in the Collège Royal – a position he held (with some interruptions) until his murder in 1572, at the hands of rioting Parisians during the St Bartholomew's Day massacre.<sup>1</sup>

In this chapter, I trace the development in Ramus's writings of a historical narrative of ancient mathematics. As I will show, at the beginning of his career, Ramus thought very highly of ancient mathematics, and particularly of Euclid. He gave the art a history commensurate with this view: repeating the stories about the ancient origins of mathematics, he assumed that it had remained quite the same in its transmission from the ancient patriarchs to the mathematicians of the Greek world. Over time, however, Ramus's view of mathematics changed, becoming much more critical of the state of Greek mathematics (again, with the focus on the *Elements* of Euclid); and as his attitude towards mathematics shifted, so did his history of mathematics. He laid out this history in various prefaces he wrote to mathematical works that he published. These often sketchy, abbreviated accounts of the development of mathematics nevertheless bespeak a growing engagement with the science,

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<sup>1</sup> On Ramus's biography see Waddington (1855) and Ong (1958a) – with caution, as each is a partisan history, in its own way. The literature on Ramus's logic and other scholarship is vast; for surveys of the field see Sharratt (1972), Sharratt (1987) and Sharratt (2000). Meerhoff (2001) has been particularly formative on my understanding of Ramus's arts. See also Goulding (2006b).

in which problems in its history were becoming central to Ramus's understanding of the arts in general. In the course of these works, one can see Ramus working out his thinking on issues that would receive a full treatment in his 1567 *Prooemium mathematicum* – the full-scale history of mathematics that is the subject of the next chapter.

## Ramus and the Reform of Dialectic

Ramus was, at first sight, the least likely person to write an influential history of mathematics. He was no great mathematician himself. His sympathetic biographer Nicholas Nancel related that Ramus would spend the mornings being coached in mathematics by a team of experts he had assembled, and in the afternoon would lecture on the very same subjects.<sup>2</sup> Ramus was from his earliest career a logician, and remained one in all his works, whether writing on mathematics or Virgil. Moreover, he conceived of all the arts – and especially mathematics – as unchanging structures of necessarily true propositions.<sup>3</sup> There seemed to be little room for historical development in the sciences as he imagined them.

Yet there can be no doubt that Ramus held mathematics in particular esteem. It has been argued, in fact, that he played a crucial role in linking philosophical discourse to mathematics and in promoting the use of quadrivial reasoning in the study of the natural world.<sup>4</sup> The origins for his enthusiasm for mathematics are to be found in his account of the nature of the arts and critique of the curriculum of the universities; his career as a *historian* of mathematics, I will argue, was directed by problems that arose in that theory as he began to immerse himself in the sciences of the ancient world.

Ramus set out his fundamental positions in his very first printed work, the *Dialecticae institutiones (Education in dialectic)* of 1543, a contribution to the on-going humanist attack on scholastic logic, in which he rehearsed many of the commonplace criticisms of the university dialectic. Humanists complained that logic no longer concerned itself with real human reasoning; instead, it had become a discipline studied for its own sake, wreathed in its own incomprehensible jargon, and of no practical interest at all. The new humanist dialectics of Lorenzo Valla and Rudolph Agricola, by contrast, attempted to teach the kind of practical reasoning useful for composing a speech or letter; these scholars borrowed extensively from the rhetorical works of Cicero and Quintilian to develop a highly rhetoricized logic. Questions about the formal validity of arguments were of little interest to the

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<sup>2</sup> Sharratt (1975, 198–200).

<sup>3</sup> See, for instance, Ramus (1543a, fol. 31v): “... nam si res constantes sunt et aeternae, earum disputatio, explicatioque firmis, perspicuis, necessariis argumentis addici debet.” (“For if things themselves are constant and eternal, then any discussion about them, or explanation, must rely on strong, clear and necessary arguments.”)

<sup>4</sup> See Reiss (1997) and Reiss (2000).

practitioners of this new humanist logic; what mattered was whether the arguments were persuasive.<sup>5</sup>

In his *Dialecticae institutiones*, Ramus took the humanist reformulation of dialectic a step further. He argued that dialectic – or, in fact, any art or science – consisted of three elements: nature, doctrine and exercise. The natural workings of the mind formed the most basic and significant element, with exercise or practice coming second. The third element, doctrine, was nothing more than a record of natural reasoning; in importance it paled next to nature and practice.<sup>6</sup> The logic of the universities bore no resemblance to the true, natural dialectic, as Ramus argued at length in the companion volume to the *Institutiones*, the innocuously titled but exuberantly offensive *Aristotelicae animadversiones* (*Observations on Aristotle*).<sup>7</sup> The question, then, remained: how do we gain access to this “natural reasoning?”

Ramus’s answer was surprising. He directed his reader to find a group of men – *not* scholars, but completely uneducated vineyard workers. Question them about the coming year: the fertility of the soil, the quality and quantity of the crop. “And then (he wrote) from their minds, as from a mirror, an image of nature will be reflected.”<sup>8</sup> In the reasoned replies of these uneducated men, Ramus said, one discovered every part of logic needed for *any* purpose, whether everyday discourse or the composition of poetry: the invention of arguments, the assessment of their truth and their proper and orderly presentation. Other humanists had praised man’s natural logical faculties and distrusted the artificial, but Ramus was the first to look beyond the walls of the university and the writings of the ancients to find natural dialectic at work in the world around him.

If even the uneducated possessed some grasp of the arts, then the arts taught at the university should do no more than clear away the misleading junk in the mind, and allow its natural clarity to shine through.<sup>9</sup> Logic should be easy to learn. For Ramus this was not merely a pedagogic ideal; a natural art, if truly natural, required only practice and minimal guidance. And if logic as it was taught was *not* easy to learn (and such were the mind-boggling complexities of scholastic logic) then that was a good sign that it was not the natural art but something “fabricated” (a *commentitium*, one of Ramus’s favorite critical terms).<sup>10</sup>

In order to restore an art to its natural simplicity, it needed organization or “method,” a term for which Ramus became and has remained famous (or notorious,

<sup>5</sup> See Copenhaver (1992, pp. 29–30), and especially pp. 223–225 on Valla’s rhetoricizing of philosophy.

<sup>6</sup> Ramus (1543a, fols 5v–6r): “Comparatur igitur dialectica, sicuti vis artium reliquarum, natura, doctrina, exercitatione. . . . [Doctrina] (cui perpauculum loci reliquum est) sola extrinsecus a magistris assumenda est.”

<sup>7</sup> Ramus (1543b).

<sup>8</sup> Ramus (1543a, fol. 6v): “. . . tum ex eorum ingeniis veluti speculis imago naturae resultabi.”

<sup>9</sup> *Ibid.*, fol. 7v: “. . . ut hoc artificioso quasi speculo natura formae suae dignitatem perspicere, et si qua macula sit aspersa, delere atque eluere possit.”

<sup>10</sup> See Ong (1958a, pp. 45–47) for Ramus’s use of this term, beginning with his infamous master’s disputation “Quaecumque ab Aristotele dicta essent, commentitia esse.”

depending on one's point of view). Although the term did not occur in the 1543 works, the same concept did, under the name "second judgment" (so called because it followed his treatment of "first judgment," or the assessment of syllogistic and other forms of argument).<sup>11</sup> There was, claimed Ramus, a unique way to organize any art: from the most general propositions to the most specific, an arrangement often realized by dividing and subdividing categories into two. In later writings, he would describe this process by invoking a striking image. Suppose that all of the "facts" of grammar or any other art were written out onto hundreds of slips of paper, and then shaken up together into an urn. The skilled dialectician should be able to pick out the slips one by one, and place each in its unique position in the sweep from general to particular.<sup>12</sup>

The conclusion must be that there is a unique, correct order to be imposed on the discovered facts of any art. Moreover, this order is *natural*, in two ways: it reveals the real structure of the world,<sup>13</sup> and – as Ramus argued at length in his discussions of natural capacities and art – it conforms to the structure of the human mind.<sup>14</sup> This was the crucial point. In the case of dialectic, the methodized art was not just a useful way to arrange the precepts of logic, but a representation of the deep structure of discourse, and hence of the human mind, the instrument of discourse and the natural source of dialectic. In exactly the same way, a methodized physics would itself be a reflection of the structure of the world. Moreover, because such a physics would have a dialectical structure, it too would conform perfectly to the human mind. And, in each case, this logical structure would reflect the order in the mind of God, who created both the human mind and the physical world that it inhabits.<sup>15</sup>

Ramus made explicit the metaphysical linkage of nature, God and dialectic in the central section of his 1543 *Dialecticae insitutiones*. In a dense and difficult passage on "third judgment," Ramus's contentious anti-Aristotelianism verged into an idiosyncratic form of Platonism. The third form of judgment, he wrote, was the next and final step beyond second judgment (or method). By third judgment, the entire structure of all the arts was revealed to the human mind. He explained:

There remains the final step of dialectical judgment, concerned with perceiving that power of the human sciences which is directed towards the ultimate end of all things. Through it,

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<sup>11</sup> Ramus (1543a, fols 27r–30v).

<sup>12</sup> This image first appeared in the *Dialectici commentarii tres*, issued under Omer Talon's name in 1546 while Ramus was banned from teaching philosophy. The relevant passage is translated in Ong (1958a, pp. 245–246).

<sup>13</sup> See, for instance, Ramus (1543a, fol. 34v). Having described the affinity of his "second judgment" with the Platonic notion of individuals emanating from ideas, he wrote: "Herein lies the most beautiful correspondence of the art with the wisdom of nature." ("Haec artis est cum naturae sapientia, pulcherrima contentio.")

<sup>14</sup> In the conclusion to the 1543 dialectic, he claimed that a first approximation to the untaught, natural logic could be found in his own logic, "which expresses in all its parts an image of natural dialectic – crude and unpolished, no doubt, but nonetheless a true and dependable image." (Ramus, 1543a, fol. 58r): "qui . . . dialecticae naturalis imaginem quamvis rudem, impolitamque, tamen veram constantemque membris omnibus expresserit.")

<sup>15</sup> This point is made at length – based on a study of Ramus's *Dialectique* – in Walton (1970).

the reward of human labor can be judged and the most excellent parent and author of all things can be recognized.<sup>16</sup>

The process by which one attained such an intuition was banal enough. The dialectician should begin by constructing a methodized image of all the arts together, filling in as many details as he could. Third judgment itself, the highest point of education consisted of recovering this total structure, a process which would cleanse the mind of its false beliefs and allow it to recognize its innate dialectical constitution. The newly-cleansed mind, which would naturally take up into itself the whole universe of discourse, was very nearly an image of the mind of God.<sup>17</sup>

Ramus illustrated his third judgment with a reference to Plato's myth of the cave. Human beings were like Plato's prisoners, compelled to look upon the shadowy play of sensory particulars. In Ramus's interpretation, the light-source behind the prisoners' heads was God; its light was human reason and dialectic. The objects casting the shadows were "the genres of things and the species contained in the arts;" and the shadows themselves, "delicate, flickering with the lightest of motions, are all the things that can be touched, heard, seen and perceived through the other senses."<sup>18</sup> Freeing oneself from the chains in the cave, one turned from these illusory shadows to gaze upon the "reality" of dialectic itself, spreading out like a web behind the discrete particulars of the world.

It was from this lofty summit of dialectic that Ramus invoked the highest science of all, mathematics. The mind, once freed from its shackles, would take in the arts properly and entirely for the first time. Beginning with grammar and rhetoric, it would proceed to moral philosophy and physics, and at last find rest in mathematics.<sup>19</sup> In the next passage, Ramus posited an interesting, two-way movement between mathematics and dialectic. The dialectician, at the height of his attainment, would approach the mathematical arts in a special way through the dialectical third judgement giving them a privileged role in understanding the world.<sup>20</sup> At the same time, however, the mathematical arts themselves began to take on the very qualities of dialectic itself: liberating human minds from the chains in which they were held, illuminating the world and all of the arts – in short, allowing one to transcend the

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<sup>16</sup> Ramus (1543a, fol. 35r): "Postremus superest dialectici iudicii gradus in perspicienda scientiarum humanarum virtute ad supremum rerum omnium finem referenda positus, ut laboris humani fructus possit aestimari, et optimus rerum omnium parens, atque author agnosci."

<sup>17</sup> Ramus (1543a, fols 37r–v): "But when dialectic freely marvels at everything, then it will turn in towards itself and begin greatly to marvel at itself, and it will not be able to judge that it is not the divine image of the divine mind." ("Sed cum haec omnia dialectica libenter admirabitur, tum in seipsam conversa vehementius incipiet admirari, et divinae mentis imaginem non divinam non poterit arbitrari.")

<sup>18</sup> Ramus (1543a, fol. 36v): "Imagines medio interiectae spatio, genera rerum, speciesque disciplinis et artibus comprehensae, quarum tenues, levissimoque motu nutantes umbrae, sunt haec omnia, quae tangi, audiri, cerni, caeterisque sensibus percipi possunt."

<sup>19</sup> Ramus (1543a, fols 36v–37r).

<sup>20</sup> Ramus (1543a, fol. 39v): "Itaque cum has disciplinas lumine suo dialectica lustraverit, quanto iam plenius naturalium principia rerum, et umbrarum illarum causae cernentur."

limitations of the human condition and approach the perfect knowledge of God.<sup>21</sup> Mathematics was both perfected by dialectic and identical with dialectic; and the paradox which seemed to arise from this dual conception was indeed only apparent. *All* the arts were, in their deepest “methodical” structure, dialectical, as was the world which formed their subject of investigation. Mathematics, however, was the most purely dialectical, insofar as it was eternally, indisputably, and necessarily true – and everyone agreed it to be so. The fact that such a perfect science existed, and existed so *undeniably*, validated Ramus’s metaphysics of art, tying together in the clearest way the action of the human mind, the world which confronted it, and the deity who was the source of both the world and the commensurate structure of the human intellect.

## The Turn to History

As I have said, such a theory of knowledge did not appear to leave much room for historical development within the arts. There was, after all, only one possible art of dialectic or mathematics, imitated from the structure of the human mind and expressed through a network of connections which obtained necessarily and eternally. Ramus’s dissatisfaction with the sciences of the university curriculum, however, compelled him to face a set of historical questions. If human beings had the structure of the arts hard-wired, as it were, in their minds, one might expect that they would develop mastery of the arts spontaneously. It was a puzzle, then, that so many were unaware of this structure, that there was dissent over the nature of the arts, that (in short) people needed to rely on the arts to recover their natural skills.

In his 1543 *Remarks on Aristotle*, Ramus attempted a preliminary answer to these questions by way of a historical narrative. He wrote that the art of dialectic was first formulated (though in a crude way) by Prometheus, systematized by Zeno of Elea, and brought to perfection by Plato. These authors developed their art through observation and use; theirs was a *genuine* dialectic, just as Ramus had described it in the *Institutiones*. Yet this promising beginning was soon squandered: “Up to this point, dialectical truth, and the employment of that truth was simple and naked. Henceforth, it began to be distorted and corrupted.”<sup>22</sup> For Ramus, the ill-employment of a natural faculty built up habits that gradually obscured the innate art. Who was to blame? The subsequent decline of the practice of dialectic (and hence the effacement, through bad education, of our natural dialectic itself) Ramus laid at the feet of Aristotle:

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<sup>21</sup> Ramus (1543a, fol. 40v): “Hominem corporis exigui, velut carceris angusti custodia constrictum querimus? Mathesis liberat, seu potius hominem hac mundi universitate maiorem reddit.”

<sup>22</sup> Ramus (1543b, fol. 2v): “Hactenus veritas dialectica, veritatisque utilitas simplex et nuda fuit, quae deinceps turbari et corrumpi coepit.”

And so, as we can know from the texts of old writers, Aristotle with his books was the first to spoil the simple truth and practice of the ancients.<sup>23</sup>

In a striking phrase, he accused Aristotle's craven followers of "sui desperatio:" losing faith in themselves.<sup>24</sup> So little did they esteem their natural abilities that they allowed themselves to become intoxicated by their teacher's claims to authority. This would become Ramus's central theme in his histories of the arts. Each art, he imagined, once possessed a primal simplicity. But corruption crept in, by the ineptitude and arrogance of a single author and his followers: they elevated personal ingenuity and fabrication over the unspoiled action of nature, eventually overshadowing it all together. It was hardly a coincidence that Ramus identified the originators of corruption with the standard university authors: Aristotle destroyed dialectic, Cicero corrupted rhetoric<sup>25</sup> and so forth. Students were estranged from their natures and their innate talents because the schools and universities, which should have been gently polishing the mirrors of their natures, were instead clouding them with the false so-called knowledge of the authorities.

In Ramus's account of dialectic, history was all but forced upon him. The enormous disconnect between simple, natural reasoning and the artificial problems of the modern logicians demanded an explanation, which only historical narrative could provide. At this early stage in his work, however, Ramus saw no need for a history of *mathematics* because he saw it, in its role as the ultimate end of third judgment, as essentially ahistorical. To put it another way, Ramus was delighted to find in mathematics a necessarily true and unchanging science, one which was also the purest expression of the natural dialectical order of the world (or so he thought). For Ramus, the unchanging existence of mathematics as a realized, perfect science was the clearest indication that his conception of the arts was essentially correct.

## Ramus Engages with Mathematics

Ramus's attacks on Aristotle and modern logic provoked immediate fierce opposition from within the University of Paris. In 1544, after a group of politically influential professors agitated for his removal, he was banned by royal order from teaching philosophy and both his books were suppressed.<sup>26</sup> It was then that Ramus first turned to a sustained consideration of mathematics; although it was the culmination of his philosophical system, it seemed he had hardly given the art much serious thought.<sup>27</sup> In an oration of November 1544, he announced his intention to

<sup>23</sup> Ramus (1543b, fol. 3r): "Primus igitur Aristoteles (quod ex veterum monumentis intelligi possit) simplicem antiquorum veritatem et exercitationem libris suis depravavit."

<sup>24</sup> *Ibid.*

<sup>25</sup> Ramus presented his argument against Cicero in Ramus (1549).

<sup>26</sup> See Waddington (1855, pp. 40–52).

<sup>27</sup> Ramus had most likely taught mathematics before his ban from teaching, but there is no firm evidence. A student's notes are extant, made during a course of Ramus's lectures on a textbook by Oronce Fine; but they may have been made as late as 1544. See Sharratt (1966).

devote himself to mathematics, leaving the teaching of rhetoric and grammar to his colleagues Omer Talon and Barthélemy Alexandre.<sup>28</sup>

In the course of the speech, Ramus expressed his admiration for the art and sketched out its history, emphasizing its great antiquity and unequalled reputation among the liberal arts. He admitted some regret at being banned from teaching philosophy; but the overarching purpose of the oration was to praise mathematics to such a degree that his turn to this art would seem an elevation rather than a retreat. In this oration, just as in his *Institutiones* of the previous year, mathematics was the most natural of arts, expressing the “free thoughts” of the mind.<sup>29</sup> It had, moreover, a history that surpassed that of the other arts. For, anticipating the charge that he intended to corrupt the youth by teaching them new subjects, Ramus pointed to testimonies of the ancients that demonstrated mathematics to be anything but “new.” Drawing on Josephus, Ramus observed that the mathematical arts had flourished well before the Flood, while grammar, rhetoric and philosophy had all been much later inventions of the Greeks.<sup>30</sup> The very first human beings had cultivated these arts, which they had passed on to later civilizations:

It was the first human beings, I say, who discovered this science. Most say that Adam, Seth and Noah discovered it; and that certain wise men among the Greeks – Pythagoras, Archytas and Timaeus – refined it. But I have labored too long over this point.<sup>31</sup>

The history of mathematics was not, indeed, Ramus’s primary theme in this oration, as his impatience to move on to other subjects shows. But he expressed certain ideas for the first time here, which would reappear frequently in later works more focused on history. First, the idea that mathematics was natural to the human mind remained constant throughout his career. In later writings, Ramus would question whether the particular form of mathematics bequeathed to Europe by the Greeks was in fact that natural mathematics, or whether it, like dialectic, had been somehow spoiled. In the 1544 oration, however, Ramus expressed no doubts about the nature of Greek mathematics: the mathematics he intended to teach was, he said, that which both the earliest human beings *and* the wisest Greeks had practiced.

Mathematics, said Ramus, was brought to a high state of perfection by Archimedes, who devised such marvelous applications,<sup>32</sup> and by Plato and the mathematicians among his followers. The sign over the door of the Academy – “let no one uneducated in geometry enter here” – showed the high regard in which Plato and

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<sup>28</sup> The text of this oration is at Ramus (1599, pp. 229–239).

<sup>29</sup> Ramus (1599, p. 231): “mathematicas artes invisamus, et animis (quorum sunt liberae cogitationes) velut praesentes et expositas intueamur” (“let us look upon the mathematical arts, and let us contemplate them as though they were present and put before our minds of which they are the free thoughts.”)

<sup>30</sup> *Ibid.*, p. 235.

<sup>31</sup> *Ibid.*, p. 232: “Primi, inquam, homines illi propagatores generis humani, Adamus, Sethus, Noëus, invenisse; excoluisse Graecae gentis quidam viri sapientes, Pythagoras, Archytas, Timaeus existimantur; verum diutius hic immoramur.”

<sup>32</sup> *Ibid.*, pp. 232–233.

his fellow Greeks held the art.<sup>33</sup> Here and elsewhere in his writings on mathematics, Ramus would single out Plato and Archimedes for the highest praise: Archimedes because of his emphasis on *use*, so crucial for Ramus, and Plato because Ramus saw him and Socrates as pioneers of the true dialectic.

Finally, there was Ramus's insistence that the mathematical arts were very old; older, in fact, than the other university arts. He would insist repeatedly in later writings that mathematics received its name (which means simply "learning" in Greek) because for many ages it was the *only* art studied. Its first students were the very first human beings – a mark of its superlatively natural character; this idea, too, Ramus would cleave to in all his later mathematical writings.

In his 1544 oration, then, Ramus adumbrated a number of themes that would occupy a central place in his historiography of mathematics. Yet, in this epideictic oration, he never addressed the question of how mathematics – a frozen snapshot of the real dialectical structure of the human and divine minds and the world – could have a history in the first place. How could change enter such a perfect art? The question must have occurred to Ramus himself, for in his next mathematical work he attempted to address it.

Within a few months of his oration on mathematics, Ramus published a Latin edition of Euclid's *Elements*, his first work devoted to the discipline.<sup>34</sup> This was hardly a great work of scholarship. Ramus printed the Latin text only, without any of the proofs or diagrams – that is, he published only the statements of the propositions. By the standards of the time, Ramus had some justification for his editorial decision to issue such a meager edition. A long tradition maintained that Euclid had not written the proofs, but that the Alexandrian mathematician Theon, who lived half a millennium after Euclid, was responsible for them. Ramus was aware of this tradition (it was, in fact, almost universally accepted in the Renaissance)<sup>35</sup> but he had other reasons for "removing the comments and figures of the interpreters"<sup>36</sup> as he put it in the preface to this edition. On a practical level, omitting them kept the price of the book down,<sup>37</sup> so that it could be used in every school. This was an important consideration, given the place of mathematics in Ramus's educational program: he envisioned the text of Euclid as a key building block of his curricular reform.

Even more to the point, Ramus simply did not see the need for demonstrations in the *Elements*. He referred to demonstrations not as proofs, but as "explanations"; and he suggested that if a student ran into difficulty understanding the material, it would be far easier for his teacher to "explain" it to him in person than for the

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<sup>33</sup> *Ibid.*, p. 234.

<sup>34</sup> Euclid (1549). The first edition of this work was published in 1545, but only a single mutilated copy survives (Ong, 1958b, p. 34). The edition of 1549 is quite common, and has often been taken to be the first edition; the work was reprinted again, without alteration, in 1558.

<sup>35</sup> On Ramus and the roles and identities of Euclid and Theon, see the sixth chapter.

<sup>36</sup> Ramus (1599, p. 121): "semotis interpretum et commentis et figuris."

<sup>37</sup> *Ibid.*

student to stare at a static diagram.<sup>38</sup> Ramus was still convinced (as he was in the *Institutiones*) that mathematics was an expression of natural dialectic. Here, he had no doubt that the *Elements* was a perfect record of that deep structure of the human mind. In fact, he explicitly identified the propositions of the *Elements* with the “golden chain” of dialectic linking God, human mind and created order, an image he had used for logic in his 1543 works.<sup>39</sup>

But, Ramus believed, as a “natural” science the facts of geometry would be easily and immediately taken up by the student. Therefore Ramus took no interest in the kind of mathematical demonstration found in the *Elements*.<sup>40</sup> To his very last writings on the subject, he would continue to insist that mathematical proof had no place in a genuine science founded upon nature. On the contrary, truths, when placed in their proper, “methodical” relationship with other truths (like the slips of paper drawn from an urn) were *self-evident*; if “explanations” were needed, that in itself indicated a departure from natural order. In the case of the *Elements*, Ramus thought that the proofs were simply superfluous: since Euclid had placed the truths of geometry into their optimal arrangement, the explanations could be omitted without loss of clarity.

As I have said, the problem of the possibility of historical change in mathematics seems first to have occurred to Ramus when he came to write the preface to his *Euclid*, very shortly after the 1544 oration.<sup>41</sup> Here he attempted to account for the problem by presenting a highly idiosyncratic interpretation of the Platonic theory of knowledge. He commended “Plato and Pythagoras” for their notion that mathematics was something divine, lying beyond the human senses; and he echoed an opinion of Proclus that the word “mathesis” meant essentially the same as “remembrance.”<sup>42</sup> The truths of mathematics were, according to Plato, impressed in the mind in imitation of the eternal exemplars of the first intelligence. But, in his gloss on this passage, Ramus did not consider the possibility that each *individual* recalled mathematics, like the slaveboy of the *Meno*. Rather, as he put it,

What they seem to mean is that so great a science was not invented by man but was divinely impressed in our souls, and by recollection of things that had been noticed was recovered little by little. But how long was that forgetting, and how late a remembering?<sup>43</sup>

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<sup>38</sup> *Ibid.*: “Si quid autem obscurum fuerit, longe commodius viva praeceptoris intelligentis oratio, quam picta in libris interpretum manus explicabit.”

<sup>39</sup> Ramus (1599, p. 120): “Hic enim prima mediis, media postremis, omniaque inter se, velut aurea quadam Homeri catena . . . vincta colligataque sunt. . .” (“For here the first are connected and linked to middles, middles to final like some golden chain of Homer”). For Ramus’s use of this image with reference to dialectic, see Bruyère (1984, p. 124).

<sup>40</sup> He does refer to “demonstrations” at the conclusion of the passage quoted in the previous note, but this refers to his own notion of “demonstration” – synonymous with proper, methodical ordering. From Ramus’s point of view, the actual proofs found in the *Elements* were merely elucidations and could be omitted without injury to the mathematical structure of the work.

<sup>41</sup> The preface is dated “5 Cal. Febr. 1544” – i.e., January 28, 1545 (Ramus, 1599, p. 121).

<sup>42</sup> Ramus (1599, p. 120).

<sup>43</sup> *Ibid.*: “quasi tanta scientia non ab homine inventa, sed divinitus in animis nostris impressa, recodatione animadversarum rerum paulatim recrearetur. Verumenimvero quam longa oblivio, quam

Ramus thus turned the Platonic notion of reminiscence into a process in history, and identified it with his own theory of the origins of arts: it was a re-collecting or recording (*recordatio*) of “things that are noticed” – in exactly the same way that dialectic was an art formed by noticing the best practices of natural reasoning. With this in mind, he retold the familiar narrative derived from Josephus, according to which the biblical patriarchs achieved extraordinary advances in the sciences, and were the source of all later Greek learning. Ramus interpreted this well-known story as one of gradual reminiscence or recovery. The first patriarchs, with their preternaturally long lives, could devote decades to observing and recording the mathematical action of the mind.<sup>44</sup> Faced with the impending Flood and concerned about human “forgetfulness,”<sup>45</sup> they inscribed their already substantial results on two pillars, which could withstand destruction by either fire or water. After the re-establishment of the human race, this primitive wisdom was rediscovered and spread through a continuous *translatio studii*: to the Egyptians, Greeks, Italians, Sicilians, Arabs, Spaniards, Germans and, last of all, the French. Countless men, he wrote, have been involved in this “work of recollection” (*recordationis opus*), like so many smiths and architects bringing the edifice of mathematics to perfection.<sup>46</sup>

Although Ramus identified mathematics with dialectic, at this point he invoked two very different historiographical models for the two arts. The story of dialectic was one of gradual discovery, leading up to a moment of perfection and completeness (with Plato), followed by a process of corruption brought on by human pride and arrogance. Mathematics, on the other hand, had developed constantly through “reminiscence” throughout history, though it was not yet complete. Ramus tried to find a compromise between the Josephan record of a *prisca scientia* stretching back to the very first human beings, and the undoubted ingenuity of Greek mathematicians. While mathematics began with Adam and had been transmitted to Ramus’s own time in an unbroken chain, the Jewish patriarchs were not doing anything *qualitatively* different from any other mathematician involved in the great act of remembering. It seems that Ramus would reject Josephus’s notion that Adam and the first humans had a superlative knowledge of mathematics which we can scarcely approach. Instead, Ramus clearly valued the Greek achievement: it was the *Elements*, after all, which had gathered together all the isolated mathematical facts from earlier practitioners and – like the grammarian picking slips of paper out of an urn – placed them all in just the *right* places.

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tarda recordatio ista fuit?” For other examples of Ramus’s assimilation of Platonic metaphysics to his own theory of knowledge, see Bruyère (1984, pp. 262–264).

<sup>44</sup> Ramus (1599, p. 120): “Primi illi homines (ut Josephus antiquitatis Judaicae scriptor ait) Adamus, Sethus, Enus, Noeus vitae et longissimae et contemplationi deditissimae beneficio, in hanc recordationem incubuerunt.” It is worth noting that Ramus included Adam in this list, even though Josephus did not explicitly say that he had pursued mathematics.

<sup>45</sup> *Ibid.*: “ne alia novae oblivionis caligine circumfusa teneretur. . .”

<sup>46</sup> Ramus (1599, pp. 120–121): “Hinc tot, tamque excellentia ingenia excitari . . . coeperunt, videlicet ad huius mathematicae recordationis opus exaedificandum, tot fabros, tot architectos adhiberi oportuit. . .”

A decade later, however, when he came to write his next mathematical work, Ramus reached very different conclusions. In his *Arithmetica* of 1555, he provided mathematics with a history that looked much more like that of dialectic, complete with villainous and selfish corrupters of the arts. What had happened? It seems that, in the intervening years, Ramus had devoted some time to the actual study of mathematics, and had discovered that the art was not at all what he had assumed it to be. When he published his *Euclid* in 1545, he clearly thought that mathematics was the most natural and well-organized of arts; therefore, it would be easy to learn. In his intellectual apology *Oratio de professione sua* written in 1563, Ramus recalled that he later had a change of heart, probably some time in the years 1551–1555<sup>47</sup>:

There are 15 books of Euclid's *Elements* which I thought had been put together by the one and only instrument of Logic – just like absolutely every other art. Thus, I thought, it could subsequently be analyzed by means of the same instrument. In fact, I had long since devoted myself to logic, preparing it for the sake of mathematics above all else. I was persuaded by my own argument and tried to ignore the many great obscurities endemic to mathematics; by hard work and my own sharp mind I got all the way through to the 10th book. Pierre de Mondoré<sup>48</sup> had been most eruditely explaining and clarifying that book for me. However, its immense subtlety still exercised me enormously. One day . . . in fact, I had been trying unsuccessfully to get to the end of a demonstration on the binomial residue; I concentrated my mind on it entirely; after keeping my body stuck in one position for a whole hour, I felt all the muscles in my back seize up. And at that, I threw away my drawing-board and ruler, and burst out in rage against mathematics, because it tortures so cruelly those who love it and are eager for it.<sup>49</sup>

Quite against his expectations, mathematics – the goal and paragon of his natural, logical method – turned out to be *hard*.

This defeat marked a major crisis in Ramus's intellectual development. He had built an entire philosophy on the association of natural dialectic with mathematics. But now it turned out that mathematics was *not* a natural, immediately graspable science at all. To remedy this situation, Ramus did two things: first, he wrote his own mathematics (in the form of his *Arithmetic*, and later his *Geometry*, *Algebra* and

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<sup>47</sup> In the 1563 oration, when relating the incident described below, Ramus said that he had spent 8 years of his career teaching the trivium, followed by four years of teaching mathematics. If he is dating the beginning of his career from his publications of 1543, then the mathematical phase of his career (as he considered it) was 1551–1555.

<sup>48</sup> Mondoré (1552).

<sup>49</sup> Ramus (1599, p. 409): “Quindecim Euclidis libri sunt, quos (ut omnes omnino artes) sicut uno Logicae organo contextos esse primum, sic eodem postea retexi posse cogitabam. Organum autem illud una imprimis mathematicum causa diu multumque praecultum nobis ac praeparatum est. Quare persuasione hac inductus nihil reputans quot et quanta mathematicum per se obscuritates essent, prompto atque alacri animo ad decimum usque librum penetravi, sed immensa subtilitate operis illius, licet eruditissimis P. Montauri vigiliis explicati et illustrati, tamen sic exercitatus sum . . . ut quodam die cum binomii et residui cuiusdam demonstrationem summa animi intentione, corpore horam integram idem vestigium premente nondum conclusissem, senserim collo nervos obriguisset: tum vero abacum radiumque abieci, indignatusque mathematicis succensui, quod sui studiosos et amatores tam acerbè cruciant.” See also Waddington (1855, p. 108).

*Optics*) which would form the core of his own mathematical teaching; and second, he returned to writing the history of mathematics, this time in far greater detail.

In the preface to his 1555 *Arithmetica*, Ramus again presented the standard narrative of the origins of mathematics, just as he had done in the preface to his *Euclid*. Adam, Seth and Noah had spent their time contemplating mathematics “in order to appreciate God’s mathematical work.”<sup>50</sup> Abraham passed the science on to the Egyptians, whence it was taken up by the classical civilizations. In ancient Greece and even, to some extent, in ancient Rome, there followed a golden age of mathematics. Boys studied the art, practicing it by drawing in the sand, and craftsmen like painters and architects both knew and used mathematical techniques.<sup>51</sup> In other words, an art of mathematics existed, but one that conformed to natural mathematics, as it was expressed by human beings using arithmetic and geometry to practical ends. Ramus was still thinking about the relationship between mathematics and dialectic; now, however, rather than seeing it as the lofty pinnacle of dialectic, he had the eloquent vine-dressers of the 1543 *Institutiones* in mind, and the *useful* dialectic he intended to teach in the schools.

What happened after this golden age? There was a collapse into barbarism for many centuries, followed by a revival of mathematics, but only in a limited sense: those who revived the mathematical arts in Europe thought “that they were not like the others, which were useful after they had been learnt, but only *while* they were being learnt”<sup>52</sup> – that is, as a tool to sharpen the mind before going on to “higher” disciplines, such as philosophy. The very difficulty of mathematics thus became a recommendation for its study – for Ramus an absurd, even self-contradictory idea. And what was the cause, both of mathematics’ precipitous decline and later, its perverse revival? More than anything, Ramus said, it was the obscurity of the subject. He laid the blame for this state of affairs squarely at the feet of Euclid and Theon.

By Ramus’s lights, if Euclid really *had* put together the *Elements* according to the natural method, then his work should pass the test of the three “laws of method” which Ramus developed after his return to philosophical publication in 1551.<sup>53</sup> Not surprisingly, Euclid failed miserably as a Ramist logician. Arithmetical precepts were (said Ramus) often expressed in terms of general magnitude, which was properly the province of geometry. This broke the “law of justice” or homogeneity: “arithmetic should be taught arithmetically, geometry geometrically.”<sup>54</sup> Further, number should be logically prior to magnitude, according to Ramus at least; yet the *Elements* began with geometry – clearly a violation of the “law of wisdom,” which required more general sciences to precede more particular. Lastly, Euclid

<sup>50</sup> Ramus (1599, p. 121): “Haec enim primorum generis humani parentum, Adami, Sethi, Noëi divina contemplandis optimi maximeque Dei mathematicis operibus otia fuerunt.”

<sup>51</sup> Ramus (1599, p. 122).

<sup>52</sup> Ramus (1599, p. 122): “sed [opinantur] prodesse has artes non caeterarum more, cum perceptae fuerint, sed cum percipiuntur.”

<sup>53</sup> See Ong (1958a, pp. 258–262).

<sup>54</sup> Ramus (1599, p. 123): “Itaque arithmetica arithmetice, geometrica geometrice doceantur.”

introduced his definitions in two groups, at the beginning of books I and V; but as the grammarian with an urn of grammatical facts knew, precepts of an art should be introduced only where they belong in the natural order of things.<sup>55</sup>

Ramus concluded that Euclid, although no doubt a fine collector of individually excellent mathematical truths (most of them unearthed long before him by the first human beings), was a dunce when it came to arranging them according to their nature. In another departure from his position in the 1545 *Euclid*, Ramus now believed that the demonstrations were a necessary part of the *Elements*, and that this was itself another black mark against Euclid's name. Euclid may have written his work without demonstrations, thinking it was sufficiently clear in that form; but the very fact that Theon thought it necessary to add explanations to the originally naked text only confirmed – and deepened – the obscurity of Euclid's arrangement.<sup>56</sup>

Ramus required a properly arranged mathematics, “by which an absolute beginner who wants a perfect and complete grasp of the art can be perfectly and completely taught”<sup>57</sup> – a *natural* mathematics, in which there would be no need for demonstrations. He exhorted his readers:

Establish, finally, the elements of mathematics according to these laws of logic: the individual propositions arranged in place and order will not only be statements of their own truth, but even *demonstrations* of it.<sup>58</sup>

Ramus tried to provide precisely this in his *Arithmetica* and other mathematical books; although he was never completely satisfied with his reformed mathematics, they remained popular school textbooks for more than a century after his death.<sup>59</sup>

Ramus had now constructed a history of mathematics which in outline essentially matched his history of dialectic: an original, natural state, corrupted by the pride and arrogance of Euclid who, like Aristotle, elevated his “contrived demonstration” over the natural structure of discourse.<sup>60</sup> Ramus's narrative was also beginning to take on the shape of the story of sacred history itself: innocence, fall and finally redemption (through the application of proper method). In the final expression of his thought on the question, the *Prooemium mathematicum* of 1567, Ramus would

<sup>55</sup> Ramus (1599, pp. 123–124).

<sup>56</sup> Ramus (1599, pp. 124–126): “Atque haec elementa licet a primis usque hominibus repetita, tamen hunc in modum et proposita et collocata ab Euclide existimantur; quem virum mathematica singularum propositionum scientia tanquam singularem et prope divinum suscipio . . . at logica recte et ex ordine docendi prudentia parem efficere nequeo. . . . Quare licet [Theonem] mathematicarum rerum intelligentia non inferiorem putemus, attamen videmus adhuc quam demonstrationibus suis elementa mathematica non illustret, sed obscurat.”

<sup>57</sup> Ramus (1599, p. 123): “quibus perfecte et absolute rudis et imperitus institui possit.”

<sup>58</sup> Ramus (1599, pp. 126–127): “Denique mathematica elementa logicis legibus illis institue; propositiones singulae loco et ordine collocatae, ipsaemet suae veritatis non tantum propositiones, sed etiam demonstrationes erunt.”

<sup>59</sup> See Ong (1974), for Ramus's continuous emendation of his mathematical texts.

<sup>60</sup> Ramus (1599, p. 126): “non Aristotelis commentitia illa quidem, sed certe naturali et aperta demonstratione singulariter et eximie demonstrari.”

make explicit the connection between disciplinary and religious history, while substantially modifying in every detail the history of mathematics as he had received it from earlier authors, and even as he himself had presented it in his series of mathematical prefaces.



<http://www.springer.com/978-90-481-3541-7>

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Mathematical History

Goulding, R.

2010, XX, 5 p., Hardcover

ISBN: 978-90-481-3541-7