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# Magnets and garlic: an enduring antipathy in early-modern science

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## ABSTRACT

Since antiquity, sources report that garlic deprives a magnet of its power of attraction. Although in later centuries some authors disproved or questioned this effect by experience or trial, several, if not the majority of, writers referred to garlic and magnets as “enemies” until well into the seventeenth century. It will be argued that the probable textual origin of the “garlic effect” is a corrupt or ambiguous passage in Pliny’s *Natural History*, reading “al(l)ium” (garlic) instead of “aliud” (another) in one passage. With a focus on the early-modern period, it will be elucidated why so many authors did not doubt this physical effect, and some even presented causal explanations for it. It shall be emphasized, moreover, that magnetic attraction, and thereby also the garlic effect, was used as an important example or analogy since antiquity. This illustrative or explanatory use of analogies drawn from the garlic–magnet antipathy certainly goes some way towards explaining the longevity of this odd relation between the two substances.

## KEYWORDS

Magnetism; early-modern experiments; sympathy and antipathy; superstition and folklore; transmission of ancient ideas

For 7 December 1683, the transactions of the *Oxford Philosophical Society* record the following experiment: “It was deliver’d by Mr. Harris, as found true by a late triall, that Juice of Onions did not take off ye attractive power of the Magnet”.<sup>1</sup> It was presumably John Harris, the author of the famous *Lexicon technicum* (1701), who conducted this strange experiment, even before he became a scholar at Oxford University in 1684. In the eighteenth century, the *Universal-Lexicon* (1733–1754) of Johann Heinrich Zedler (1706–1751) referred to an apparently similar effect, but stated more cautiously: “Whether the magnet’s power can be reduced by garlic has not yet been proven through persistent experience (*ist durch eine beständige Erfahrung noch nicht erwiesen*)”.<sup>2</sup> “Not yet”, as if this effect was still considered to be subject to future trials!

These experiments with magnets and garlic or onions go back to accounts in antiquity.<sup>3</sup> Ancient sources report that garlic deprives a magnet of its power of attraction. Although, in later centuries, scholars disproved this effect by experience or trial, several, if not the majority of, writers referred to garlic and magnet as “enemies” until well into the mid-seventeenth century. The accounts of Harris and Zedler show that the issue was still under investigation in the late seventeenth and early eighteenth centuries.

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To modern readers, the garlic effect (hereafter “GE”), by which I mean garlic’s supposed power to hinder magnetic attraction, may sound very strange indeed. Without having to test it we immediately and intuitively consider it to be impossible. So, a couple of questions emerge: How did ancient authors come up with it? Did they and their medieval and early-modern predecessors actually believe in it? Why and in what way was it repeated in so many texts? Why did it take so long to refute it? How was it refuted?

Recently, Daryn Lehoux (2012), Nicolas Weill-Parot (2013), and David Wootton (2015) have tried to answer some of these questions.<sup>4</sup> Although their studies present interesting material and make important observations, their conclusions or answers to the above-mentioned questions remain partly unsatisfactory as they are based on a relatively small quantity of available sources. This study will prepare the ground for a more balanced and comprehensive attempt to answer these questions. With a focus on the early-modern period, it will be shown how philological, philosophical, and experimental approaches interacted in order to undergird or to discredit the GE. It will be argued, overall, that the GE had a rather contingent textual origin and that the use of analogies drawn from magnetic attraction played a pivotal role in the longevity and conceptual importance of the GE. Thereby, this article also tries to highlight how the history of science can benefit from attention to philological details.

Since Lehoux’s study has already introduced and discussed most of the few known ancient textual testimonies of the GE, Weill-Parot elucidates the medieval part of the story, and Wootton has significantly enriched our understanding of how early-modern authors dealt with the GE, this study shall not repeat all this already-known evidence at length. Moreover, the structure of this article is not chronological, but the focus of this paper is on the probable emergence of the GE, its longevity, and its rationality, by addressing four questions: How did the GE come about? How did scholars try to make sense out of the GE? How and in which context did they try to disprove the GE? How did scholars use the GE as an analogy in order to illustrate something completely different?

## Who came up with the idea of the GE?

The GE enters the stage of clear textual evidence around the year 100 AD, in Plutarch’s *Convivial Questions*.<sup>5</sup> Plutarch speaks about the magnet and garlic as an example of “sympathy and antipathy”. The common understanding of this passage is the following: as amber attracts light objects and loses this power when the objects are wetted with oil, the magnet attracts iron and loses its attractive power when rubbed with garlic. For ancient philosophers “sympathy and antipathy” included several such relationships.<sup>6</sup> Whenever natural things attract each other it was considered to be a strong indication of sympathy. If this attractive power was oppressed, destroyed, or even converted into repulsion by the presence of another natural object, it was often referred to as an “antipathy”.

However, although this philosophical theory of “sympathy” was very popular among authors writing in ancient Latin and Greek, the GE is only mentioned in Greek sources of (late) antiquity, such as in Plutarch, Ptolemy, and other, less-known authors.<sup>7</sup> Most of them in some way link the GE to “sympathy and antipathy”, and as early as in Plutarch, the GE was treated as commonplace. Similar examples of “sympathies and antipathies” are widely found in sources preceding Plutarch, and Pliny’s *Natural History*, in particular,

assembled many of them.<sup>8</sup> His work is of particular importance for the textual history of the GE. In what follows, it shall be argued that an ambiguous or even corrupt reading of his *Natural History* can be seen as the probable origin of the GE.

In book 20, Pliny introduces the concept of “sympathy and antipathy” in nature with examples such as “water extinguishes fire” (*ignes aquis restinguentibus*) and many more.<sup>9</sup> He also notes that “the magnet attracts iron and another [stone] drives it away from it” (*ferrum ad se trahente magnete lapide et alio rursus abigente a se*). In the context of Pliny’s work this makes perfect sense, as magnetic attraction and repulsion are a clear illustration of “sympathy and antipathy” and attributed to two different types of magnet, as Pliny explains later, in book 36.<sup>10</sup> This “other stone” was a kind of quasi-magnet that only repels iron and was named “Theamedes” in a corrupt reading of the passage.<sup>11</sup>

Yet, in the nineteenth century (1868), the physicist and historian Timoteo Bertelli followed a suggestion by the librarian Luigi Barbieri of the Biblioteca Palatina in Parma that some manuscripts and prints of the passage from book 20 in Pliny’s work did not read “another” (*alio*) but “garlic” (*allio*).<sup>12</sup> As Pliny and most ancients – in contrast to medieval and neo-Latin – spelled the Latin word for garlic more often “alium” than “allium”, the mistaken understanding does not even presuppose a corrupt text.<sup>13</sup> But if there was a corrupt text, only one single letter (“l”) would have given rise to the idea of the GE, and would have distinguished Pliny’s “correct” (“another”) from Pseudo-Pliny’s mistaken reading (“garlic”).

Leaving the semantic issue aside, as it will be discussed shortly, the codicological issue is difficult. Louiche Desfontaines in his Pliny edition of 1829 remarked that this misreading, “allio” instead of “alio”, was not to be found in any manuscript and therefore could not be the origin of the GE.<sup>14</sup> Spot tests from three medieval or Renaissance manuscripts (BNF, Latin 6797, fol. 133r; BNF, Latin 6804, fol. 100r; and BNF, Latin 6795, fol. 222v) corroborate his conclusion. None of them reads “allio”. The editors of the Teubner edition (1892) do not give any variants in the critical apparatus and the *editio princeps* of 1469 reads “alio” as well.<sup>15</sup>

But there is more to it. An edition from Venice, edited by the Italian humanist and physician Alessandro Benedetti in 1507, clearly reads “allio”, and the reading can still be traced as late as 1825.<sup>16</sup> It is, however, particularly interesting that Fortunio Liceti, a famous and erudite physician of the seventeenth century, pointed to the supposedly corrupt passage from Pliny in a letter (1536) to Baldus Baldus (Baldus de Baldis), physician to Pope Urban VIII.<sup>17</sup> Baldus asked Liceti to take a stand concerning the refutations of the GE by Gerolamo Cardano and Giambattista Della Porta, which will be sketched in a later section. Liceti refers to a passage from Della Porta’s *Villa* (1592), in which Della Porta quotes Pliny in exactly the mistaken way (“allio” instead of “alio”) and thus ascribes, mistakenly, according to Liceti, the belief in the GE to Pliny as well.<sup>18</sup>

The huge importance of Pliny has in fact led some early-modern readers to believe that the GE was firstly mentioned in the *Natural History*, probably just because some editor or typesetter (at least the one of the 1507 edition) made a mistake that was copied by some authors. There is no final answer to the question of the textual origin of the GE; still, some observations render one specific scenario the most plausible. Bertelli’s philological theory is crucial for my claim, but his theory still misses one important point about the chronology of the textual witnesses of the GE. As I argue in the following, it may be Pseudo-Pliny’s

text that gave rise to the GE, but it was another work of the tenth century, the so-called *Geoponica*, which bears traces of the earliest source for the GE.

Pliny's statement in book 20 of his *Natural History* was that "the magnet attracts iron and another [stone] drives it away from it" (*ferrum ad se trahente magnete lapide et alio rursus abigente a se*). If we, however, read "al(l)io" (garlic) instead of "alio" (another stone), the sense of the passage changes significantly: "the magnet attracts iron and through garlic [the magnet] drives [the iron] away from [the magnet]".<sup>19</sup> Let us assume that this is how some of the earliest readers understood the passage (here referred to as Pseudo-Pliny's reading.).

In terms of chronology, Plutarch's *Convivial Questions* is the first extant source mentioning the GE. The work is written around 100 AD in Greek and there is no direct proof that Plutarch knew Pliny's *Natural History* directly, which was written in Latin around 77 AD.<sup>20</sup> Plutarch, like Pseudo-Pliny, integrates the GE in a set of sympathies and antipathies; however, they are not the same as those presented by Pseudo-Pliny.<sup>21</sup> Plutarch does not refer to repulsion at all and does not use a Greek phrase equivalent to Pliny's "abigere".<sup>22</sup> This also holds true for the mention of the GE in Ptolemy's *Tetrabiblos* (second century) and in an anonymous alchemical treatise from the seventh century.<sup>23</sup>

The GE is also mentioned in the sixth-century work *On the Months* by the Byzantine scholar John Lydus, although he does not speak about garlic but about onion's juice (χυλὸν κρομμύων).<sup>24</sup> Lydus does not refer to repulsion either, but he is the first author who mentions an alleged GE cure with goat's blood, which is crucial for my argument and will be elucidated shortly. The most important Greek source for the GE, however, is the *Geoponica*, a compilation allegedly undertaken by Cassianus Bassus that was probably started in the sixth century, but was only finished in the tenth century in Byzantium.<sup>25</sup> We read: "The magnet, or sideritis, attracts iron; but *it is divested of this power* [or: *it repels*], when rubbed with garlic. It recovers its power, if the blood of a goat is poured upon it".<sup>26</sup> This passage seems to imply the idea of a magnetic repulsion in connection with garlic, because the verb "ἐκπνέω" can either literally mean "breathe forth/repel" or figuratively "expire/lose power". Here, for the first time and centuries after Pseudo-Pliny, we find a source in which "garlic" and "repulsion" can be found in one passage.

If we read this evidence, which still may sound far-fetched, against the background of the medieval and early-modern reception of the GE, this reading can be corroborated. In a thirteenth-century Arabic work, some oil is introduced as a means to make the magnet repel iron.<sup>27</sup> This text also refers to the cure of goat's blood. Around the year 1400, Jacopo da Forlì wrote that an unnamed "magister" taught that a magnet anointed with oil would attract iron at one side and repel it at the other side.<sup>28</sup> Thus, medieval authors wrote about the possibility of inducing magnetic repulsion by the aid of a substance like oil. The part of the *Geoponica* dealing with the GE was not translated into Latin in medieval times.<sup>29</sup> Its early-modern Latin translation rendered the Greek verb "ἐκπνέω" quite literally into "expirat", having the same semantic spectrum (breathe forth/expire). Pietro Andrea Mattioli (1554) referred to the counter-magnetic power of garlic using the phrase "ferrum respuere", which could also mean "to expel iron".<sup>30</sup> Contemporary authors used the verbs "respuere" or "abigere" to describe the GE on the magnet as repelling iron.<sup>31</sup> The same verb (*respuere*) was also used by Pliny for the repelling type of magnet ("Theamedes") in book 36, and here Pliny clearly referred to repulsion.<sup>32</sup> Some early modern German *herbaria* rendered Mattioli's Latin in the way that a

magnet anointed with garlic “drives forth the iron” (*treibet das eisen vor sich*).<sup>33</sup> Also, Andreas Goldschmid in his monograph on amber (*Succini historia*, 1551) pointed out – probably referring to the *Geoponica* – that a magnet does not attract iron that is anointed with garlic but even repels iron.<sup>34</sup> It certainly can be concluded that some authors thought, following the *Geoponica*, that garlic does not simply destroy the magnet’s power to attract iron, but actually induced a repulsive power.

Although this probably was not the common understanding, as most Latin authors did not think of the repulsive power of garlic, we should not take the mentioned exceptions as random misunderstandings but as something which is already hidden in the *Geoponica* and probably in earlier (now lost) Greek sources of the GE, which may have derived from Pseudo-Pliny. There is more justification to this thesis. The idea that garlic causes the repulsion of iron has no basis in Plutarch, but has in the *Geoponica*, indicating that the latter’s author had access to a more ancient and “original” source than Plutarch. According to this understanding, the *Geoponica* and Pseudo-Pliny share the notion of repulsion induced by garlic, because the Greek “ἐκπνέι” is able to cover the meaning of Pliny’s “abigat” (repel) adequately, while Plutarch’s text is not. The author of the *Geoponica* presents the GE in a chapter on “sympathy and antipathy”, ascribed to Zoroaster. Although he explicitly refers to Plutarch’s *Convivial Questions*, the variety of examples for sympathies clearly testifies that Plutarch was by no means his only source, and, until now, the source(s) of the mention of the GE in this chapter still remain(s) very unclear.<sup>35</sup>

It can be argued that the *Geoponica* is a closer witness to the textual origin of the GE than Plutarch, although it was compiled at a later date. At any rate, the *Geoponica* could not have relied on Plutarch alone. Two examples can prove with regard to the magnet. First, Plutarch calls the magnet “siderites” (σιδηρίτις λίθος) but the *Geoponica* calls it “magnetis or sideritis” (μαγνήτις λίθος, ἥτοι σιδηρίτις). The Greek name “μαγνήτις λίθος” was also mentioned in Pliny’s account of the magnet (*lapis magnēs*) in book 36.<sup>36</sup> Second, the reference to goat’s blood is not mentioned in Plutarch, either.<sup>37</sup> It even seems possible to infer this magnet/goat’s blood connection from Pliny’s text.<sup>38</sup>

In Pliny, the instance of the magnet is followed by an account of an antipathy between the diamond and goat’s blood, which claims that if one soaks an unbreakable diamond (*adamas*) in goat’s blood, it can be crushed.<sup>39</sup> Maybe these two instances of antipathy merged in the *Geoponica* and were both linked to the magnet. Pliny later tells his readers that a diamond prevents magnetic attraction, too.<sup>40</sup> Moreover, in medieval Latin, the word “*adamas*” sometimes denotes the magnet, and in ancient Greek the word “ἀδάμας” originally referred to steel.<sup>41</sup> The combination of the two antipathies, magnet/garlic and diamond/goat’s blood, into a single one thus also has a philological basis.<sup>42</sup>

Although there is no clear answer to the question of sources, a likely scenario might have been the following: the author of the chapter of the *Geoponica* had access to many “lists of sympathies”, as there were many of them in antiquity.<sup>43</sup> The unknown author of one of these lists relied on Pseudo-Pliny’s *Natural History*, while Bassus or the later collators of the *Geoponica* additionally used Plutarch’s *Questions*. Plutarch’s text only refers to the GE as a hindrance to attraction, while Pseudo-Pliny also connects the GE with the concept of repulsion. This connection between garlic, magnetic repulsion, and antipathy can be read into the *Geoponica* as well. Plutarch, Ptolemy, Lydus, and the anonymous alchemist may also have relied on the source of the *Geoponica* or a later (unknown)

altered version of it, but they all understood the GE in a slightly different way. This specific interpretation offered in the *Geoponica*, as we have argued, is closest to the way Pliny's text could have been misunderstood due to an ambiguous reading. Therefore, the *Geoponica* may bear witness of the oldest source of the GE which directly relied on the mistaken reading of Pliny's work.

## How did the historical authors deal with the GE?

It may be one thing to argue for the textual origin of the GE, but another certainly no less difficult question is to explain why so many ancient, medieval, and early-modern scholars believed in it. In the following sections, it shall be elucidated how the historical authors assessed the GE. More or less, they either repeated the GE, defended the GE and tried to explain it, refuted the GE, or they used the GE as an analogy to make their own point about something else. All four strategies will be dealt with in what follows.

Most of the sources of the Middle Ages (Latin and Arabic) and the early-modern period simply repeated the GE by mentioning it as one of the properties of the magnet or of garlic in the context of so-called *lapidaria* or *herbaria*.<sup>44</sup> These repetitions are neither telling nor surprising, and they appear in the books as simply copied from older sources or each other. However, they testify that knowledge about the natural world was, to some extent at least, not derived from autoptical experience but from ancient and medieval authorities alone.<sup>45</sup>

## Explanations

Ancient sources referring to the GE as an antipathy seem to imply that this effect, albeit natural, was not to be accounted for by any causal explanation. In fact, Cicero, Plutarch, and Pliny explicitly state that these instances of "sympathy and antipathy" were, rather, to be admired than to be explained.<sup>46</sup> Yet, in the course of the following centuries, authors attempted to explain the GE.

One of the first authors to deal with the GE in the context of natural philosophy was Averroes. In his commentary on Aristotle's *Physics*, he refers to it in order to elucidate his notion of attraction by arguing that attraction can only take place under certain circumstances. Thus, if a magnet is rubbed with garlic, iron is not moved towards the magnet.<sup>47</sup> The garlic, as Averroes puts it in another passage, changes the composition of the magnet's matter (*complexio magnetis transmutatur*).<sup>48</sup> The medieval physician Pietro Torrigiano de Torrigiani followed this idea and reasoned that the form of garlic prevents the iron from moving towards the magnet.<sup>49</sup> Pietro d'Abano also refers to Averroes's analysis of "attraction", but makes a surprising remark on the GE. He tells his readers that he could not observe the GE "unless, perhaps, the magnet is laid in goat's blood for an entire day".<sup>50</sup> Here, the blood is supposed to have quite the opposite effect as in the *Geoponica* and other sources: goat's blood does not recover the strength of a magnet, but instead the magnet lost all powers in this blood bath.

If we reach the early-modern period, we find several attempts to explain the GE in terms of natural philosophy or alchemy. In his alchemical dialogue *De auro* (1584), Abraham Portaleone noted that amber, when it was rubbed, warms up and thereby becomes attractive, and thus wondered if heat in general strengthened all types of



attraction.<sup>51</sup> In that case, a hot magnet would need to show increased attraction and hot garlic or a hot diamond would prevent the attraction of a magnet even more vigorously. As this was not observed, he considered it necessary to distinguish between the amber's bituminous nature and the nature of other bodies (*mixta*). The way Portaleone dealt with the issue might suggest that he considered the GE to be a natural, almost chemical effect and not a magical, inexplicable antipathy.

Several authors gave lists of conditions or substances that did harm to the magnet's powers. The GE was often part of these lists. Johannes Eck referred to a Benedictine monk known to him, who had taught him that the magnet lost its effect through garlic, but got it back through vinegar.<sup>52</sup> Georg Agricola reports the GE along other circumstances impeding magnetic attraction. A magnet in the presence of a diamond, a rusty magnet, or a magnet of impure substance will not attract iron either.<sup>53</sup> Even Paracelsus wrote that a magnet would not attract iron if either the iron was "anointed" (*bestrichen*) with "mercurial oil" or the magnet with leek (*lauch*).<sup>54</sup> Also Portaleone, Andreas Libavius, and Johann Baptist Van Helmont mentioned the harmful effect of garlic and added the destructive effect of quicksilver.<sup>55</sup> Van Helmont even claimed that garlic prevented the magnet from pointing to the pole (*polum negligit*), as the magnet's sensitive spirit falls asleep (*sensatio spiritualis obdormiscit*).<sup>56</sup> Hence, the GE was integrated in a set of techniques to affect the magnet's power by means of physical, almost chemical manipulations. Although this does not imply an explicit physical explanation of the GE, these examples testify that GE was not considered an effect *sui generis* but in relation to other natural substances or methods in order to modify the attractive power of a magnet.

Other scholars were more concerned about the properties of garlic. Antoine Mizauld, who generally denied the GE after testing it by trial, considered – in order to safeguard the observations of important authorities such as Ptolemy – that maybe Egyptian garlic was able to prevent the attraction of a magnet.<sup>57</sup> Levinus Lemnius imagined that garlic was "greasy" (*pingue*) and, for that reason, had its effect on the magnet.<sup>58</sup> Probably the first proper and explicit attempt to explain the GE in terms of natural philosophy was undertaken by the Jesuit Franciscus Toletus, referring back to Pietro d'Abano's failed experience.<sup>59</sup> As Toletus puts it, garlic acts on the magnet by its great "heat" which it has due to its elementary mixture.<sup>60</sup> Therefore garlic "undermines" (*divertit*) the warmer and active parts in the magnet and thereby prevents it from attracting iron. If, however, the GE sometimes does not occur, it is only due to the low heat of the particular garlic used. Thus, both Mizauld and Toletus refer to a specific type of garlic.

Lucilio Vanini argued that the attraction of the magnet is mediated by the emission of a form that changes the iron through the air. To substantiate this, he refers to the effect of garlic and refers to the effect of oil, which prevents this leakage of the magnetic "spiritus".<sup>61</sup> A very similar line of argumentation was followed by Alessandro Vicentini (Alexander de Vicentinis).<sup>62</sup> He argued that the attraction of a magnet is not caused by an "occult quality", as many have argued, but rather by its "temperament"; that is, by the elementary qualities (hot/cold, wet/dry) of the stone.<sup>63</sup> In order to demonstrate this, Vicentini refers to an experience (*experimentum*), namely that the magnet's temperament can be disturbed by garlic so that the magnet loses its attractive power. He links this power of garlic to the fact that iron begins to rust when laid in the juice of garlic. Although Vicentini does not mention that rust also has a destructive effect on the magnet's powers, it is clear



that he conceives the GE to be a very natural, quasi-chemical reaction with the matter of the magnet.

Fortunio Liceti, in his letter to Baldus, tried to reconcile the more recent falsifying trials of Cardano and Della Porta with the ancient reports of an actual GE. He argued that there were several kinds of magnets, and that old magnets would become more vulnerable to the “virus” of garlic.<sup>64</sup> While Della Porta criticized the lore of mariners according to which garlic would affect the functioning of a compass, Liceti pointed out that this power of a magnetic needle to point to the north was something completely different from its attractive power and thus garlic had no effect on this directing force anyway.<sup>65</sup> Moreover, a compass would normally come in a case of glass, which prevents any harm by garlic as it cannot enter through the pores of the glass.<sup>66</sup> Caspar Ens noted in 1649 that garlic shared with other plants its degree of “heat”, its origin, or its astrological influence, but differed clearly in smell from other plants.<sup>67</sup> It was therefore its unique smell, with which it infected the air, which robbed the magnet of its power.

A further attempt to naturalize the GE was conducted by Alexander Ross. In 1645, he criticized the corpuscular explanation of magnetic phenomena as put forward by Kenelm Digby in his *Two Treatises* (1645).<sup>68</sup> One of Ross’s counterarguments was that he thought Digby’s explanation failed to account for the GE by means of his “atoms”. In 1652, Ross chose another British adversary: Thomas Browne and his catalogue of popular errors (*Pseudodoxia epidemica*, 1646). Browne considered the GE to be completely fictional.<sup>69</sup> Ross, however, explained that the ancient authors who wrote about the GE had another kind of magnet and probably also another kind of garlic, which was “hotter”.<sup>70</sup> This more vigorous kind of garlic in hotter (e.g. Mediterranean) regions was also the kind Horace had sung about, saying that it was worse than snake poison.<sup>71</sup> In fact, since antiquity, several astonishing effects were attributed to garlic, when it was used in a variety of medical and magical contexts.<sup>72</sup> The GE was part of these natural properties of garlic, at least for several early-modern writers.

Just as Ross had tried to corner Digby, so James Primrose argued against Henricus Regius, claiming that his mechanical explanation of magnetic attraction would not account for the GE.<sup>73</sup> Neither Digby nor Regius ever tried to explain the GE in mechanical terms, but Robert Midgley did so a couple of years later:

Also there may be a reason given why the Load-stone being rubbed with Garlick, or Oyle, doth not so easily draw Iron to it, especially if you also rub them with it; because these strange corpuscles by their Oyliness do hinder the emission of the corpuscles out of the Load-stone, and also their entrance into the Pores of the Iron, and do break their elastic force.<sup>74</sup>

The examples of Liceti and Ross clearly show that ancient testimonies were taken as reliable reports of observations. All early-modern examples illustrate the fact that authors tried to account for the GE in natural philosophical terms (“temperament”, “corpuscles”), or by referring to particular circumstances (“different type of magnet/garlic”). According to these authors, there was no categorical difference between the GE and other known (and actually effective) methods of destroying the attractive power of the magnet, such as rust, fire, or acid.

Moreover, the GE was not only defended by early modern philosophers, but some even attributed quasi-practical use to it. In 1521, the papal physician Ferdinando Ponzetta,

clearly inspired by the GE, recommended using garlic as a remedy against poisoning by iron.<sup>75</sup> Della Porta considered garlic as a drug against poisoning from magnets and explicitly related this antidote to the antipathy between garlic and the magnet.<sup>76</sup> This medical use of garlic inspired by the GE was later criticized by William Gilbert, who also was a physician.<sup>77</sup>

In the posthumous and probably spurious fifth book of François Rabelais's *Pantagruel* (1564), the GE entered the stage of early-modern pseudo-mechanics.<sup>78</sup> The author described the closing mechanism of a temple door. This door mechanism was constructed with iron plates and magnets and the idea was that it could open automatically without being pushed. Two magnets were supposed to open the iron doors by pulling them from the left and right side. Garlic was hanging right and left from the two magnets on cords which could be pulled up and down so that the garlic enabled and disabled the magnet's attraction on the iron doors by its proximity to the magnets. Hence, when the garlic was pulled up, away from the magnet, the magnet would attract the iron plates in the doors and the door would open.

### Refutations

It has been said that *lapidaria* very often simply repeated the GE uncritically, but not all did. Maybe the first to at least wonder about (or marvel at) the alleged GE (*quod saepe miror*) was Christoph Entzelt in his *De re metallica* of 1551.<sup>79</sup> Gerolamo Cardano denied the GE in the second edition of his *De subtilitate* (1554).<sup>80</sup> Antoine Mizauld (1566) also denied the GE by recourse to experience.<sup>81</sup> Michele Mercati considered the claim that garlic has a bad influence on the magnetic instruments on a ship to be a seaman's yarn.<sup>82</sup> According to him, such fables endured because authors carelessly copied them from ancient authors.<sup>83</sup>

Anselmus de Boodt, Ulisse Aldrovandi, and Bernardo Cesi attacked the alleged GE only on the authority of Della Porta's *Magia naturalis* (1589).<sup>84</sup> Della Porta indeed devoted a chapter on the disproof of the GE and claimed to have tested it personally.<sup>85</sup> There are two noteworthy things about his disproof, however. First, in the edition his *Magia* of 1558, Della Porta did not hesitate to uncritically mention the GE and the mariner's belief that Garlic causes troubles for their compasses; moreover, he even referred to it, without any criticisms, in another chapter of his 1589 edition, dealing with "sympathy and antipathy".<sup>86</sup> Also in 1588, Della Porta claimed in his *Phytognomonica* that garlic and the magnet had opposed medical powers as there was an antipathy between them, as mentioned by Plutarch and Ptolemy.<sup>87</sup> Della Porta still mentioned the GE in a chapter on garlic in his *Villa* of 1592.<sup>88</sup>

This inconsistency can partly be explained by the second noteworthy point. Della Porta wrote his entire book on the magnet, as a part of his 1589 *Magia*, on the basis of a treatise by Leonardo Garzoni that only survived in manuscript.<sup>89</sup> Garzoni attacks the GE by stating that it was contrary to experience.<sup>90</sup> It seems likely that Della Porta, when compiling his voluminous *Magia* of 1588, simply failed to take care of the consistency of his work, after he had integrated the experimental results of Garzoni.<sup>91</sup>

A similar inconsistency can also be observed in Bernardo Cesi's *Mineralogia*, which followed Della Porta's disproof of the GE when discussing the false beliefs about the magnet. In two further passages not directly dealing with the magnet, Cesi, however, did not

hesitate to invoke the GE without criticism. In one passage, Cesi quoted an astrological work of Alessandro degli Angeli in which the author stated that the “powers of the magnet are weakened by garlic, as we learn from daily experience”.<sup>92</sup> In another passage, Cesi criticized the view of Pietro Andrea Mattioli, who, like Goldschmid and Plutarch, compared the GE with the effect of oil for the amber effect.<sup>93</sup> Cesi denied that amber would not attract oily objects, as he himself had observed the contrary, without doubting the GE here. In both cases the magnet and the GE were not topics in their own right, but only invoked as analogies or examples.

Early-modern authors denying the GE typically called it a “fable” that could easily be disproved by experience. William Gilbert assumed that this type of error was passed on from book to book because their authors simply copied to fill their huge volumes.<sup>94</sup> The findings presented from the sixteenth century, however, not only show how experimentalists got rid of the GE but also that its disproof became a subject of this very mechanism of copying as well. Cesi, Aldrovandi, Boodt, and partly even Della Porta may have claimed the inevitability of observation and experience, but they actually depended on others and did little more than copy what somebody else had claimed to have observed or experienced. Della Porta and Cesi did not even take care of the inner coherence of their works as the GE was invoked at one place and refuted at another.

## Analogies

In his *Parasceve ad historiam naturalem et experimentalem* of 1620, Francis Bacon picked up the critical spirit of the experimentalists:

Lastly, there are things which are downright unreliable but which are bandied about and celebrated all the same – things of the kind which, partly from carelessness, and partly from figurative usage have flourished for ages (such as that diamond binds loadstone and garlic weakens it; that amber attracts everything except basil; and many other things of the kind); these should not be quietly set aside but be publicly proscribed lest they do any more damage to the sciences.<sup>95</sup>

With these words, Bacon not only condemned the GE as a pseudo-fact based on ignorance (*neglectu*), but he also links the GE’s survival to its use as analogy (*propter usum similitudinum*). Indeed, Bacon’s observation is sometimes neglected by historians of science, namely that some “facts” are taken for granted so that the author could refer to these “facts” in order to draw an analogy between two instances related to each other by similarity. This background played an important role for the GE.

Almost all of the early modern sources I have discussed that denied the GE were dealing with magnets/loadstones (or garlic) as their subject matter. However, the magnet was not only an important topic of its own but was also a very popular “source domain” for analogies and metaphors in scientific matters.<sup>96</sup> These scientific matters are the “target domains” of magnetic metaphors or analogies, and they varied highly, including disciplinary fields or research contexts such as medicine, astronomy, natural magic, alchemy, and theology.

Magnetic attraction was an important example or instance of certain causal relations or physical notions, such as “attraction”, “action at a distance”, “unperceivable (occult) power/quality”, or “disposition to interact only with a particular substance”.<sup>97</sup> Beyond

this use as example, the GE was considered a very powerful vehicle to illustrate the following concept by analogy: a given substance (the magnet) has the disposition to lose another disposition or power (attraction of iron) if a particular second substance (garlic) interacts with it (magnet or iron). The type of disposition underlying the GE is “relative”, just as the disposition “toxic”.

Dozens of works used the GE as an analogy in various contexts. The earliest use of the GE as an analogy can be found in medieval medicine, where it was used to illustrate the idea of bodily parts attracting their nutriment if they are in a specific disposition.<sup>98</sup> Jean Fernel used a magnetic analogy to point out that the human soul is a simple and undivided substance which can perform different actions and has different “faculties” or powers.<sup>99</sup> This can be seen in a magnet as well because it is a single substance and yet performs two actions: namely, attracting iron and pointing to the north. The GE analogy was also useful to Fernel to make another point: as the human being could lose certain powers or faculties, say that old men stop growing, a magnet could lose its power to attract iron, too; namely, when it was rubbed with garlic.<sup>100</sup> Within medicine, the GE analogy not only informed physiology but also pharmacology. Eustachio Rudio, for example, refers to the “sympathy and antipathy” of drugs and their use and abuse as remedies against particular diseases.<sup>101</sup> In this context he not only invoked magnetic attraction and repulsion (which he attributed to two different types of magnets), but also the GE. Similar “impediments of effect”, as Rudio put it, were also found among drugs.

The GE was also used rhetorically in astrology, beginning with Ptolemy’s *Tetrabiblos*.<sup>102</sup> Ptolemy argued that some events on earth were not determined by the influence of the stars by necessity but could be prevented. Likewise, he says, some natural effect can be prevented as well, as in the case of the GE, where the magnetic attraction is lost which would otherwise persist. In degli Angeli’s work (1615), the author discussed the astrological thesis that the powers of stones derived from the stars.<sup>103</sup> Within this discussion, the “daily experience” of the GE was put forward as a counter argument: if garlic devitalized the magnet, why then should one not assume that the attractive power simply resides within the magnet itself instead of referring to the power of the stars?

Natural magic was the science that investigated the astonishing effects of nature in order to use those effects for the benefit of mankind in technology or just to entertain and impress a specific audience.<sup>104</sup> One of those magical instruments which was considered illicit was the “mining rod”. Georg Agricola invoked the GE in his critical discussion of this tool:

Those who advocate the use of the twig make this reply to these objections: when one of the miners or some other person holds the twig in his hands, and it is not turned by the force of a vein, this is due to some peculiarity of the individual, which hinders and impedes the power of the vein, for since the power of the vein in turning and twisting the twig may be not unlike that of a magnet attracting and drawing iron toward itself, this hidden quality of a man weakens and breaks the force, just the same as garlic weakens and overcomes the strength of a magnet.<sup>105</sup>

In *De incertitudine et vanitate scientiarum et artium* (1530), Heinrich Cornelius Agrippa dealt with the magic of poisons and pointed out that magicians could also influence other people and objects with the sheer power of words, for example through magic formulas, to draw them to themselves or repel them. The inner force acting here is similar to the attraction of the magnet on iron, or the ability of garlic and diamond to stop this attraction.<sup>106</sup>

The GE analogy was also used in moral and theological contexts. Following Philipp Melanchthon, several Protestants repeated that the GE could not be compared to the Original Sin, as the magnet continues to attract iron after the garlic is removed from it, while Luther had argued that the Original Sin would remain forever a part of human beings.<sup>107</sup> Siegfried Sack suggested in 1596 that perfect theologians would even know the actual cause of the GE.<sup>108</sup> Here, the GE served as an example of an effect almost impossible to understand. Simon Menz (1604) argued that prayers would make the planets lose their destructive meteorological powers just as garlic worked on a magnet.<sup>109</sup>

The Protestant pastor Johann Mathesius (1562) chose the magnet analogy as the theme and leading metaphor for a sermon addressed to the miners of his town in Saxony. Christ, as the magnet, attracts the hearts of all Christians. But just as the magnet loses its powers by the GE, or by exposure to diamonds or rust, Christian hearts could also be weakened, so that they would no longer be attracted by Christ: “If the hearts are restive and anointed with Egypt garlic and Roman onions, and Turkish ‘maschlach,’ or covered with rust and sins against the conscience, our magnet [Christ] will not accept the heart”.<sup>110</sup> Here, garlic and onions are metaphors for the religious threat of Islam and Catholicism.

But, of course, Catholics also invoked the GE. For example, Luigi Novarini (1627) claimed that, although preachers were supposed to act like magnets on their listeners, they often did not exert their attraction because they were addicted to worldly desires and thus to the destructive effect of garlic; just as the listeners, like iron, could also be deprived of the attraction of the heavenly magnet by onions and garlic, whereas the juice of the Holy Word was never mixed with onions.<sup>111</sup> The Jesuit Maximilian van der Sandt (1645) used the GE analogy to emphasize that, unlike the magnet inhibited by garlic, Mary the Mother of God always performs her “magnetic work”.<sup>112</sup> The GE, van der Sandt remarks, can also be tried out (*probare, si placet*).

These examples show the prolific and creative use of the GE analogy in various disciplinary fields in order to illustrate very different ideas. Certainly, most of the authors using the GE as an analogy did not engage with experiments testing the GE but rather invoked the GE as a literary commonplace; but the more experimental and critical approaches even informed the use of the GE analogy.

When Cardano commented on Ptolemy’s *Tetrabiblos* (1554), he refers to his own disproof in *De subtilitate* but defended Ptolemy at the same time: “Examples”, Cardano says, “are not given because they are right but for the purpose that those who are taught understand it”.<sup>113</sup> Regarding the “occult” powers of drugs on the one hand and the magnet or the GE on the other hand, Thomas Erastus (1574) explicitly ridiculed the analogical use of the GE, as they would be physically mistaken and therefore no reliable basis for any analogy.<sup>114</sup> In an astrological context, Tommaso Campanella (1630) refers to the GE as an example of strange ancient beliefs that also persist among astrologers, while it is now clear (*hodie novimus*) that the GE is pure fiction.<sup>115</sup> And even theologians, like Luis Alcázar (1614) and Marin Mersenne (1634), knew the analogical use of the GE but remarked that this effect did not exist in reality.<sup>116</sup>

## How shall we assess the GE?

From the first century onwards, readers encounter the statement that garlic prevents iron from being attracted by a magnet. This article argues that the origin of the GE lies in a

specific (mis)reading of a passage in Pliny but then developed a life of its own. The GE originated from a context in which it served as an instance of “sympathy and antipathy”, and, as such, it was not subject to further causal assumptions. Yet, in the ongoing centuries, the GE often lost its connection to “sympathy and antipathy” and was enumerated among other properties of the magnet (or garlic). Several authors since the Middle Ages reflected on the cause of the GE and worked out different hypotheses. The first experimental disproof of the GE took place in the sixteenth century. The lack of belief in the GE became a statement repeated in later accounts of the magnet, just as its affirmation had been before. Simultaneously, the GE served as an important and frequent analogy or metaphor in early-modern science and the GE even informed the use of garlic in pharmacology and imaginary mechanics; but, even as an analogy, it was not uncritically accepted by all.

Given this short story of the GE it remains to ask: how shall we assess the GE from a modern perspective? How can we explain not only its textual emergence but also the belief in it and its longevity?

### ***Fallacy and error***

Early-modern critics of the GE did not deal with the question as to why their predecessors and contemporaries believed in the GE in the first place. The first theory to account for this mistaken belief in the GE can be found in 1736. The weekly science journal from Danzig, *Erläuterte Merkwürdigkeiten der Natur*, edited by Michael Christoph Hanow, discussed the GE in two of its issues.<sup>117</sup> According to the (anonymous) author, the belief in the GE was probably to be explained by a coincidence: some magnet had lost its power for whatever reason, and its owner had, coincidentally, stored it together with garlic.<sup>118</sup> After he discovered that his stone had lost its attraction, he blamed the innocent garlic for it. This fallacy (today usually called “post hoc ergo propter hoc”), however, was not the only theory, as, in the journal’s following issue, it was speculated that the juice of garlic might have caused rust on the magnet, which certainly deprives a magnet of its attractive power.

The English nature writer Richard Jefferies reasoned in his posthumous *Field and Hedgerow* (1900) about the origin of the GE. Although he was very much aware that his contemporaries no longer believed in the GE, he remembered autobiographically how he was reading a work of Ptolemy:

When I was a boy, among other out-of-the-way pursuits, I took an interest in astrology. The principal work on astrology, from which all the others have been more or less derived, is Ptolemy’s *Tetrabiblos*, and there, pointing out the mysterious influence of one thing upon another, it mentions that the virtues of the magnet may be destroyed by rubbing it with garlic. This curious statement has been thrown against Ptolemy and held to invalidate his theories, because upon experiment garlic is not found to affect the magnet. Possibly, however, the plant Ptolemy meant may not have been the plant we now call garlic, for there is nothing so uncertain as the names of plants. There is a great confusion, and it is difficult to identify with certainty apparently well-known herbs with those used by the ancients. Possibly, too, the experiment was performed in a different manner.

Reading this, I chanced to be talking to a village clockmaker about watches. We were discussing what a difficulty it was sometimes to get a watch to go right. I said I had heard that



watches sometimes got magnetised, and went on in the most erratic manner until the magnetism was counteracted. Ah yes, he said, he recollected a case in the shop where he learnt his trade; they had a watch brought to them which had got magnetised, and he believed the influence was at last removed by the use of onions. Instantly memory ran back to Ptolemy's garlic; perhaps after all there was something in his statement.<sup>119</sup>

It seems that Jefferies was intent on defending Ptolemy's experience against the accusation of scholars for whom the GE is a testimony to ancient stupidity. His botanical assumption closely refers back to the physical explanations also given by early-modern authors. Jefferies' point is that we should not limit Ptolemy's statement to a naïve modern reading of his text, but to take into account that the words he used may refer to different entities than we expect them to, or that there was a procedure completely unknown to us that could in fact deprive the magnet of its powers by using garlic. Here we find aspects of a botanical explanation and philological reflections closely intertwined.

The authors of the articles of 1736 and Jefferies wish to explain that there might be a rational explanation for the emergence of the GE. Yet, they both agree that it was not so simple that garlic in fact had the power to damage a magnet. They rather thought about possible scenarios in which some fallacy or posthumous misconception blurred what really happened.

### ***Mentality, ontology, and the distribution of knowledge***

Today, as readers of pre-modern texts, we often encounter claims about the existence of some effect or thing which we simply cannot believe from a modern perspective. Even if there is a philological explanation for the emergence of the GE, it still remains to ask: why did pre-modern scholars believe in the GE for so long, or why did they care about an experimental proof or disproof of the GE in the sixteenth century for the first time? Following Michel Foucault's concept of "episteme" – as a set of historical and "fundamental codes of a culture" that govern the "empirical orders" of every man in the past – one should underline the historical difference of the pre-modern and the modern "episteme".<sup>120</sup> The interpretations of Lehoux, Weill-Parot, and Wootton have tried to understand how this epistemic shift came about.

Lehoux refers to Thomas Kuhn's (and Ian Hacking's) notion of "world" and writes that "Plutarch lives in a different world than we do", as, in his world, garlic and the magnetic "had been of a kind [...], and during the scientific revolution the lodestone got reclassified".<sup>121</sup> This taxonomic rupture particularly came about when a physical and experimental approach to the magnet in its own right no longer followed a tradition in which the magnet mostly was invoked as an instance of a cosmic "system of relations", that is of "sympathy and antipathy". Thereby the magnet lost its evident connection to other elements of this "system of relations", be it garlic, diamond, or goat's blood, and, we may add, established new connections, e.g. to the planet Earth itself or to other heavenly bodies.<sup>122</sup>

Weill-Parot remarks that medieval natural philosophers following Averroes frequently referred to the GE; a fact not taken into account by Lehoux, as "sympathy" did not play any role for those Aristotelian philosophers. Yet, with explicit recourse to Lehoux, he points out that the GE fulfilled a specific task in Averroes's and most medieval philosophers' arguments and therefore was an important tool to analyze the notion of attraction, regardless of whether it was mistaken from an experimental point of view.<sup>123</sup> Moreover,



Weill-Parot stresses the fact that medievals often rather relied on *auctoritas* for their *experimenta* and did not consider it necessary to test those experiments or alleged observations for themselves.

Wootton also raises some justified critical questions about Lehoux's thesis. He emphasizes that the GE could remain an instance of antipathy while it was disproved in another chapter of the same book. Della Porta did not have a problem with referring to the GE uncritically as an example of antipathy and to deny the very same GE in the discussion of the magnet's powers. Maybe he simply did not notice the contradiction because his work was so voluminous and copied from such a variety of sources.<sup>124</sup> Wootton's own explanatory remarks on the contrary do not so much operate on a conceptual level but rather involve the conditions of transferring knowledge. He assumes that the first experimental disproof of the GE was made in the manuscript treatise by Leonardi Garzoni known to Della Porta, who made the GE disproof public.<sup>125</sup> "Printed books, by improving access to information, make it far easier to establish and refute facts. In the course of a few years della Porta's personal experience came to be shared with the whole of educated Europe".<sup>126</sup> Wootton not only overlooks that the GE was already disproved in Cardano's best-seller decades earlier, but also does not really explain why ancient authors believed in the GE in the first place.

## Conclusion

Lehoux, Weill-Parot, and Wootton all are all sensitive to the particular conceptual or epistemic contexts in which the GE was affirmed or refuted, but they hardly take into account that the GE was not only accepted by many but even explicitly defended and explained. Moreover, none of them present a plausible theory of how the GE came about in the first place. Therefore, their theories need to be combined and expanded by three theses defended in the course of this article.

- (1) There is a plausible theory of the first textual occurrence of the GE. The missing of one letter could make the "repulsive magnet" (*alio*) to "attraction depriving garlic" (*allio*), given the specific grammatical and conceptual conditions of Pliny's text. Philologists have long known that the contingency of textual transmission played a pivotal role for the generation of novel "facts" or "objects".<sup>127</sup>
- (2) The historical authors had rational theories to explain the GE and no compelling reasons to mistrust their ancient authorities categorically. Living in a pre-modern world of many things the human mind was taken to be incapable to understand, the GE was certainly surpassed by many other much more fantastic marvels that cried out for disbelief, but still were passed over from century to century.<sup>128</sup> As long as the magnet was not a research topic in its own right, very few felt the need to test it at all. And even if they did, like Pietro d'Abano, it was still maintained that, under specific conditions, one could reproduce the GE. When, due to a more experimentalist approach in the sixteenth century and an increasing interest in the subject of magnetism, scholars disproved the GE categorically, it was still not completely irrational to defend the GE. The assumption that ancient garlic was more powerful than modern garlic, for example, might be hard to prove, but it was not irrational or even an unempirical objection.
- (3) The GE was taken to be very useful in analogies in which it was of secondary importance whether the GE was experimentally proven. An analogy might be more compelling or

illuminating if it relies on an existing fact, but it does not need to. If nobody ever believed in the GE it would have been difficult to use it as an illustration, but as soon as it became commonplace it could be (and in fact was) used and empirically criticized at the same time. Indeed, authors relied on analogies drawn from fiction very often, e.g. from classic literature or Greek mythology. Thomas Browne, for example, explicitly ridicules the GE by alluding to Homer's *Odyssey* (X, 302–6), in which Hermes gave some garlic named “Moly” to Odysseus in order to protect him from Circe's spells.<sup>129</sup> For Browne, both the Moly effect and the GE were fictional and therefore he probably would not have endorsed grounding any (scientific) analogy on either of them; but for his persuasive and rhetorical purpose, the Moly analogy was just apt.

Even if it may seem unlikely that any early-modern author would have used an analogy derived from an experimental “scientific” research area, such as magnetism, and at the same time be aware that that analogy relied upon was evidentially wrong and disproved, this still would presuppose that scholars (and readers) of a very specialized field, say Protestant theology, knew the particulars of current research in the field of magnetism.<sup>130</sup> The theologian Mathesius read the mineralogist Agricola's chapter on the magnet before he wrote his sermon drawing on the GE analogy and even asked an astronomer to check the scientific correctness of his sermon.<sup>131</sup> He nonetheless referred to the GE, as neither Agricola nor his referee knew about its disproof.

Even in those cases in which we can take it for granted that the author knew that the GE was disproved, the same GE was still employed as an analogy or example of antipathy. This inconsistency probably can be ascribed to the fact that these voluminous works contained too many facts for the author to oversee, but it cannot be ruled out entirely that these authors deliberately used the GE as an example to illustrate “sympathy and antipathy” or as an illustrative analogy, although they knew that the GE was inexistent at the same time. It seems that Cardano even assumed that Ptolemy knew about the falsity of the GE and yet used it as an analogy to make his point clear to his less sophisticated readers.

Either way, a probable reason as to why the GE was employed in analogies so often and for such a long time is that it could illustrate a quite abstract dispositional relation between two substances. This capacity, and the integration in the even more frequent and overarching magnet analogy, made the GE analogy a powerful tool to describe very difficult matters in a relatively plain and easily imaginable way.

The GE was neither a core belief of pre-modern science nor was its disproof a cornerstone of the “scientific revolution”, although Lehoux and Wootton make it a good example of how a novel concept of “scientific fact” emerged during the early-modern period. This article has shown that the story of the GE is more complex: early-modern scholars not only refuted the GE but also contributed to its longevity. Moreover, and probably more importantly, it has become clear that – on a methodological level – historians of science might benefit from paying more attention to philological details and from surveying a wider array of sources.

## Notes

1. Gunther, *Early Science in Oxford*, vol. 4, 26–7. For magnetic experiments in the circle of the British scientific societies of the seventeenth century, see Pumfrey, “Mechanizing Magnetism”.

2. Zedler, *Universal-Lexicon*, vol. 29, 385.
3. In this article, the word “magnet” is used to denote the mineral “loadstone”. Cf. also Sander, “Magnetism in Renaissance Science”.
4. Lehoux, “Tropes, Facts, and Empiricism”; Lehoux, *What Did the Romans Know?*, 133–54; Weill-Parot, *Points aveugles*, 262–7; Wootton, *The Invention of Science*, 268–83.
5. Plutarch, *Moralia*, vol. 8, 174: “ἡ δὲ σιδηρίτις λίθος οὐκ ἄγει τὸν σίδηρον, ἂν σκόρδῳ χρισθῇ”. Cf. also Plutarch, *Ethica*, 577: “magnetem ferrum, si alii succo fuerit tinctum, non attrahere”.
6. This is discussed in Lehoux’s study. Cf. also Röhr, *Der okkulte Kraftbegriff*, 67; Gemoll, *Nepualii fragmentum*; Wellmann, *Die Physika des Bolos Demokritos*.
7. Various authors are discussed in the following. Cf. also Radl, *Der Magnetstein in der Antike*, 62; Lippmann, “Chemical and Technological References in Plutarch”, 10; Wiedemann, “Beiträge zur Mineralogie usw. bei den Arabern”, 50–1; Lippmann, *Entstehung und Ausbreitung der Alchemie*, 38, 413, 415; Sticker, “Pharmakologie und Toxikologie”, 18–9; Serapion (Ps.), *De simplicibus medicinis*, 261; Lång, *Unlocked Books*, 271; Wiedemann, “Zur Geschichte des Kompasses”, 114; Steneck, *Science and Creation*, 114; Albertus Magnus, *Physica*, 523; Wallace, “Amaze Your Friends!”, 181.
8. On Pliny, see Conte, *Generi e lettori*; French, *Ancient Natural History*; Healy, *Pliny the Elder on Science and Technology*.
9. Cf. book 20, chapter 1, parts 1 and 2 in Pliny, *Naturalis historia*, 1892:

quod Graeci sympathiam et antipathiam appellavere, quibus cuncta constant, ignes aquis restinguentibus, aquas sole devorante, luna pariente, altero alterius iniuria deficiente sidere atque, ut a sublimioribus recedamus, ferrum ad se trahente magnete lapide et alio rursus abigente a sese, adamanta, rarum opum gaudium, infragilem omni cetera vi et invictum, sanguine hircino rumpente, quaeque alia in suis locis dicemus paria vel maiora miracula.

From a grammatical point of view, his enumeration is parallelistic, as all instances are rendered as ablative absolute.

10. Pliny, *Naturalis historia*, 1897, in book 36, chapter 25, part 130: “alius rursus in eadem Aethiopia non procul magnes ferrum omne abigit respuitque”.
11. Ancients scarcely referred to magnetic repulsion and, if they did, they mostly assumed that this was exerted by another type of magnet. On this and the “Theamedes”, see Sander, “Magnetismus und Theamedismus”.
12. Bertelli, “Di un supposto sistema telegrafico magnetico”, 102, n. 3; Benjamin, *The Intellectual Rise in Electricity*, 143; Balmer, *Beiträge zur Geschichte der Erkenntnis des Erdmagnetismus*, 44; May, “Garlic and the Magnetic Compass”, 231. Bertelli writes: “Molto saviamente il Sig. abate [Luigi] Barbieri mi fa osservare [...] che nel passo di Plinio [...] alcuni codici e stampe leggono erroneamente allio (scilicet illito) rursus ecc”. See also note 16. In 1701, the Jesuit Giovanni Stefano Menochio also tried to explain that the belief in the GE had begun with this mistaken reading of Pliny. See Menochio, *Stuore*, vol. 2, 674.
13. On Garlic in Pliny, see book 19, chapters 50–7, and book 20, chapter 113 in Pliny, *Naturalis historia*, 1892.
14. Pliny, *Naturalis historia*, 1829, vol. 6, 493: “Ita MSS. omnes, ipsaque loci sententia ita legi postulat. Frustra sunt Mathiol[us], Caesius, alique, qui allio hic scriptum a Plinio autumant, quo ejus viri auctoritate magnetis et alii dissensionem et antipathiam stabiliant”.
15. The first edition is Pliny, *Naturalis historia*, 1469.
16. Pliny, *Naturalis historia*, 1507, 150v. See also Pliny, *Naturalis historia*, 1513, 119v. This edition was, with the same mistake, also edited by Benedetti. Pliny, *Naturalis historia*, 1519, 162v, however, reads “alio”. The *allio* mistake also occurs in more recent editions of Pliny: see Menochio, *Stuore*, vol. 2, 674; Lemaire, *Poetae latini minores*, vol. 4, 406. Menochio corrects “allio” to “alio”. This typo also occurred the other way around in other texts, transforming “allio” into “alio”, e.g. in Agrippa, *De incertitudine et vanitate*, 1531, H4r. Cf. also note 106.
17. Liceti, *De tertio-quaesitis*, 216–23.

18. Liceti, *De tertio-quaesitis*, 218; Porta, *Villa*, 798. Liceti claims that Simeone Maiolo and Bernardo Cesi followed this mistake, too, which I can only confirm for Maiolo, *Dies caniculares*, 567.
19. In this reading, “allio” is not the subject of the *ablativus absolutus* but an *ablativus instrumentalis* within the *ablativus absolutus*. Reading “allio” as the subject of the *ablativus absolutus* would mean that garlic drives iron away, which is less reasonable but does not present an obstacle to my theory.
20. It is certain that Plutarch had a safe reading knowledge of Latin, that he knew several Latin texts of his time (mostly poets and historians, though), and that he most likely knew Pliny’s nephew Gaius Plinius Caecilius Secundus (Pliny the Younger) in person, as they shared the same circle of friends. Cf. Jones, *Plutarch and Rome*, 61; Strobach, *Plutarch und die Sprachen*, 33–8. Of course, the Younger knew the Elder’s *Natural History*. Plutarch and Pliny (the Elder) occasionally refer to the same details, e.g. to a medical treatment reported by Marcus Porcius Cato. See Draycott, “Flower Power”. However, the textual dependency for the case of the GE is very uncertain.
21. See note 5.
22. Moreover, it can be argued from a grammatical point of view that Plutarch actually thought that the garlic must be applied to the iron, not to the magnet. If we take into account that Plutarch compared the effect of oil applied to the objects of attraction exerted by amber, the GE would also require that garlic be applied to the object of the magnet’s attraction, that is to iron. If we come to the next chronological appearance of the GE in Ptolemy, this observation is borne out further. Weill-Parot, *Points aveugles*, 263, however, says: “Alors que le commentaire d’Averroès, de même qu’une source comme le *Quadripartitum* de Ptolémée, précise bien que c’est l’aimant qui est frotté avec l’ail”. He then, however, shows that several medieval authors thought that the garlic had to be put on the iron.
23. Ptolemy, *Apotelesmatika*, 18: “οὐτε τὸν σίδηρον ἢ μαγνήτις ἐλκύσει παρατριβέντος αὐτῇ σκορόδου”. Cf. also Ptolemy, *Quadripartitum*, 5v: “Nec iste lapis magnetis ferrum attrahet si cum alleis ungatur”. See Berthelot and Ruelle, *Collection des anciens alchimistes grecs*, vol. 2, 429: “τὸ σκόροδον προστριβόμενον κατὰ τὸν μαγνήτην κωλύει αὐτὸν τῆς τοιαύτης φυσικῆς ἐνεργείας”. This alchemical treatise clearly says that the garlic must be applied to the magnet.
24. John Lydus, *Liber de mensibus*, 76:

‘Ὅτι ᾧ τρόπῳ ὁ τοῦ μάγνητος λίθος τὸν σίδηρον ἐφ’ ᾧ κινεῖται διὰ τὴν ἐμφέρειαν τῆς κατὰ τὸν ἀσώματον λόγον ὁμοουσίῳ δυνάμει μεταφέρει, τοῦτ’ αὖ τρόπῳ τὰ ἐμπερὶ ἄψυχα τοῖς ἐμπερέσιν ἐμψύχοις ὑπακούει μεταφερόμενα. ὅτι δὲ ἐμπερὶ τῷ μάγνητι λίθῳ κατὰ τινα δύναμιν ὁ σίδηρος εὐμαρὲς συνιδεῖν· ὁ γὰρ ἐξ αὐτοῦ μεταλλευθεὶς σίδηρος οὐδὲν ἤττον τὸν ἐξ ἄλλης ὕλης μεταλλευθέντα σίδηρον εἰς ὃ κινεῖται μεταφέρει, πλὴν εἰ μὴ χυλῷ κρομμύων ἀλιφῇ, ὡς τοῖς φυσικοῖς δοκεῖ. αὐθις δὲ τραγέῳ αἵματι χριόμενος ὁ μάγνης τὴν ἐλκτικὴν ἀναδέχεται δύναμιν.

Cf. also John Lydus, *Ioannes Lydus*, 58:

Simile autem vi quadam ferrum esse magneti facile est ad intelligendum: effossum enim ex eo ferrum nihilo minus ex alio lapide effossum ferrum, ad quod transmovetur, alio transfert, at vero cedit unguento ex caeparum succo confecto, ut physicis videtur: rursus autem cruore hircino si ungitur magnes, attrahendi vim recipit.

It seems very clear that Lydus supports the idea that the juice of an onion needs to be applied to the iron not to the magnet, while the goat’s blood needs to be applied to the magnet, instead. See, on this passage, Wellmann, *Die Physika des Bolos Demokritos*, 25; Radl, *Der Magnetstein in der Antike*, 124–5; Halleux, *Le problème des métaux*, 151, n. 12. On John’s work, particularly on book 4, see Maas, *John Lydus*, 52–6. In the current critical edition, John Lydus, *On the Months*, 148, the section on the GE has been placed somewhere else (in March instead of January, in ch. 27 of book IV). Lehoux has overlooked this passage.

25. On the textual transmission of the *Geoponica*, see Scardino, *Edition antiker landwirtschaftlicher Werke*, vol. 1, 5–58.

26. *Agricultural Pursuits*, 194. Cf also *Geoponica*, 435: “ἡ μαγνήτις λίθος, ἥτοι σιδηρίτις, ἐφέλκεται τὸν σίδηρον· ἐκπνεῖ δέ, σκορόδου προστριβέντος αὐτῇ· ἀναζῇ δὲ πάλιν τραγείου αἵματος ἐπιχυθέντος αὐτῇ”. Cf. *De agricultura*, 292: “*Magnetes lapis sive siderites attrahit ferrum. Expirat autem si allium ipsi affricetur. Reviviscit sanguine hircino ipsi infuso*”. Here it seems again that the garlic has to be applied to the iron, although at least the Latin pronoun “*ipsi*” can refer both to iron (*ferrum*) and to the magnet (*lapis magnetes*). The Greek pronoun “αὐτῇ” is feminine and can only refer to the magnet (both “μαγνήτις” and “σιδηρίτις” are feminine) and not to iron (“σίδηρον” is neuter).
27. Zakariyā ibn Muhammad, *Das Steinbuch*, 38.
28. Jacopo da Forlì, *In primum Canonem Avicennae*, 219v:
 

Primo. in re uno numero non est nisi forma substantialis una numero et adaequata, quamvis in eodem sint plures specificae distinctae secundum speciem, ut in magnete virtus attrahendi et expellendi ferrum cum ipsum inungatur oleo et secundum diversas eius partes, ut testatur magister tractatu de magnete, quia pars septentrionalis attrahit ferrum et meridionalis expellit.

See also Jacopo da Forlì, *In primum Canonem Avicennae*, 218r: “Tertio per diversas proprietates occultas in diversis partibus repertas eiusdem ut pars septentrionalis et meridionalis magnetis. Quarto ex parte varietatis dispositionis passi, sicut ferrum purum attrahit magnes et inunctum oleo expellit a se”. Cf. Jacopo da Forlì, *In primum Canonem Avicennae*, 221r.
29. In Buonamici, “Liber de vindemiis”, this part of the work is not translated.
30. Mattioli and Pedanius Dioscorides, *Commentarii*, 20, only states: “si alio confricetur id neutiquam agit”. However, Mattioli and Pedanius Dioscorides, *Commentarii*, 120, reads: “magnes ferrum respuit, si adsit adamas, vel si alio affricetur”. As Mattioli also mentions the diamond, it seems plausible that the phrase “ferrum respuere” was not meant to refer to repulsion, as this effect was not ascribed to the diamond at all. Cf. also note 93 and Agricola, *De re metallica*, 1556, 194.
31. Cf. Lemnius, *Occulta naturae miracula*, 1559, 186r: “Sic Magnes alio perunctus ferrum respuit, quod pingue quiddam alio insit, quo vis eius retunditur”. Cf. Mizauld, *De arcanis naturae*, 65v: “magnes si alio confricetur, ferrum abigit”.
32. See note 10.
33. Mattioli and Handsch, *New Kreüterbuch*, 208r: “so man in aber mit Knoblauchsafft schmieret/ treibet er das eisen vor sich”; Durante, *Hortulus sanitatis*, 29: “alles Eysen von sich vertreibt”.
34. Goldschmid, *Succini historia*, c. 8: “Denn so man mit knobloch das eisen bestreiche/ zeucht es der Magnet nicht alleine nicht an sich/ sondern schlecht und treibet es gleich von sich”. Goldschmid also assumed that the garlic had to be applied to the iron, not to the magnet.
35. According to Halleux, *Le problème des métaux*, 151, n. 12, the author of the passage containing the mention of the GE is Pamphilus of Alexandria. Although Pamphilus’ work *Physicorum* (Φυσικῶν) was used by the author of the *Geoponica*, there is no reason to believe that the mention of the GE originated in this writing. On this author and his role for the *Geoponica*, cf. Wellmann, “Pamphilos”, 50. The ascription of the entire chapter to Zoroaster cannot be taken for granted, either. Cf. Beck, “Thus Spake Not Zarathustra”, 530. Pliny’s *Natural History* was among the sources of the *Geoponica*, cf. Oder, “Geschichte der Landwirtschaft I”.
36. Pliny, *Naturalis historia*, 1897, in book 36, chapter 25, part 127: “sideritim ob id alio nomine vocant”.
37. This difference is also noted by Wellmann, *Die Physika des Bolos Demokritos*, 29, n. 2.
38. However, if we assume that the *Geoponica* took the theory about goat’s blood from Pliny directly, we might wonder why we find the same theory in a text that was composed earlier than the final redaction of the *Geoponica*, namely in Lydus’ work of the sixth century. There is no reason to rule out that the *Geoponica* relied on *On the Months*, and at first sight it even seems very plausible to assume a connection between the two works.

First, both works originate from a Byzantine context. Both works mention, for the first time, the effect of goat's blood. Yet, there are also important differences. Lydus does not speak about garlic but about onions. Lydus does not invoke the concept of "sympathy and antipathy", as do Pliny, Plutarch, and the *Geoponica*. Lydus does not mention the name "siderites" for the magnet. We can conclude that it is rather unlikely that Lydus is the direct or exclusive source for the mention of the GE in the *Geoponica*. But how did Lydus know about the alleged GE? Lydus, although he wrote in Greek, was famous for his knowledge of Latin and he frequently referred to Pliny's *Natural History* in other works. Cf. Maas, *John Lydus*, 32, 127. Lydus also referred to Plutarch's *Table Talks* in *On the Months*. Cf. Maas, *John Lydus*, 127. Either way, both alleged sources, Pliny and Plutarch, are not convincing options for being considered the direct or exclusive sources for the mention of the GE in Lydus's *On the Months*. First, Plutarch does not mention the goat's blood theory and calls the magnet "siderites". Second, if Lydus misread Pliny's work in the way that has been argued for – "allio" instead of "alio" – it seems strange why Lydus does not refer to repulsion at all and does not even speak about garlic but about the juice of onions.

39. See note 9 and Ohly, *Diamant und Bocksblut*. This "goat's blood cure" was first mentioned by Lydus but known among Latin authors as it was repeated in a work (*De lapidibus*) falsely attributed to Aristotle, which was probably written by a Persian or Syrian author, but was translated into Arabic and Hebrew and later also into Latin. See Ruska, *Das Steinbuch des Aristoteles*, 197:

Si iste lapis antequam calcinetur ponatur in aqua ceparum aut alliorum et sit ibi per tres dies coopertus in aliquo vase amittit omnino vim suam. Sed recuperabit eam si ponatur in sanguine hyrci per tres dies ita quod sanguis quolibet die renovetur. Et qui voluerit ei auferre vim quam habet ex calefactione superponat ei parum sanguinis hyrcini et sic tollet ei.

The expression "iste lapis" might not refer to the magnet but to a brick that contained pulverized magnet being made and calcinated in an alchemical process the author had described right before this quotation. The effect of goat's blood and garlic (and the alchemical process) is also mentioned in Serapion (Ps.), *De simplicibus medicinis*, 261. Cf. also Wiedemann, "Zur Geschichte des Kompasses", 114. Rather surprising, however, is the passage in Ullmann, *Die Natur- und Geheimwissenschaften im Islam*, 412: "Der Speichel eines Fastenden tötet den Skorpion und macht die Anziehungskraft des Magneten zunichte". Cf. also Maslamah ibn Ahmad Majrīti, *Picatrix*, 1986, 220; Maslamah ibn Ahmad Majrīti, *Picatrix*, 1962, 406. Georgius Pachymeres, a scholar from Byzantine, mentions that the diamond (*adamas*) is made soft by goat's blood and by iron. Cf. Georgius Pachymeres, *Epitome*, 1548, 2v; Georgius Pachymeres, *Epitome*, 1560, 15. He does not refer to garlic or to the magnet repelling iron.

40. Pliny, *Naturalis historia*, 1897, in book 37, chapter 15, part 61: "adamas dissidet cum magnete in tantum, ut iuxta positus ferrum non patiatu abstrahi aut, si admotus magnes adprehenderit, rapiat atque auferat".
41. Pinder, *De Adamante*, 16, 53–4, 77–83; Krause, *Pyrgoteles*, 20, n. 2; Marbod von Rennes, *De Lapidibus*, 57. See also Forbes, *Metallurgy in Antiquity*, 439, 459.
42. Alternatively, the author may have reasoned that if garlic and the diamond were enemies of the magnet, and goat's blood was the enemy of the diamond, it follows that goat's blood also would have to be the enemy of garlic. Therefore, he might have concluded that goat's blood simply undid what the garlic had caused, and thus restored magnetic attraction.
43. See note 6.
44. For the GE in *herbaria*, see Mattioli and Pedanius Dioscorides, *Commentarii*, 20; Mattioli and Handsch, *New Kreüterbuch*, 42r; Mylius, *Hortus philosophicus*, 563; Durante, *Hortulus sanitatis*, 29.
45. See, e.g. Draelants, "Encyclopédies et lapidaires médiévaux".
46. Lehoux, *What Did the Romans Know?*, 141; Migdał, "Nauka i magia".
47. Averroes, *De physico auditu*, 315r: "Et ideo, quando magnes fricatur cum alio, amittit virtutem, nam ferrum tamen non acquirit de lapide in illa dispositione qualitatem, per quam



innatum est moveri per se ad lapidem”. Cf. note 98. For the medieval discussion, cf. Weill-Parot, *Points aveugles*, 262–7.

48. Averroes, *De physico auditu*, 374v:

et similis ferrum est quoquo modo de numero eorum, quae naturali moventur, cum non moventur a magnete, nisi per alterationem, quam acquirit, mediante aere a magnete. Et non quum complexio magnetis transmutatur, non attrahit; sicut accidit ei, quando confricatur cum alliis, et ut dicitur.

For Averroes’ notion of locomotion, see also Knox, “Copernicus’s Doctrine of Gravity”, 158. For the notion of *complexio*, cf. Köhler, *Homo animal nobilissimum*, vol. 1, 310.

49. Torrigiano de Torrigiani, *In Microtegni Galieni*, 124r: “tunc non procedit actio ex magnete excitans virtutem motus in ferro, allium etiam non prohibet illam actionem nisi ex forma sua, que talis actionis est impeditiva”. Cf. also Montanus, *Consultationes medicae*, 515: “quia allium habet formam specificam contrariam magnetis actioni”.
50. Pietro d’Abano, *Conciliator controuersiarum*, 76r: “Quod expertus sane non reperi nisi sanguine fortassis una die intingatur hircino”. On Abano’s approach towards experience, see Leemans and Coucke, “Egostatements and Experience”. On another medieval author who does not dare to judge whether the GE takes place or not, see Weill-Parot, *Points aveugles*, 173.
51. Portaleone, *De auro*, 152–3. Such an assumption was obviously made by Giordano Bruno in *De magia* (1590). Cf. Bruno, *Opera latine conscripta*, vol. 3, 422:

Quod vero per effluxum partium, qui fit ab huiusmodi subiectis, haec attractio prove-niat, illud indicat, quod magnes perfrictus et ambra paleam trahendo et ferrum tanto amplius roborantur; calor enim ille maiorem partium effluxum inducit, in cuius virtute est poros aperire et corpus rarefacere.

52. Eck, *Physica*, 91r: “si magnes fricetur aleo perdit virtutem alterativa, et si reponitur in acetum recuperat eam, ut patet Vitus divi Benedicti Auguste sacerdos me docuit”. Eck deals with the assumption that the iron changes through the magnet and moves to the magnet thereby. This “Vitus” is probably Vitus Bild, cf. Posset, *Renaissance Monks*, 147, 157.
53. Agricola, *Opera*, 251: “Sed magnes ad se non allicit ferrum si fuerit rubiginosum, aut impurum, aut oblitum alli ceparumve succo. Nec vero minus adamas eius viribus resistit. Si enim iuxta ferrum ponitur, non potest id magnes ad se allicere, aut si iam traxit, quamprimum adamas fuerit appositus, ipsum demittit. Quinetiam magnes si diu ferro aut eius vena careat, aliquam virium iacturam facit; quod ne fiat, squama ferri est obruendus”. Cf. Agricola, *Opera*, 172.
54. Paracelsus, *Medizinische, naturwissenschaftliche und philosophische Schriften*, vol. 2, 448.
55. Portaleone, *De auro*, 9, 68. Cf. also Libavius, *Syntagmatis*, vol. 1, 37. He also refused the idea that either garlic or any other metal than iron and steel could be magnetized. Cf. Libavius, *Syntagma-tis*, vol. 1, 39: “Frustra in hydragyrum magneticam vim traduces, frustra in alli succum”. The influence of quicksilver and garlic is also reported in Helmont, *Ortus medicinae*, 606.
56. See note 85.
57. Mizauld, *Enchiridion*, 56v:

Quae res, cum saepenumero et mihi, et amicis meis aliter probata et explorata fuisset, eo me duxit, ut facile crediderim viros ille eximios, et in primis Ptolemaeum, nequaquam de communi opinione id dixisse, quin potius de suo Aegyptiaco allio rem eam intellexisse.

Cf. also Mizauld, *Centuriae novem*, 136. He refers to Torrigiano de Torrigiani (cf. note. 49). In translations it is mistakenly ascribed to “Drusianus” (=Turrisanus) that Egyptian garlic might be involved. Cf. Mizauld, *Neunhundert Gedächtnuß-würdige Geheimnuß*, 497–9; Rochlitz, *Artzneybuch*, vol. 2, 164v. In Mizauld, *Sylvula*, 15r; Mizauld, *De arcanis naturae*, 19v, 65v, the GE is not refuted.

58. Lemnius, *Occulta naturae miracula*, 1559, 186r: “Sic Magnes allio perunctus ferrum respuit, quod pingue quiddam allio insit, quo vis eius retunditur”. In a later edition he adds to this “ac minus adherescit”. See Lemnius, *Occulta naturae miracula*, 1564, 220v.



59. Toletus, *Physica*, 198r: “se [i.e. Pietro d’Abano] expertum esse, magnetem unctum alliis ferrum trahere: dicit tamen, quod si magnes, aut ferrum per diem sanguine hircino intingeretur, non esset talis attractio: nec dubito, aliquando decipere illam experientiam de alliis”.
60. Toletus, *Physica*, 198v:

Causa autem, quare allium talem virtutem habeat, existimo esse, quia calidum est, et calor eius mordax, et divulsivum partium subtiliorum et ita appositum magneti divertit partes calidiores, quae magis activae sunt, et ita impedit ab actione; et hinc provenit aliquando, quod non impediat propter debilitatem caloris aliorum.

For a similar account of the GE, cf. Marcellus, *De anima*, 51v. On medical uses of garlic, see note 72.

61. Vanini, *De admirandis naturae reginae*, 146:

Ego vero dicerem, accidentis facultate, quae a Magnete exit, ferream substantiam trahi, sicut odores exire sentimus manifeste atque nos alterare, cuius rei signum est, quod allio si perungatur Magnes, ferrum non attrahet ex Ptolemaei sententia, neque si oleo (addam ego) vel quacunq[ue] pingui alia re obliniatur, obtunduntur enim Magnetis spiritus a multo humido et crassitie.

62. See also Thorndike, *Magic and Experimental Science*, vol. 7, 310. Lehoux, “Tropes, Facts, and Empiricism”, 334, seems to rely exclusively on Thorndike.
63. Vicentini, *De calore*, 122, argues: “Nullas esse qualitates occultas, et quam relationes habeant ad Coelum rerum particularium eventus et proprietatis”. Cf. Vicentini, *De calore*, 128–9:

Attrahit Lapis haerculeus ferrum non ratione qualitatis cuiusdam per se sumptae, sed ratione similitudinis temperamenti, quae ex primis qualitibus dependent, unde cum unum quodque naturaliter feratur in id a quo perfectionem aliquam accipere potest, ut materia prima in formam, ita ferrum fertur in lapidem per speciem eius sibi in debita distantia obiectam, ut fere sit in vim veritas haec experimento comprobatur, nam si allio liniatur lapis non amplius fertur ferrum in illum, quia allium prohibet ne species lapidis representetur ferro prout est, sed contraria potius omnino ratione, cum allium sit ferree substantiae destructivum, sic ferrea allii succo innuncta, et rubigine inficiuntur, et deteriora fiunt.

64. Liceti, *De tertio-quaesitis*, 222:

tum quia multae species magnetis existunt, quarum aliae virus allii negligunt ac superant invictae, aliae succumbunt eius halitui faetido: tum quia iuvenis ac robustus magnes allium impune tolerat, e contra senio languidus allii virulentiam non sustines: tum non minoris aestimandae sunt auctoritates, ac experientiae tot insignium Classicorum, quam unius Portae, atque Cardani.

65. Liceti, *De tertio-quaesitis*, 222. See note 85.

66. Liceti, *De tertio-quaesitis*, 223.

67. Ens, *Thaumaturgi physici prodromus*, 29–30:

Varia occurrerunt, in nullo acquiescere potui nisi in allii odore; quod ille vim Magneticam obtundat. Ratio, quia allium gradum caloris, locum nativitatis, influxum a sideribus, pluraque alia communia habet cum ceteris sive plantis, sive lapidibus: odore vero praeditum est singulari, quo aerem inficit; isque infectus vires Magnetis obtundit.

For the attribution of this anonymous work to Ens, see Thorndike, *Magic and Experimental Science*, vol. 7, 595. Ens’ work of 1649 is probably a sequel of Ens, *Thaumaturgus mathematicus*.

68. Ross, *Philosophical Touchstone*, 34. It is a critique of Digby, *Two Treatises*, 218–52. See also note 73.
69. Browne, *Pseudodoxia Epidemica*, 67: “But certainly false it is what is commonly affirmed and believed, that Garlick doth hinder the attraction of the Loadstone”.
70. Ross, *Arcana Microcosmi*, 110:

yet I cannot believe that so many famous Writers who have affirmed this property of the garlick, could be deceived; therefore I think that they had some other kinde of Load-stone, then that which we have now. For Pliny and others make divers sorts of them, the best whereof is the Ethiopian. Though then in some Load-stones the attraction is not hindred by garlick, it follows not that it is hindred in none; and perhaps our garlick is not so vigorous, as that of the Ancients in hotter Countries; yet I finde, that not onely by garlick is this attraction hindred, but also by fire, rust, oyl, and other fat things, also by the presence of another Load-stone.

See also Ross, *Arcana Microcosmi*, 191–2:

Whereas the ancients held that garlick hindred the attraction of the Loadstone, he contradicts this by experience; but I cannot think the ancient Sages would write so confidently of that which they had no experience; of, being a thing so obvious and easie to try; therefore I suppose they had a stronger kind of garlick, then is with us, which made Horace write so invectively against it, calling it poison and worse then hemlock.

Only the first passage is quoted in Wootton, *The Invention of Science*, 279.

71. Cf. McMahon, “Garlic’s Ancient Serpent Connection”; Porter, “Quo, Quo Scelesti Ruitis”; Renfrew and Sanderson, “Herbs and Vegetables”, 104; Ritoók, “Dichtkunst und Knoblauch”.
72. Mattioli and Pedanius Dioscorides, *Commentarii*, 20; Bartholomaeus Anglicus, *De rerum proprietatibus*, 798; Porta, *Villa*, 798; Mylius, *Hortus philosophicus*, 563; Sticker, “Pharmakologie und Toxikologie”, 14–5; Rivlin, “Historical Perspective on the Use of Garlic”; Adamson, *Food in Medieval Times*, 6–7; Watts, *Dictionary of Plant Lore*, 161–3. See also Albertus Magnus (Ps.), *De mirabilibus mundi*, 133: “Si vis capere talpam, pone in foramine eius cepem vel porrum aut allium, et statim egredietur sine viribus”.
73. Cf. the *Anditotum* on page 10, printed in Maire, *Recentiorum disceptationes*: “Sic quoque magnes allio imbutus dicitur non trahere [...] Quod si impelleretur, posset accedere, etiamsi magnes allio esset oblitus”.
74. Midgley, *New Treatise*, 31.
75. Ponzetta, *Libellus de venenis*, lib. 2, tr. 4, c. 5: “Et pro antidoto debet dari Allium, vel pondus octo granorum ordeï Smagradi [sic] triti cum vino”. The use of garlic in a medical recipe is also mentioned in Serapion (Ps.), *De simplicibus medicinis*, 260. On Ponzetta, see Marini and Mandosio, *Degli architri pontifici*, vol. 1, 227–36.
76. Porta, *Phytognomica*, 299. See also Porta, *Magia naturalis*, 1589, 7: “deleterie facultatis magnes est, et allium contra venenum est”.
77. Gilbert, *De magnete*, 35.
78. For the text, cf. BNF, Français 2156, 112r–114v. This manuscript is edited in Rabelais, *Le Cinquiesme et dernier livre*, 152–6; Rabelais, *Les Quatre livres*, vol. 3, 125–7, 309:

Seulement y pendoit un Diamant Indique, de la grosseur d’une febve Egyptiatique, enchassé en or obrizé, à deux pointes, en figure exagone, et en ligne directe: à chascun costé vers le mur, pendoit une poignee de Scordeon. [...] puis tira le Diamant pendant à la commissure des deux portes, et à dextre le jetta dedans une capse d’argent, à ce expressement ordonnee: tira aussi de l’essueil de chascune porte, un cordon de soye cramoisine longue d’une toise et demie, auquel pendoit le Scordon, l’attacha à deux boucles d’or, expressement pource pendantes aux costez, et se retira à part. [...] Par, donques, la rapacité violente de l’Aimant, les lames d’Acier, par occulte et admirable institution de nature, patissoient cestuy mouvement: consequemment les portes y estoient lentement ravies et portees, non tousjours toutesfois, mais seulement l’Aimant susdit osté: par la prochaine session duquel l’Acier estoit de l’obeissance qu’il a naturellement à l’Aimant absout et dispensé, ostees aussi les deux poignes de Scordeon, lesquelles nostre joyeuse Lanterne avoit, par le cordon cramoisin, eslongnees et suspendues, par ce qu’il mortifie l’Aimant et despouille de ceste vertu attractive. En l’une des tables susdites à dextre, estoit exquisitement insculpé en lettres Latines antiquaires ce vers Iambique senaire.

On this work, see Giacone, *Le Cinquiesme livre*; Huchon, *Rabelais grammarien*, 412–89. The GE mechanism was inspired by Colonna, *Hypnerotomachia Poliphili*, N7r–v:

Erano daposcia mirabilmente due Axule di latitudine triente, di ottimo Magnete Indico, al quale lo Adamante non dissideva, di Calistone amatore, agli humani ochii praestabile, dal scordeon mortificabondo. Agli navanti singularmente opportuno, le quale del suo conveniente colore monstravano ceruleo, lisce et illustre, affixe perpolittamente nella crassitudine, dilla apertione dil marmoreo muro, cioè nelle poste, alle ante contigue della artificiosa porta. Dunque per questo modo dalla violentia della rapacitate del Magnete, le lamine calybie erano violentate, et consequentemente per sé le valve cum temporata lentitudine, se reseravano. Opera eccellente et exactissima, non solamente de vedere, ma oltramodo di subtile excogitato. Quanta improbitate di investigato di artifice.

Cf. also Francis, “The Mechanism of the Magnetic Doors”; Françon, “Francesco Colonna’s ‘Poliphili Hypnerotomachia’ and Rabelais”. Colonna mentioned the harmful power of diamonds and garlic (*scordeon mortificabondo*), but only in order to describe the Indian magnets used and not as part of the actual mechanism.

79. Entzelt, *De re metallica*, 175.

80. Cardano, *De subtilitate*, 1560, 493; Cardano, *De subtilitate*, 2004, vol. 1, 668: “Nec, ut fabulantur, allio caepisve impeditur, multo minus adamante; nisi forsan adeo leviter, ut in minimis solum ac debilibus deprehendatur, in reliquis autem sensum effugiat”. The GE is also doubted in Erastus, *De occultis pharmacorum potestatibus*, 26.

81. Mizauld, *Enchiridion*, 56v. Cf. Mizauld, *Centuriae novem*, 136: “Verum et illi, et reliquis omnibus manifesta refragatur experientia, rerum incertarum magistra certissima”. Mizauld refers to Della Porta, but not to the 1589 edition of Della Porta’s *Magia*, which had not yet appeared. Regarding the GE, Mizauld also gives another account, cf. note 57. In an earlier but similar work of the author, the GE is reported without any criticism, see Mizauld, *De arcanis naturae*, 19r–v, 65v. Bodin (1596) seems to rely on Mizauld’s account as he also refers to experience as “magistra” when refuting the GE. See Bodin, *Universae naturae theatrum*, 249; Blair, *The Theater of Nature*, 96.

82. Mercati, *Metallototeca*, 166. According to Accordi, “Michele Mercati”, 7, Mercati seemed to have finished his work before 1589.

83. Mercati, *Metallototeca*, 166:

Recentiores tamen veterum auctoritate contenti, nihil interim, quod licebat, experti, multa falso memoriae prodiderunt; et antiquas, ut ita dicam, fabulas scriptis suis intexuerunt, auxeruntque; quo in genere saepe ab ipsis peccatum est, dum priores duces secuti, errores superiorum temporum ad posteros propagant et extendunt.

For a similar point, see note 94.

84. Boodt, *Gemmarum et lapidum historia*, 456; Aldrovandi, *Musaeum metallicum*, 557534; Cesi, *Mineralogia*, 534. Another author also relies on Della Porta, cf. Rochlitz, *Artzneybuch*, vol. 2, 164r–164v.

85. Porta, *Magia naturalis*, 1589, 145: “Sed quum haec omnia expirer, falsa repperi”. Similar to Mercati, Della Porta also refers to the belief of seamen that the GE also occurs on magnetic compasses. However, Della Porta mentions having reinvestigated the matter among seamen and found that they do not believe in the GE at all; they would rather lose their lives than abstain from eating garlic and onions. On the seamen’s belief, cf. May, “Garlic and the Magnetic Compass”. See also note 56. Rivlin, “Historical Perspective on the Use of Garlic”, 952, notes that, in Ancient Rome, “Garlic was fed to troops and to sailors for strength”.

86. Porta, *Magia naturalis*, 1558, 90; Porta, *Magia naturalis*, 1589, 7. This is also noted in Wootton, *The Invention of Science*, 270, who refers to the fact that Della Porta had to rework his 1558 edition to avoid the Catholic censorship of his work.

87. Porta, *Phytognomonica*, 299.

88. Porta, *Villa*, 798.

89. Garzoni, *Trattati della calamita*. Della Porta's plagiarism is also taken into account by Wootton, *The Invention of Science*, 272. See also Sander, "Early-Modern Magnetism", 342–3.
90. Garzoni, *Trattati della calamita*, 91–2, 283:

essendo ciò cosa in esperienza falsissima; cercano ancora, et si meravigliano, con qual forza occulta l'odore delli agli impedisca la medesima virtù, togliendo a lei la forza di tirare a sé il ferro, et all'aco del bossolo da navigare levando la virtù di girarsi al Polo, conciosia che nissuna di queste proposte in prova si verifichi, come ogni giorno si può facilmente vedere. [...] La virtù delle due faccie non si può estermiare del tutto dalla calamita, né con aglio, né con altra cosa, se non solo col fuoco infocando la pietra.

91. On the contrary, Wootton, *The Invention of Science*, 276, argues:

One could suggest that the new section on magnetism was added at the last minute, and that della Porta simply failed to revise his introduction [i.e. the part on 'sympathy'] in the light of his new conclusions [derived from Garzoni]. This will not do [...]. Della Porta must have realized that he was contradicting himself.

I do not think that Della Porta must have realized this, because the revision that was due to censorship focused on issues that were relevant for the censors and the GE was not a typical instance of superstition, which was among the criteria of censors. On superstitious and censored trivia around the magnet see, e.g. Baldini and Spruit, *Catholic Church*, vol. 1, 724, 776.

92. Cf. Angeli, *In astrologos coniectores*, 37. See Cesi, *Mineralogia*, 40: "retundi vires magnetis alio, experimentis discimus quotidianis". Both Lehoux, "Tropes, Facts, and Empiricism", 335, and Wootton, *The Invention of Science*, 277, fail to realize that this is a quotation. Probably they depend on Thorndike, *Magic and Experimental Science*, vol. 7, 256, who does not realize this, either.
93. Mattioli and Pedanius Dioscorides, *Commentarii*, 20; Cesi, *Mineralogia*, 409.
94. Gilbert, *De magnete*, 2, 33.
95. Bacon, *The Oxford Francis Bacon*, vol. 11, 466–7:

Postremo res Damnae fidei, tamen iactatas et celebratas; quales, partim neglectu, partim propter vsum Similitudinum, per multa iam saecula inualuerunt (veluti, quod Adamas liget Magnetem, Allium eneruet; Electrum omnia trahat praeter Ucymum; et alia multa huiusmodi) oportebit non silentio rejicere, sed verbis expressis proscribere, ne illa amplius Scientijs molesta sint.

96. The concepts "source domain" and "target domain", applied to metaphors, come from Lakoff and Johnson, *Metaphors We Live By*. For scientific analogies, cf. as a starting point Hesse, *Models and Analogies in Science*; Meheus, "Analogical Reasoning".
97. Many examples for the use of the magnet in the mentioned regards can be derived from Jammer, *Concepts of Force*; Hesse, *Forces and Fields*. For the example of "occult qualities", cf. e.g. Hutchison, "What Happened to Occult Qualities in the Scientific Revolution?"; Weill-Parot, "Astrology, Astral Influences, and Occult Properties".
98. On this combination of magnetism and nutrition, see Sander, "Nutrition and Magnetism". See, e.g. Averroes, *De physico auditu*, 315r, on book 7, chapter 1, commentary 10:

Attractio autem, in qua attrahens est quiescens et attractum motum, non est attractio in rei veritate, sed attractum movetur ex se ad attrahens, ut perficiat se, ut lapis movetur ad inferius et ignis ad superius. Et similiter oportet hoc intelligere de motu ferri ad magnetem et nutrimenti ad membra [...] Nutrimenta vero non moventur ad nutriendum, nisi cum fuerint in quadam dispositione de nutrito, et similiter ferrum non movetur ad magnetem, nisi cum fuerit in aliqua qualitate de magnete. Et ideo quando magnes fricatur cum alio, amittit virtutem. Nam ferrum non acquirit de lapide in illa dispositione qualitatem, per quam innatum est moveri per se ad lapidem.

See also Averroes, *De physico auditu*, 374v, and note 48. For a discussion of this account, see e.g. McVaugh, “Theriac at Montpellier”, 125. For another use in medicine, see Sudhoff, “Pestschriften VII”, 176: “In domo semper teneatur ignis, quia multum impedit impressionem. Nam nos videmus, quod lapis magnes, si fricetur cum al[l]eo non trahit ferrum, ita etiam ignis impedit impressionem caelestem et purificat aerem”. See also Sudhoff, “Pestschriften XVIII”, 26.

99. Fernel, *Universa medicina*, 88: “Una siquidem animae substantia multis facultatibus et viribus se fundit atque ostendat: [...] Magnes lapis vim obtinuit, qua ad coeli se vertices convertit aspectumque refert, vim aliam qua ferrum ad se prolecat”.
100. Fernel, *Universa medicina*, 89: “igitur magnetem alio perunctum quia ferrum allicere non potest, trahendi facultate orbatum dicimus aut saltem praepeditum”. In the modern edition the editors misread – just as in the case of Pliny – “alio” (another) instead of “allio” (garlic). Cf. Fernel, *Physiologia*, 314.
101. Rudio, *De morbis occultis*, 10.
102. See note 23. See also Wedel, *The Mediaeval Attitude*, 8. Cf. also Pruckner, *Studien*, 178:

Apparet etiam a simili, quia videmus, quod virtus allii et similiter virtus lapidis, qui vocatur dyamas, impediunt influenciam attractivam magnetis, et ita etiam in inferioribus rebus multe vires et dispositiones possunt emergi reddentes eas ineptas ad recipiendum superiorum influencias.

On this, see Steneck, *Science and Creation*, 114.

103. Angeli, *In astrologos coniectores*, 37. See also notes 55, 92, and 63.
104. On the agenda of natural magic, see, as a starting point, Shumaker, *Natural Magic and Modern Science*. Della Porta and others referred to the GE in this context simply as instances of antipathy or of effects that cannot be explained by reason. See note 86.
105. Agricola, *De re metallica*, 1950, 39; Agricola, *De re metallica*, 1556, 27. See also Roling, “Virgula divinatoria”, 425.
106. Agrippa, *De incertitudine et vanitate*, 1531, 55v. Cf. note 16.
107. Cf. e.g. Wigand, *Von der Erbsünde*, F3r. Cf. Melanchthon, *Opera*, vol. 12, 441:

Magnes est lapis trahens ferrum, nisi impediatur: si alio fuerit tinctus, non trahit ferrum, et tamen natura magnetis manet. [...] Manet natura peccati, etiamsi remissio accedit, qua iam tollitur reatus, hoc est, Deus irasci desinit, et obligationem ad poenam aeternam aufert.

Cf. also, but quite differently, Melanchthon, *Opera*, vol. 12, 222–4. Pezel and Melanchthon, *Argumenta et obiectiones*, vol. 3, 495, also invoke the effect of goat’s blood. Cf. also Mossmayr, *Befreyungs-Ort*, 115–6.

108. Sack, *Leychpredigten*, 134r.
109. Menz, *Gross Prognosticon*, D2r. See also Menz, *Gross Prognosticon*, C4r.
110. Mathesius, *Sarepta*, 206r:

Denn wenn die herzen widerspenstig/und mit Egyptischem Knoblauch und Römischen zwibeln/ unnd Türckischen maschlach bestichen/ oder mit rost und sünden wider das gewissen ubezogen sein/ so nimpt unser magnet das herz nicht an/ welcher alleine die grossen sündler und zölner hebet/ die sich zu ihm keren und nahen sich zu ihm/ oder luaffen ihm entgegen/ wie verloren Son sein Vatter nach gehet. Dises Magnete seyten behalt ir Bergleut/ und lasset euer hertzen nicht in sünd und schandt verrosten/ oder wie ein Demant vom Teuffel verharten/ sonst hebt euch der Himlische Magnet nicht/ der wil bussfertige herzen haben. Christus ist der rechte Magnet/ der zeucht uns an sich durch sein gepredigt wort/ wie er im Johan. saget: Wenn ich erhöhet werde/ wil ich alles zu mir ziehen/ das ist/ nach meinem leiden und auferstehung werde ich durch gepredigt wort jedermann der dran glaubet an mich ziehen.

See also Mathesius, *Syrach*, vol. 2, 67v. Actually, it seems that the garlic had to be applied to the iron, i.e. to the heart, as the object of the magnet's, i.e. Christ's, attraction.

111. Novarini, *Electa sacra*, 1627, vol. 1, 241:

Sed cur Christiani Oratores, cum ipsi quoque magnetes quidam sint, tam paucos ad Christum alliciunt; [...] Addo, ut hoc firmem, de magnete illud litteris traditum; quod si allii, aut cepae succo illinatur, ferrum amplius non trahat: hic quoque sive Doctor ipse tanquam magnes terrenorum amore capiatur, que aliis, ac cepis comparantur, videtur omnem trahendi vim amittere; sive auditor ipse velut ferrum, sensuum illecebris, ac voluptatibus tanquam aliorum, ceparemque succo adspurgatur, aegre trahi poterit a spiritali magnete; Quid si magnes ipse, ferrumque ambo noxio hoc succo perfundantur, quo saepe contingere dolemus? Verbi divini manna non sapit cepas, alliaque, ac porros cupienti.

Cf. also Novarini, *Electa sacra*, 1638, vol. 3, 368.

112. Sandt, *Maria magnes*, 196: "Trahit Maria potentius Caritate, quam Magnes sua qualitate, et trahit universalis. Si Magnes caepe vel allii succo aut hircino perungatur sanguine, probare, si placet, nequitiam ferrum trahet: nam Magnetis lapidis vis attractoria malignitate rerum illarum impeditur".

113. Cardano, *De astrorum iudiciis*, 29:

et similiter lapis Hercules ferrum trahet, nisi succo allii illinatur, sequutus potius in hoc communem opinionem, quam rei veritatem. Declaratum enim est a nobis in libris de Subtilitate, hoc experimentum esse falsum de succo allii. Nam nihilominus lapis Hercules ferrum trahit: quamvis per litum allii succo, quam antea. Sed exempla dantur non quia ita sint, sed ut intelligant qui docentur.

Cf. note 80.

114. Erastus, *De occultis pharmacorum potestatibus*, 26.  
 115. Campanella, *Astrologicorum libri*, vol. 7, 7–8. In his *Magia* (1604), the GE is still affirmed, but was refuted in the Latin translation of 1620. Cf. Campanella, *De sensu rerum et magia*, 27; Campanella, *Del senso delle cose e della magia*, 23.  
 116. Alcázar, *In Apocalypsi*, 284: "Veteres existimabant, magnetem praesente adamante dimittere ferrum; nec illud ad se attrahere. Verum adamantes, quos hodie novimus, hac potentia carent. Commentitium est etiam, quod nonnulli afferunt de alliis. Unus ignis virtute hanc magneti detrudere potest". Cf. also Alcázar, *In Apocalypsi*, 272, 966, 968. Mersenne, *Questions inouyes*, 59, criticises the GE analogy of Francis de Sales, *Oeuvres*, vol. 5, 56. See also Francis de Sales, *Oeuvres*, vol. 20, 167.  
 117. Hanow, *Erläuterte Merkwürdigkeiten der Natur*, 335, 342.  
 118. In Reinzer, *Meteorologia Philosophico-Politica*, 390, the GE is ascribed to mere chance.  
 119. Jefferies, *Field and Hedgerow*, 185–6.  
 120. Foucault, *The Order of Things*, xxii:

The fundamental codes of a culture – those governing its language, its schemas of perception, its exchanges, its techniques, its values, the hierarchy of its practices – establish for every man, from the very first, the empirical orders with which he will be dealing and within which he will be at home.

Cf. also Albury and Oldroyd, "From Renaissance Mineral Studies".

121. Lehoux, *What Did the Romans Know?*, 150–1. See also Lehoux, *What Did the Romans Know?*, 200, 227–8.  
 122. On the cosmic relevancy of the magnet, cf. as a starting point Bennett, "Cosmology and the Magnetical Philosophy"; Baldwin, "Magnetism and the Anti-Copernican Polemic"; Danielson, "Achilles Gasser and the Birth of Copernicanism"; Krafft, "Vom Segen und Fluch einer Analogie"; Weill-Parot, "L'attraction magnétique".  
 123. Cf. Weill-Parot, *Points aveugles*, 267:



L'argument de l'ail est l'un de ceux employés par Averroès pour montrer que l'attraction magnétique est une altération et non un mouvement du *locatum* vers son lieu [...] Or, à la Renaissance, d'autres modèles voient le jour et tendent à se substituer à celui d'Averroès.

124. See note 91.
125. See note 90.
126. Wootton, *The Invention of Science*, 282.
127. Cf. Copenhaver, "A Tale of Two Fishes"; Walton, "Theophrastus on Lyngurium"; Ainsworth, "Legendary History"; Dines, "Textual and Pictorial Metamorphoses"; Bamforth, "Marvels and Unicorns"; Lecouteux, "Die Sage vom Magnetberg". On Pliny, cf. especially Gesztelyi, "A pila scudem oder apitascudem?"; Sander, "Magnetismus und Theamedismus".
128. See, e.g. Daston, "Marvelous Facts".
129. Browne, *Pseudodoxia Epidemica*, 67: "An effect as strange as that of Homers Moly, and the Garlick that Mercury Bestowed upon Ulysses".
130. See note 110.
131. For Mathesius' knowledge of Agricola, see Adams, *Geological Sciences*, 198. His *Sarepta* were sent to Johannes Praetorius, so that he would correct any "scientific" mistakes. See Loesche, *Johannes Mathesius*, vol. 2, 361.

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