
Logic and the Movement of Reasoning: Pierre Gassendi on the Three Acts of the Mind

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The aim of this paper is to assess the central role the imagination acquires in Pierre Gassendi's logic. I trace the structuring scheme of the three acts of the mind—common to a good number of late scholastic and early modern logics—to the Thomistic notion of the movement of reasoning in knowledge and argue that Gassendi revisits this notion in his logic. The three acts scheme is from the beginning a bridge between logic and the natural philosophical treatment of the soul. I show how Gassendi's take on the three acts is similarly poised between his Logic and his Physics and I discuss the rationale, sources and consequences of his attribution of the three acts to the imagination. I argue for the following points: Gassendi's conception of the logical role of the imagination answers to his empiricist epistemology, his naturalized view of the mind (which involves a defense of thinking in animals) and his notion of a natural logic; it is also operative in his pairing of the formal mechanism of logical operations with a progressive mechanism of the operations of the mind; and it serves as a counterpart to his experimental understanding of the progress of knowledge.¹

1. Logic and the Three Acts of the Mind

The organization of logical material in three main parts, according to the three 'acts of the intellect'—apprehension, judgment and reasoning—with the occasional addition of a fourth part, on method, is a relatively wide-

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spread feature of both late scholastic and early modern logics. In a scholastic context, the notion was introduced by Thomas Aquinas in his *Commentary on Aristotle's On Interpretation* with reference to a passage in *De anima* III: there is a twofold operation of the intellect, one by which the intellect apprehends the essence of a thing alone, and another by which the intellect composes or divides two simple apprehensions (i.e., puts them together in an affirmation or apart in a negation); to these must be added a third operation, by which reason proceeds from what is known to the investigation of things not yet known. Since logic is a rational science, it must look to these three operations of reason (I.1.1–2, Aquinas 2015, p. 1; see further Ashworth 1985). The preface to Aquinas's *Commentary on Aristotle's Posterior Analytics* rehearses the idea that logic deals with the act of reasoning, enumerates the three operations and explains that the first two belong to reason regarded as intellect, while the third act (advancing from one known thing to another, yet unknown) is peculiar to reason (I.1.4, Aquinas 2007, p. 2). Both texts add that this is what Aristotle was concerned with in his logical books: apprehension in *Categories*, composition and division in *On Interpretation*, and reasoning in the *Prior* and *Posterior Analytics*. The tradition adds to the latter grouping the *Topics* and *Sophistical Refutations*, in order to complete the picture of all forms of argumentation, whether demonstrative, rhetorical or fallacious (e.g., Coimbrans 1607, q. V, art. II, p. 53; Sanderson 1615, p. 3; Gassendi 1658, 1: 88a).

Late scholastic logics often (though not always) use this structuring scheme and point out that it corresponds to the division of terms, propositions and arguments (especially syllogisms) of the older logical tradition. They also do three other things: sometimes they add ordering as a fourth operation of the intellect, and under it discuss method (the orderly arrangement of arguments); they point out the relevance of the three or four acts to the “instruments” of knowledge—definition, division and demonstration; and they subsume the structure of the three acts under a description of the role of logic as that of directing or correcting the operations of the mind in its search for truth. Eustachius a Sancto Paulo is a good example of these developments. In the book on logic of his *Summa philosophiae* (1609), he explains that the object of logic is constituted by the operations the intellect performs, rather than the things it conceives (the “beings of reason”); these operations are the material object of the various sciences (such as physics, theology or dialectics), but under their formal aspect, they are the object of logic, “insofar as they are capable of guidance or rectification” (*dirigibiles, seu rectificandas*); they are the actions the mind performs in knowing things (simple apprehension, judgment and discourse or reasoning, to which Eustachius adds method), and as such are in direct relationship, respectively, with the instruments of knowledge

(definition, division and argumentation) (Eustachius 1609, *Logica*, pp. 11–12, 22–23).²

I would like to emphasize that the guiding notion behind the structuring of logic in accordance with the acts of the mind comes from the context of an investigation of the powers of the soul and of the nature of man. It was indeed with reference to Aristotle's discussion of the intellect in *De anima* III that Aquinas commented on the ingredients of logic as a science of reasoning, as we have seen. On the other hand, Aquinas was usually taken to represent the scholastic logical tradition that identified the object of logic as the "beings of reason" (*ens rationis*) rather than the three acts. The Coimbrans, for example, reference his commentary on Aristotle's *Metaphysics* IV for this view. They add that it is in conformity with Aquinas's view to understand "beings of reason", as does Toletus, as those "that result from the operations of the intellect" (Coimbrans 1607, q. V, art. II, pp. 49–50). In exchange, they identify Scotus, Avicenna and Albertus Magnus, rather than Aquinas, as representatives of the view that the object of logic is constituted by the acts of the mind (Coimbrans 1607, q. V, art. II, p. 53).³

And yet, in the explanation of the view that it is the three acts, but especially the third, discursive reasoning, that is the true object of logic, they include an unacknowledged reference to a place in Aquinas's book on man in the *Summa theologiae*. In that place, Aquinas asks whether reason and intellect are distinct powers of the human soul and answers in the negative, since, although their actions are slightly different, what they achieve is ultimately the same thing: to understand (the proper action of the intellect) is to apprehend intelligible truth, and to reason (the proper action of reason) is to advance from one thing that has been understood to another, not yet understood, and thus to reach knowledge of intelligible truth. Reasoning is to understanding as movement is to rest. We can see this better if we compare humans to angels: while angels apprehend every intelligible truth perfectly and instantly, the human condition is such that we need to advance from one thing to another through mental discourse, in other words, through a mental process that progresses through inquiry and discovery (I.78.8, Aquinas 1922, pp. 109–10). This is precisely the

2. Eustachius was a direct source for Gassendi (Armogathe 1997; LoLordo 2006, p. 35). See also Fonseca 1574, pp. 1–2; Coimbrans 1607, pp. 53–54; Keckermann 1614, pp. 167–8; Sanderson 1615, pp. 1–3; Smiglecius 1638, pp. 49–58; Burgersdijk 1660, p. A9v; Campanella 1637, pp. 11, 110–16; Jungius 1638, pp. 1–3. Case and Duplex also explain the division according to the three acts, but prefer the alternative, Ciceronian, division of invention and judgment (Case 1584, p. 9; Duplex 1984, pp. 47, 57–8). For the varieties of organizing schemes in the period, see Ashworth 1974, pp. 32–6; Michael 1997.

3. Petrescu (2018) identifies the 'Scotus' in question here as Thomas of Erfurt, and traces the line of the scholastic interest in the acts of the mind from the Coimbrans and Fonseca back to Thomas of Erfurt and the medieval Parisian *modistae*.

reason, complete with the comparison with the angels, that the Coimbrans invoke in support of their view of logic as an art of reasoning (*modus disserendi*) (Coimbrans 1607, q. V, art. III, pp. 55–6).

In the same place of the *Summa*, Aquinas also indicates that both the formal logical elements and the perfected habits of the intellect can be referred to the actions of the mind. The apprehended intelligible truths constitute principles of reasoning (the terms and propositions serving as premises of a syllogism), while the process of reasoning that proceeds from the principles constitutes the movement of the syllogism—a division that echoes the grouping of the acts of the intellect in the *Commentary on Aristotle's Posterior Analytics* described above. At the same time, the perfection of the understanding of first principles constitutes the habit of intellect (or intelligence), while the perfection of the process of reasoning towards the conclusions constitutes the habit of science (with reference to the intellectual virtues of the *Nicomachean Ethics* VI) (I.79.9, Aquinas 1922, pp. 112–13).⁴ Thus, Aquinas advances the three acts as a bridge between logic and the science of the soul (and of man), with extensions in the domain of ethics (the ethics of the epistemic accomplishments).

Let us retain the idea of the movement of reasoning, which lies behind the development in late scholasticism towards the highlighting of the three acts of the mind as governing logic. The reference is to what the intellect does in working through the formal logical operations, to the progress it makes towards truth, as well as to the obstacles it might encounter on the way (hence the language of guiding and correcting the operations of the intellect employed in describing what logic performs). This amounts to the development of an Aristotelian “art of thinking” within the scholastic tradition, independently of the humanist (Ramist) line (Petrescu 2018).

From the vantage point of the new logics of the early modern period, these developments appear feeble at best. Although packaged in such a way as to advertise interest in the movement of reasoning, the late scholastic logics are still mostly devoted to the standard discussion of terms, propositions and syllogisms. They are not really concerned with how the mind operates, nor with how notions are formed, nor with the causes of error (other than those strictly dependent on formal breaches), nor with actual methods of discovery. Such indeed becomes the stuff of the new logics (Michael 1992, 1997; Hatfield 1997). And yet, the stuff of the new logics (at least those that imported the three-act structure) *was* favored

4. It is probably this link between logic and ethics that stands behind Robert Sanderson's inclusion of an Appendix on the habits of the mind at the end of his *Logic* (Sanderson 1615, pp. 89–100). In the early modern context, the three acts were used to structure not only logics, but also works on the human soul or on human nature: see Serjeantson 2008, pp. 166–68.

by the late scholastic logical format, which expressed a high-medieval notion about the importance—to a science or art of reasoning—of the movement of reasoning. That format can be seen as an enabling framework for the shift in the new early modern logics towards considerations we today are wont to call psychological and epistemological (Ariew 2014, p. 47). To the intellectual historian, these developments are particularly interesting markers of the dynamic territory of the early modern disciplines, rather than signs that logic entered into a long period of decline from the sixteenth to the nineteenth centuries. The latter objection (Bocheński 1961; Kneale and Kneale 1962; Ashworth 1974) makes sense from the point of view of a history of logic conceived as a self-contained formal discipline. If, however, we seek to recover historical understandings of the nature, aims and objects of logic, a different picture comes to light: it becomes apparent, for example, not only that in this period logic makes room for elements which would later be recognized as epistemological or psychological but that it does so for reasons that at the time were considered internal to logic (Cassan 2012; see also the other contributions to this issue).

Recognition by historical actors is an important indicator here. Indeed, to the scholastics of the sixteenth and seventeenth centuries the new logics looked partly familiar, although with sometimes unpardonable excrescences—but they did recognize them as logics in the (then) proper sense of the term.⁵ The air of familiarity was produced by the rehearsal of the things we have looked at so far: logic presented as an art of thinking, concerned with the movement of reasoning and thus with the three operations of the intellect (plus ordering method), as well as with the guidance and rectification of the tendencies those operations have of going astray in the path towards truth. The Port Royal *Logic, or the Art of Thinking* (1662) is the most famous example of a new logic that uses the structuring and rationale of the late scholastic logic, into which it fits material derived from the Cartesian philosophy of mind and nature. In its wake, a number of Cartesian logics in the latter half of the seventeenth century repeat this format, with little variation. The general tendency is to combine traditional logical material with the new Cartesian content. The latter would mostly be found in the first part, formerly on simple apprehension, now dubbed “on ideas” (which includes Cartesian material on the nature, formation and veracity of ideas, as well as variations on the Cartesian account of error and childhood “prejudice”)

5. The *querelle des anciens et des modernes* in the later seventeenth century is a privileged historical moment from which to observe the interplay of vantage points, but also the common terrain of the definitions of logic (see Corneanu and Vermeir 2022). Feingold 1997 is particularly enlightening on the interplay of scholasticism, humanism and “new philosophy” in the field of logic in seventeenth-century Oxford, as well as on historiographic perspectives (see esp. pp. 276–82).

and in the fourth, on method (which includes elaborations on the four rules of method in Descartes's *Discours*, plus further material extracted from the *Regulae ad directionem ingenii*)—with extensions in the other two parts, on judgment and reasoning, as well.⁶ An alternative line of development rooted in the *Logique de Port Royal* includes late seventeenth- and early eighteenth-century Dutch, English and Scottish logics that endeavor to mix Cartesian, Malebranchian and Lockean material on ideas, inference and method, which they pour into the same format governed by the acts of the mind.⁷

Prior to the *Logique de Port Royal*, however, Pierre Gassendi's *Institutio Logica* (1658) took up the formula of an “art of thinking” organized around the three acts of the mind (plus method) in a way that looked both ancient and modern, yet differently modern from the other (more famous) moderns. The element of difference I will be concerned with in this paper is the introduction of the imagination in the scheme of the three acts. My aim is to attempt to understand the rationale of this curious shift away from the usual attribution—both old and new—of the three acts to the intellect, its possible sources, as well as its consequences for Gassendi's conception of logic. This is also meant as a plea for the recognition of *Institutio Logica* as an important chapter in the early modern history of logic. My guide in this endeavor will be precisely what I described as the underlying principle behind the use of the three acts in logic: the status of the three acts as a bridge between *logica* and *physica* (i.e., in scholastic vocabulary, between logic and the theory of the soul approached within natural philosophy), and the concern with the movement of reasoning that underlies this status.

2. Gassendi's Art of Thinking and the Logical Dog

The First Part of Gassendi's *Syntagma philosophicum* (1658) is devoted to logic.⁸ Before the manual of logic proper begins, there is a general introduction, followed by two books, one devoted to the “origin and variety,” the other to the “end,” of logic. The introduction already puts forward the phrase *ars bene cogitandi* as that which fully captures the fact that logic has

6. Examples include Johannes Clauberg's *Logica vetus et nova* (1658), Antoine Le Grand's *Logica* in his *Institutionis philosophiae* (1672), Pierre Sylvain Régis's *Logique* in his *Cours entier de philosophie* (1691). See Ariew 2014, pp. 157–65. On judgment, see Cassan 2015, pp. 123–30. On method, see Roux 2011, pp. 29–52.

7. Examples include Jean le Clerc's *Logica* (1692), Jean-Pierre de Crousaz's *Logique* (1720), Isaac Watts's *Logick* (1725), William Duncan's *Elements of Logic* (1748). See Buickerood 1985; Schuurman 2003; Winkler 2003.

8. I have used (and occasionally slightly amended) the translation of Gassendi's *Logica* by Rudi Garau and Justin Smith, under contract with Oxford University Press. I am grateful to the authors for allowing me to use the manuscript in advance of publication.

to do with the “internal discourse” of cogitation (or ratiocination, or the process of thinking) and the fact that it is an art, in other words, a “collection of precepts for doing something correctly.” Since there are four forms of thinking, these will be in turn the concern of the four parts of logic: imagining well (*bene imaginari*), proposing well (*bene proponere*), deducing well (*bene colligere*) and ordering well (*bene ordinare*). The results of these forms of thinking will be true images or ideas of things, correct propositions, valid deductions and well-ordered methods (1: 32b–33a).

The scheme appears again in Gassendi’s explanation of the end of logic. While the external end is truth, the internal end is thinking that is correctly carried out (as that which is capable of reaching truth). It follows that logic looks to the grooming of thinking in such a way that it makes possible inquiry and discovery of truths (the actual usage of thinking thus groomed in particular subject matters is left to the various sciences) (1: 67a). Inquiry and discovery proceed through such actions as defining, dividing and proving, where the first two are key to explanations, and the third to deductions; the most evident example of how this works is discovery and proof in mathematics. To this end, we need a guide for thinking well (which includes imagining, judging, reasoning and ordering well)—and this is what logic provides (1: 86b–87a). Now, what this looks like is a collation of the scholastic material, including the original Thomistic unpacking of the notion of reasoning as that which engages in progressive inquiry and discovery,⁹ with the new interest in mathematics—seen either as the best example of logical rules in action, or as the paragon of discovery and deduction, to be emulated by logic itself.¹⁰

What doesn’t seem to fit, however, is the reference to “imagining” and “images” instead of the (intellect’s) apprehension, intelligible truths, or (intellectual) concepts of the three-act logics, whether old or new. Indeed, it appears that in Gassendi’s account, the faculty primarily engaged in the logical operations is the imagination. In his *Physics* (in the sections devoted to the soul), Gassendi works with a model of two souls (probably inherited from Francis Bacon and the Italian naturalists): an intellectual soul, proper

9. Gassendi’s acquaintance with Thomistic thought was formed during his studies at the Faculté d’Aix, shaped by the Carmelite *ratio studiorum* (Armogathe 1997; LoLordo 2006, p. 7).

10. The search for parity between mathematical and syllogistic demonstration is one of the privileged places where to observe the dynamics of “old” and “new” in the seventeenth century. See Smiglecius 1638, pp. 97–8; Mousnier [Fabri] 1646, pp. 63, 131–2; Gilbert 1963, 87–92; Dear 1995, 31–41; Mugnai 2010. Gassendi cites Proclus’s commentary on Euclid’s *Elements*, which includes a relation of Plato’s view of mathematics—so he appears to lean towards the idea that logic is the ground of mathematics, rather than the other way round.

to man, and a sensitive soul, common to humans and brutes. The imagination is the cognitive function of the sensitive soul, to which all the internal senses of the Aristotelian tradition should be reduced (2: 402a). Still in the *Physics*, Gassendi describes the operations of the imagination as precisely those that organize his logic: simple apprehension, judgment and reasoning. In the remainder of this section I propose to discuss the way the acts of the imagination feature in both the *Logic* and the *Physics* of Gassendi and to point to what seems to be the rationale of this unusual attribution; the next section will address the issue of the possible sources behind its novelty.

The *Logic* replaces the usual appellation “simple apprehension” with that of “simple imagination” and openly introduces references to the faculty of the imagination from the very beginning. Imagination here sometimes refers to the mental content, other times to the mental faculty. Gassendi explains that, as mental content, the “image” may well also be called concept or phantasm, “insofar as it has its seat in the fancy or imaginative faculty.” Alternatively, considered as material acquired and stored in the mind, it can also be called notion, prenotion or anticipation, whereas under the aspect of the mental action involved, it is also called species or idea (1: 92a). The reference to the faculty of the imagination is also pertinent, Gassendi tells us, insofar as, in the exercise of its acts, the mind “observes” its own contents, as if looking at them; this is not, however, vision in the full sense of the term (it is only quasi vision, *quasi veluti intueamur*) and may also be called the mind’s attending to, detecting or recognizing contents (*observare, intueri, deprehendere, curare*; 1: 33a–34a, 55a, 91a, 92a, 99a, 106a). The *Physics* addresses the same idea and explains that, etymologically, *phantasia* belongs to the semantic sphere of seeing, appearing, coming to light and making visible (2: 404a). In that place, the seeing of the mind is relevant to the physiological account of the formation, via perception mechanically understood, of traces in the brain (*vestigium*), in the form of folds (*plica*). The fold is that which the mind apprehends, or sees, and is therefore to be considered an “image” (as “that which is seen”); the act of the mind’s apprehension of its images is called “imagination” (2: 405b).¹¹

The *Logic* and the *Physics* agree that simple apprehension is the mere image or idea following the perception of a thing, unaccompanied by an affirmation or negation (1: 91a; 2: 409a), while the *Physics* insists on its physiology and adds medical material on the traces in the brain and the impact on them of substances and emotions (2: 409b). The crucial difference from other accounts of this first operation of the mind is that the object of

11. On Gassendi’s theory of vision and its epistemological consequences, see Bloch 1971, pp. 19–29; Brundell 1987, pp. 86–98; LoLordo 2006, pp. 69–82.

simple apprehension is neither a scholastic intellectual species (abstracted by the active intellect from the phantasm of the imagination) nor a Cartesian idea (available to the pure intellect rather than to the imagination), but is squarely grounded in and rounded by sensible perception (1: 92b).

The primacy of sensible perception underwrites Gassendi's empiricist and nominalist account of the formation of general ideas: they are obtained in a twofold way, either through aggregation, by amassing many similar apprehensions into one class—for example, from the repeated perceptions of many individual human beings, the mind, whether of a person or a dog, amasses the general concept 'man'; or through abstraction, by identifying the common elements of individual perceptions—a procedure involving more of the intellect and thus unavailable to non-humans (1: 93a–b; 2: 410b–411a; see further Bloch 1971, pp. 136–47; LoLordo 2006, pp. 83–4). Sensible perception also plays the role, in Epicurean fashion, of the criterion of knowledge—that is, of the criterion for judging whether discovery has occurred and whether what has been discovered is true or not. Gassendi writes of a double criterion, which consists in sense evidence on the one hand, and in reasoning based on sense evidence on the other (1: 69a, 122a; for the roots in Epicurean logic, 1: 54a, 55a). The certainty of both necessary propositions and demonstrative syllogisms depends on the evidence of the senses or of reasonings based on the senses (1: 103b, 116a–b).

Gassendi's conception of evidence also includes the well-formedness of the idea. A well-formed idea of a thing is a "clear and distinct" idea insofar as the thing (with its parts and adjuncts) is as frequently, recently and attentively observed as possible (1: 92b); and it is a "perfect" idea insofar as it includes as many parts and adjuncts of the thing as possible (if it is a singular idea) or insofar as it covers as much common ground as possible (if it is a general idea), and as long as it is acquired through one's own experience, which is to say, through careful experiential investigation, and the mind is guarded against prejudice, idiosyncrasy, passions, another's authority, ambiguous words or figurative speech (1: 95a–97a).

All of this constitutes the epistemological load of Gassendi's 'logic of ideas', which has attracted most attention from commentators (e.g., Michael 1992, 1997).¹² It is however to be noted that the epistemology here answered to a need to revise the Aristotelian heritage on the question of the legitimate materials with which the mind works in reasoning and was put forward as a need intrinsic to logic (Cassan 2012). Here, I consider this only as part of the justification for the role of the imagination in Gassendi's

12. Certainly, Gassendi's epistemology is intertwined with his skepticism, on which see Brundell 1987, pp. 104–7; Darmon 2001; Popkin 2003, pp. 120–24; LoLordo 2006, pp. 60–9; Fischer 2005, Part I; Maia Neto 2014, chap. 3; Bellis 2017.

logic. In what follows I will be much more interested in the mechanism of the imagination, considered under its double psychological and logical aspect.

We will return to the “perfect” idea at the end of this paper, but for now let us note that Gassendi assesses the quality of a person’s knowledge (*scientia*) in relation to her ideas, rather than to the way she forms judgments or syllogisms: “the more singular ideas it [knowledge] contains clearly and distinctly, the more excellent it is” (1: 99b). That’s because, ideally, (well-formed) ideas contain within themselves all that is relevant to understanding: definition and division, as well the relations of a thing to other things simply follow from a well-formed idea of a thing (1: 97a–99b). With this focus on ideas, Gassendi seems to recapture the distinction between understanding and reasoning we have reviewed above in Aquinas. Recall the Thomistic equivalence between understanding and rest, and between reasoning and movement. Going through reasoning from one understood thing to the next, not yet understood thing, and thus aspiring to complete the journey of knowledge while advancing on its path is the lot of human beings. In contrast, angels have no need of reasoning, since their lot is direct access to intelligible truth. From this point of view, judgment and reasoning are ultimately for the sake of perfecting apprehension: even if they build on initial apprehensions, their ultimate role is to enrich them and bring the search to the term of perfected intelligence (ST I.85.5, Aquinas 1922, pp. 198–9; Kretzmann 1992, p. 90). Gassendi modifies the object of understanding (which he grounds in the realm of the sensible), and exchanges the angels for the wise man, but preserves the general thinking about the operations of the mind:

And in the man who is particularly wise knowledge is almost free of discursive reasoning [*sine discursu*], and is nearly simple intelligence. For in examining an idea he discerns with one look the antecedents and the consequents, while in the ignorant man this happens not without a certain amount of tiring discursive reasoning [*non sine discursu aliquatenus laborioso*] and time, for he needs to pause and speculate so that, once he has comprehended the antecedents, he sees what follows from them (1: 99b).

According to Gassendi, as we have seen, discursive reasoning and its grooming is precisely the concern of logic. The operations that are particularly relevant to this movement of reasoning are judgment and syllogism, both of which aspire to perfect apprehension (and thus intelligence)—or, in Gassendi’s reformulation, to perfect ideas.¹³

13. The place of judgment in this scheme is interestingly unstable. The highlighting of ‘idea’ in the *Institutio logica* (of 1658) and the mechanism of linear concatenation (on

The discussions of the discursive operations of the imagination in the *Logic* and the *Physics* are complementary facets of each other. The *Physics* is naturally concerned with the physiological account of the traces in the brain, which has no place in the *Logic*. Apart from this, however, both the *Physics* and the *Logic* address the three acts in a manner that could be called partly psychological, partly logical, since they look at mental contents both in terms of their processes of formation and of their formal features. The key element I will address in what follows is the highlighting, in this account, of the mind's acts of *composition*, understood as the concatenation of mutually coherent apprehensions, grasped as one thing. This notion does several things at the same time: it allows a reinterpretation of the formal features of terms, propositions and syllogisms; it invites the identification of the imagination as the relevant operator in the mechanism of mental composition; and it opens up a common ground between humans and animals, since at this level, man and dog think alike.

Judgment and especially reasoning are indeed the discursive operations. However, the act of apprehension already performs several types of creative compositional work. Starting from sensible apprehensions, the mind can form further images of things not seen, through mechanisms Gassendi took over from Epicurean logic: composition gives us such ideas as 'golden mountain' (from mountain and gold), 'centaur' (from man and horse), 'chimera' (from lion, snake and goat); enlargement and diminution give us such ideas as 'giant' and 'pygmy'; transfer (or similitude) gives us the idea of a city we have not seen starting from the idea of a city we are familiar with, or the idea of God from venerable old men we know, or the idea of angels from beautiful teenagers around us (1: 93a; 2: 409b; for Epicurean logic, 1: 54b).¹⁴ The mind can also combine single apprehensions into composite terms, such as 'white man', or into a "whole description of a thing", for example 'good and wise man who is his own judge' (1: 92a).

which see below) common to judgment and syllogism place the latter two in the same category of discursive procedures. In the *Logica Epicuri*, however (which is based on the *Philosophiae Epicuri Syntagma*, appended to the *Animadversiones* of 1649), judgment together with the apprehensions of which it is formed constituted the "clear and distinct anticipation of those things on which reasoning is built", where reasoning was uniquely identified as the inference from signs (1: 55a–b). I believe this is because the *Institutio* exhibits a new attitude to syllogism, one that acknowledges its importance while also seeking to reinterpret it. The reinterpretation is made in terms of a linear progression which makes syllogism a mere paratactic extension of judgment and both become instances of a discursive unfolding of structures intrinsic to well-formed ideas.

14. The latter two examples attracted the criticism of the Port Royal authors, who accused Gassendi of being unable to distinguish between imagination and intellection (I.1, Arnauld and Nicole 1996, pp. 40–3).

All of these are examples of simple apprehensions produced by the composition of single into composite ideas.

As for judgment and syllogism, the noteworthy thing is that both operations appear as tokens of the same type of compositive mental act: what I called above the concatenation of mutually coherent apprehensions, grasped as one thing. The *Logic* makes this apparent through the repeated description of judgment and syllogism as acts in which the mind sees, or observes, or discerns (hence the relevance of the imagination, as explained above) the coherence, or congruity, or conjunction between two apprehensions, either directly (in judgment) or via a middle term (in syllogism) (1: 33b–34a, 99a, 106a). In the case of judgment, this amounts to highlighting the mind's act of composition, joining ideas that are mutually agreeable (*mutuo congruunt*) and grasping the conjunction as such, as a thing in itself—alongside the predication (the binding of a subject and a predicate in a propositional structure by means of a copula) and the mind's assent (which constitutes the truth establishing function of the judgment) (1: 99a, 101a, 103b). The *Logic* also discusses in this place such logical topics as the necessary or contingent status of attributes and propositions, as well as the loci, or seats of arguments. In exchange, the *Physics*, while including the obvious physiological counterpart to the mental composition (the joining together of traces in the brain), elaborates at length on the logical approach to composition. It does so with a clear agenda: the defense of the *solertia brutorum*, the thesis that animals can think.

Judgment, Gassendi tells us in the *Physics*, rehearsing the material in his *Logic*, is a matter of putting together two simple apprehensions found by the mind to be congruous (*congruas*) with each other, and thus forming affirmations (in which the two apprehensions are joined in a “composition”) or negations (in which the two apprehensions are put asunder in an act of “division”). For example, a dog is able to form the judgment ‘he who’s coming is my master’ by joining together the subject ‘man’ with the attribute of the non-abstract quality ‘master’, which he remembers from previous experience (2: 410b). The two apprehensions (‘man’ and ‘master’) are thus composed, that is to say, joined together and apprehended as one thing. The human being will, of course, be able to form a proposition with the help of the predicative copula. The presence of the copula, however, while distinctly human, does not seem to indicate a different kind of act: where the dog’s mind will form the joined apprehensions ‘man-master’, man’s mind will form the proposition ‘this man is my master’, but both are cases of the compositive action of the imagination insofar as ‘master’ is apprehended as a non-abstract quality (if abstract, this will be the act of the intellect). Thus understood, Gassendi adds, the second operation of the imagination does not differ from the simple apprehension of composite

terms, whether performed by the imagination (as when it conceives ‘golden mountain’) or by the intellect (as when it thinks ‘just man’ or ‘rational animal’). In all these cases, the mind performs a composition (when it affirms) or a division (when it negates), in which the copula “be” is contained “tacitly, or potentially” (*tacite, sive virtute continetur*) (2: 411a).

Finally, syllogism, as the highest form of reasoning, is to be understood as an extension of judgment, or as the addition of a third notion to those two already present in judgment. When two notions agree with a third, Gassendi tells us in the *Logic*, as is seen in the two propositions which form the premises of a syllogism, the mind discerns this agreement and immediately connects them. He adds, possibly echoing Hobbes here (1656, pp. 2–4), that, thus understood, the syllogism is simply a matter of computation—of adding or subtracting ideas (1: 106a).¹⁵ The *Logic* goes on to discuss figures, modes, and types of syllogism (in a much simplified form, compared to its scholastic counterpart). Instead, the *Physics* offers once again a relatively lengthy elaboration of the logical material. Reasoning here should be taken to represent sensitive, as opposed to intellective reasoning, and to be once again a cognitive function shared by humans and animals. It consists in a sequence of more than two apprehensions joined together, based on their agreement with an intermediary term. An example is the sequence: Socrates – man/man – animal/so Socrates – animal, the “Galenic” syllogistic figure. Gassendi comments that this is the perfect example, here, since in it the imagination moves more easily from singulars to universals (that is, to aggregates of similar individual things) (2: 413b). The sequence could therefore be represented as the linear concatenation:

Socrates – man – animal

Another example is that of the dog who, on seeing a man bending and reaching to the ground, flees, thus indicating that his mind has formed an inference that could be represented thus:

man reaching to the ground – stone picked up – stone thrown at
dog – pain

15. Hobbes worked on the manuscript of *De corpore*, of which his *Logic* became a part in one of its versions, throughout the 1640s, while in France, during which time he also became friends with Gassendi via Marin Mersenne (Malcolm 2002, pp. 18–21). Gassendi likely became aware of Hobbes’s logical text during this period. He was certainly acquainted with it at the time of the writing of the First Part of the *Syntagma* (the first half of the 1650s), since—according to Abraham du Prat writing to Hobbes in 1656, after Gassendi’s death—he had meant to include a chapter on Hobbes’s logic in his historical overview of the ‘origin and variety’ of logic (LoLordo 2006, pp. 23, 55/n35; Hobbes 1994, p. 343). For the Aristotelian and Ramist background to Hobbes’s view of reasoning as computation, see Sgarbi 2013, p. 187.

The deduction here is a case of inference from signs, as the dog figures out that the man's gesture signifies pain (2: 412b). But even if the two examples are of distinct forms of reasoning (a syllogism and an inference from signs) (see LoLordo 2006, pp. 92–9), the suggestion is that from the point of view of the operation of the imagination, they have the same structure: that of a string of apprehensions joined together bit by bit, on account of their congruence.

Many more examples of animal reasoning are adduced in this place, followed by a chapter on animal instinct, meant to defend the point that there is no such thing as blind instinct in animals—and human infants—but rather that instinct is guided by the apprehension and reasoning of the imagination.

The *Physics* also has a chapter on the intellect and its operations, where the agenda is to defend the immortality of the specifically human soul via its immateriality. Intellection, for Gassendi, as for the scholastics, is always dependent on sensible phantasms. However, Gassendi gives up the explanatory instruments of the agent and patient intellect, and as a consequence is left with a rather vague explanation that, in cognizing incorporeal natures, the intellect “elevates itself on the occasion of the phantasms” (2: 447a; Hatfield 1997, pp. 24–6; Garber 1998, pp. 771–72). For example, in conceiving the idea of God, we imagine a corporeal image (through transfer, as explained above) but also apprehend, with the intellect, something beside the corporeal image that is, as it were, veiled by that image. The same with such abstract natures as humanity, whiteness, or honesty. Besides this (underexplained) difference from the imagination with regard to its objects of apprehension, the intellect—we are told—is also capable of self-reflexivity in a way that the imagination is not (2: 451a–b).

Apart from this, the fact that the intellect's reasoning is able to build proofs about “things of which we have no image,” such as the real size of the sun, infinite spaces or that God can create infinite worlds (2: 452b), does not by itself entail that its mechanism is different from the mechanism of the imagination. In other words, Gassendi needs (on theological grounds) to defend the distinct nature of the intellect (its immateriality); however, when it comes to the operations of the intellect, there isn't any marked difference between the judgment and reasoning of the imagination and the judgment and reasoning of the intellect (see also Gassendi 1981, pp. li–lvi). For example, the mechanism behind the dog's inference to pain is practically the same as that of man's inference to the existence of pores in the skin, an Epicurean example Gassendi adduces repeatedly to illustrate the discovery of hidden truths (of which we have no image):

[there is] sweat – sweat comes out through the skin – [there are] spaces within the skin to allow another body to pass through – [there are] pores in the skin (1: 81a)

Both are inferences from signs, where the signs (the man reaching to the ground and the existence of sweat, respectively) root the deductive process in the evidence of sense, and in which the mind moves from one known thing to an unknown one by noticing the mutual coherence of a sequence of apprehensions. There are differences, too: the man reaching to the ground is a “suggestive sign” (it suggests a thing hidden for a time), while sweat is an “indicative sign” (it indicates a thing hidden by nature)—and, Gassendi comments, it is the latter type of hidden truth that philosophers seek (1: 68b–69a); and the inference to pores in the skin involves a number of principles which are themselves arrived at through induction from sense perceptions (such as, bodies move through space; two bodies cannot be in the same place at the same time; and one body cannot move through another body) (1: 81a). However, the mechanism of compositive thinking remains the same. This is not to say that dogs are philosophers or that philosophers are nothing but dogs, only that, from the point of view of their cognitive operations, the difference is one of degree, rather than nature.

In summary, we have seen that in his treatment of the three logical acts of the mind, distributed as it is between the *Logic* and the *Physics*, Gassendi reduced to a minimum the distinction between the imagination and the intellect that is pertinent to logic; was concerned with defending the existence of reasoning in animals, and used the three acts as attributed to the imagination to build his defense; and identified the act of composition (whether in the guise of the composite terms of simple apprehension, the concatenations of judgment or those of syllogism) as the core mechanism of the three acts. Let us now see how novel all of this was.

3. The Epicurean Mind and Scholastic Composition

In looking for the sources of Gassendi’s account of the logical imagination, the first thing to note is that behind it lies the Epicurean mind. Gassendi’s logic is openly presented as an elaboration of the Epicurean logic: the opening books introduce the format of the canonic, as well as the criterion of the evidence of sense as the pillars of logic (1: 32a, 69a).¹⁶ In the section devoted to Epicurus in book one, on the “origin and variety” of logic, Gassendi refers to the Epicurean mind as that which forms opinions or judgments on the basis of sense perception—whether we call it the imaginative, imagination, intellect or mind (1: 53b). An alternative reference is in the chapter on the operations of the imagination in the *Physics*, where we are told that the imagination is to be understood as an equivalent of *animus* or of what the Greeks (i.e. in this place the Stoics) called

16. For the development of Gassendi’s Epicurean project, see Joy 1987, pp. 66–82; LoLordo 2006, pp. 20–24.

the *begemonikon* (the commanding soul). It is thus possible to call it intellect, reason, thinking, opinion, prudence or counsel (2: 398a). The notion of idea is also suggested by the Epicurean anticipation, as is the account of composite terms and inference in terms of the composition of phantasms (1: 54b–55a). However, I would like to suggest here that an equally pertinent source is constituted by scholastic natural philosophy.

Late scholastic logic includes little of the type of material we reviewed in the previous section. It does, however, feature a discussion of the copula in predication that is pertinent to what I described as the composition of judgment. A distinction is sometimes drawn between the act of assertoric judgment, which binds a subject and a predicate in a propositional structure, and the act of mentally apprehending the conjunction as such, as a thing-in-itself. This distinction is openly discussed by the Coimbra commentators (which refer to the medieval distinction between two conceptions of the copula, one *in actu signato*, the other *in actu exercito*) and John of St Thomas (Aho 2014, pp. 336–9). An undeveloped suggestion in this sense is also in Eustachius, who mentions, alongside the attribution of one concept to another that constitutes judgment, a perception by the mind of an affinity (*convenientia/conformitas*) between the two concepts (Eustachius 1609, *Logica*, p. 21).

But it is scholastic natural philosophy (in the parts devoted to the soul) that includes much more pertinent material. This cannot come as a surprise, since, as mentioned from the start, the three acts of the intellect are a topic approached under both natural philosophy and logic *within* the Aristotelian tradition. But there is more: late scholastic natural philosophy also makes room for the three acts as functions of the imagination. The context is the discussion of the internal senses as those faculties which humans share with brutes: here we are to take *phantasia* as a unified internal sense, subordinating all the other sensitive faculties of the medieval tradition (the *aestimativa*, the cogitative power and memory). As such, it is also called “particular reason,” which humans and animals have in common, although in humans it functions in conjunction with the intellect.

In their commentary on Aristotle’s *De anima*, for instance, the Coimbrans state that “*phantasia* can compose (*conficere*) propositions out of singular terms and can discourse pertinently on their objects” (Coimbrans 1600, cap. III, q. II, art. II, p. 401).¹⁷ This is valid for humans, not brutes, since *phantasia* can perform these acts in virtue of its conjunction with the intellect

17. With reference to Thomas Aquinas ST I.78.4 (on the internal senses: the cogitative power—engaged in comparing, adding and dividing—owes its excellence to a certain affinity and proximity to universal reason, which so to speak overflows in it, so it is more perfect than in brutes) and ST IIaII.47.3 (on prudence, which takes cognizance of singulars). The Coimbrans make it clear that they do not distinguish *phantasia* from the cogitative power (1600, cap. III, q. II, art. II, p. 401).

(*propter coniunctionem intellectus*); therefore, it is not absurd to suppose that it can also reflect on its own act. As far as the copula is concerned, we should take it in two senses: a) *formaliter*, in which case it is a relation of reason; b) *materialiter*, in which case it consists of the terms themselves, joined together (*ipsos terminos, inter se iunctos*) (1600, cap. III, q. II, art. III, p. 403). In his *Physica*, Eustachius writes in a similar way of the *aestimativa*, which he sees as a specification of the imagination understood as the unified internal sense (Eustachius 1609, *Physica*, p. 396): it “composes, divides, makes propositions, and pertinently discourses in its own way about singulars”; he adds (somewhat more irenically than the Coimbrans) that the *aestimativa* of humans does not differ from that of brutes except in an accidental way, owing to its proximity to reason (Eustachius 1609, *Physica*, p. 406).

While these texts mention the acts of the imagination only in the sections devoted to the internal senses, Johannes Velcurio’s *de anima* commentary introduces them in the same breath as the acts of the intellect, in the section devoted to the latter, while also defending animal thinking. He describes the simple and the composite intellect and then continues:

So too is *phantasia* simple, that is, incomplex imagination, which is also in brutes, as when a dog thinks “this is my master,” and composite *phantasia*, that is, complex imagination, which is, of course, imagination and conception in an affirmative or negative proposition, such as most deny to be in brutes. Some nevertheless affirm it, and I am of that opinion (Velcurio 1537, p. 46).¹⁸

It appears thus that the scheme of the three acts is already transferred to the imagination within the scholastic discussions of the internal senses, with reference to the topic of “particular reason”, i.e., the cognition and reasoning about singulars and particulars which humans share with brutes—a topic inherited from medieval discussions of the *aestimativa* and the cogitative power (Black 2000). Gassendi shifts the weight of the comparison here, though: while the scholastics often warned that the judging and discoursing imagination they talk about is specific to humans, since it works in conjunction with the intellect (although there were also dissenting voices, witness Velcurio), Gassendi turns the reasoning function of the imagination into a square defense of thinking in animals.¹⁹

18. On animal thinking in early modern philosophy, see Buchenau and Lo Presti 2017; for the ancient tradition, Sorabji 1993; and for contemporary discussions, Andrews and Beck 2018. For a comparison of Gassendi and Descartes on the issue, see Torero-Ibad 2009. Gassendi’s defense of animal thinking, joined to a thesis about the identity of imagination and intellect, is already in the early *Exercitationes* of 1624 (Gassendi 1959, p. 14).

19. Possibly under the influence of Pierre Charron (1606, pp. 105–8), himself indebted to Montaigne.

In addition, late scholastic natural philosophy offers elaborations on the acts of composition, and sometimes suggests rapprochements between the composition of apprehension and that of judgment, and between those specific to the imagination and those specific to the intellect. The context here is the discussion of sensible and intelligible species.

Eustachius, for instance, divides the sensible species into *sensatae*, as perceived by the senses, and *non-sensatae*, representing sensible things under an aspect that the senses do not perceive, e.g., when the sheep represents the wolf under the aspect ‘enemy’. Sensible species can also be simple or composite (Eustachius 1609, *Physica*, pp. 394–95). The joining together of the simple species into composite species is one of the offices of the imagination: under its description as *phantasia*, it composes and divides sensate species (Eustachius 1609, *Physica*, p. 400)—as in ‘golden mountain’; under its description as *aestimativa*, it joins together sensate species with non-sensate species (Eustachius 1609, *Physica*, p. 406)—as in ‘wolf-enemy’.

Similarly, for Velcurio, one of the offices of *phantasia* is to elicit ‘intentions’ (i.e., non-sensible species) from sensible species, and to compose intention with species and species with intention, as when a sheep sees a wolf and conceives ‘enemy’ (Velcurio 1537, p. 30) (and, presumably, something like ‘this is my enemy’, which, as noted above, he takes as a simple imagination). *Phantasia* is, of course, also able to compose species with species and obtain, among other things, monstrous images, such as that of a centaur (Velcurio 1537, p. 29).

Further, Velcurio blurs the divide between intellect and imagination in his discussion of intelligible species. The intelligible species are, just like the intellect (and the *phantasia*), of two kinds: a) incomplex notions of simple things, e.g., “when I understand *heaven, earth, man, stone, justice, faith, chimera, golden mountain, cold fire, white crow, fresh snow* to be or not to be” (Velcurio 1537, p. 47); b) complex or composite notions of propositions, whether true or false. The explanation of the latter is particularly interesting:

Just as a proposition is made of a predicate and a subject, or from multiple terms, so this species is composed from images of many things, which the proposition includes. For instance, when I understand propositions of this kind—*that the heavens are perpetually moved; that the earth, the centre of the world, does not move; that human beings are the noblest of creatures*—in any one of these propositions I conceive the subject and the predicate at the same time, as if I saw a picture composed of many images, such as in a picture of a battle. For here I conceive *heaven, perpetual, motion*, and likewise *earth, centre, world, immobile*. (Velcurio 1537, p. 48)

Thus, for Velcurio, the other face of predication, understood as a mental grasp of subject and predicate “at the same time” (*simul*), and discussed as a case of complex intelligible species, is a composite mental image, or, as he puts it, a sort of “picture composed of many images” (*veluti picturam ex pluribus imaginibus collectam*).

Moreover, Velcurio lists the “collation of phantasms” (*per collationem diversorum phantasmatum*) among the five ways in which the intellect cognizes the essences of things (the other four include types of definitions and descriptions) (Velcurio 1537, p. 49). As examples of the collation of phantasms, he mentions the ‘golden mountain’, as well as ‘monsters’ and other imaginary species (such as, presumably, the ‘centaur’) and any proposition that brings together at least two species (such as, presumably, the proposition that relies on the ‘heaven-perpetual motion’ composite picture).

It has emerged, then, that Gassendi’s illustrations of the composite terms listed under simple apprehension in his *Logic* are stock examples of the compositions of the imagination in scholastic natural philosophy, e.g., the ‘golden mountain’, the ‘centaur’, the ‘chimera’. The ‘man-master’ example of animal judgment recalls the same mechanism, whether in the guise of Velcurio’s self-same ‘master’ example or in that of the standard ‘enemy’ example. As I noted above, in his *Physics*, Gassendi wrote that the composition of judgment in ‘man-master’ and the composition of the simple apprehension involved in such composite terms as ‘golden mountain’ or ‘just man’ were of the same order—the result of which was a blurring of the boundary between the imagination and the intellect. The same, it has emerged, occurs in Velcurio. He lists ‘golden mountain’ and ‘chimera’ as simple intelligible species, whereas elsewhere they were standard examples of composite sensible species. Moreover, Velcurio thinks of predication in terms of a picture-like composition, and so does Gassendi. Velcurio also thinks that the composite mental images are ways in which the intellect apprehends the essences of things; and so does Gassendi.²⁰

In sum, the elements of novelty in Gassendi’s attribution of the three acts to the imagination—the concern with animal thinking, the blurring of the divide between imagination and intellect, and the focus on the acts of composition—were enabled by a double heritage, Epicurean and scholastic. However, Gassendi also imports this material into his logic (which was not the case with scholastic logic) and makes it central to his account of the movement of reasoning. What the consequences of this move were for his conception of logic will be our concern in the final section below.

20. As suggested by his blurring of the line between definition and description at 1: 54b, 1: 83a, 1: 97b. Compare the explanation of the dividing line in Eustachius (1609, *Logica*, pp. 155–6).

4. The Movement of Reasoning Revisited

So far I have emphasized three things about Gassendi's approach to logic: the objects of the mind's logical processes are much more closely tied to sense perception than they ever were for the scholastic tradition; the mechanisms of the logical processes are analyzed in terms of a linear concatenation of mutually coherent apprehensions, grasped as one thing (which the scholastics approached in their natural philosophy but not in their logics); and the preeminence of the imagination in the explanation of the logical processes is a function both of the grounding of reasoning in sense perception and of the conception of reasoning as the mind's capacity to "see" or attend to the concatenation of its objects. I have also proposed that all of this derives from Gassendi's revisiting of the Thomistic notion that attention to the three acts is ultimately attention to the movement of reasoning that aspires to understanding. In this final section I would like to address the consequences of this revisitation, which seem to me to fall into two categories: one has to do with the notion of the naturalness of the mind's logical operations; the other, with the idea of the progress of the mind and its connection with the progress of knowledge. I understand "progress" here in the etymological sense of the term, as a temporal, gradualist, structured sequence. The linear concatenation I have discussed so far will emerge as ultimately a progressive concatenation.

The distinction between natural and artificial logic is an old, scholastic distinction. The "moderns" of the seventeenth century take it over and turn it into a rally cry of the new logics, about the ambition to build "natural" logics which follow the natural mechanisms of the human mind, and which are polemically contrasted with the "artificial" nature of scholastic logic (Lu-Adler 2018, pp. 48–63; Corneanu and Vermeir 2022). Gassendi joins the chorus and identifies a worthy precedent in the logic of Epicurus:

Hence [Epicurus] was of the opinion that where anticipations about things existed, as it is necessary they do, then what comes together and what follows or does not follow can be perceived without any artifice or dialectical machination, and can be inferred naturally by anyone, even by a peasant. Hence all one needs to do is to be careful to have clear and distinct anticipations of those things on which reasoning is built (1: 55a).

The distinctive way in which Gassendi defends the naturalness of his logic, as modelled on that of Epicurus, is to identify precisely the mechanism of the linear concatenation of reasoning as a natural one: the mind needs only to perceive (*pervideri*) the way ideas display their natural affinities ("what comes together" [*quid congruat*]) and it will thus naturally (*spon*

grasp the consequences (“what follows and what does not follow” [*quid sequatur, aut non sequatur*]), with no need of the “artifice” of dialectical machinery. A logic is thus a mirror of the natural logical instruments of the human mind—in fact, of the mind of humans who are not yet wise (and still need *discursus*), as well as of the mind of brutes. For Gassendi, the notion of a natural logic is in direct relation with the naturalization of the mind, via his account of the workings of the imagination.

The example Gassendi gives to illustrate the idea of a naturally logical mind in the account of Epicurean logic is the proof of the proposition “A man is a body.” The proof consists simply in the inspection—the “seeing” by the mind—of the ideas ‘man’ and ‘body’, which spontaneously generates the conclusion that these two ideas agree (as “we imagine him [man] as something endowed with the dimensions of longitude, latitude, and depth, and also being resistant to touch”) (1: 55a). In his own logic, Gassendi develops the account in his explanations of syllogistic reasoning and of the method of discovery. It is at this point that we can start to see the progressive nature of the logical concatenation.

The key to this is Gassendi’s use of the Porphyrian tree of genus and species. He introduces a variant of it in the part on simple apprehension, and calls it a “series of ideas or things” (Fig. 1).

The part on syllogism and the part on method offer discussions of variants of the question, “is man a body”: “is man a living being” and “is man a substance,” respectively. The formal mechanism of a syllogism, of course, is one in which the proof depends on the valid way in which the middle term connects the subject and the attribute. The progressive mechanism of the syllogism—the one that Gassendi superimposes on the formal mechanism—is one in which the mind goes up and down the series of things and follows the agreement of the ideas, step by step. It does so by comparing ideas, two by two (1: 106b; also 1: 97b). For example, the proof of the proposition “man is a living being” consists in the following formal mechanism:

Man is an animal.

An animal is a living being.

Thus: Man is a living being (1: 107a).

The progressive mechanism is the following: the mind inspects ‘man’ and, going up the series of things, compares it with ‘animal’, and then, going up again, compares the latter with ‘living being’ and finds that they agree. The mind’s progress along the series of things could be figured thus:

man – animal – living being

Recall that in the *Physics*, Gassendi gave a similar example and explained that in this “Galenic” figure, it is easy to understand how the imagination

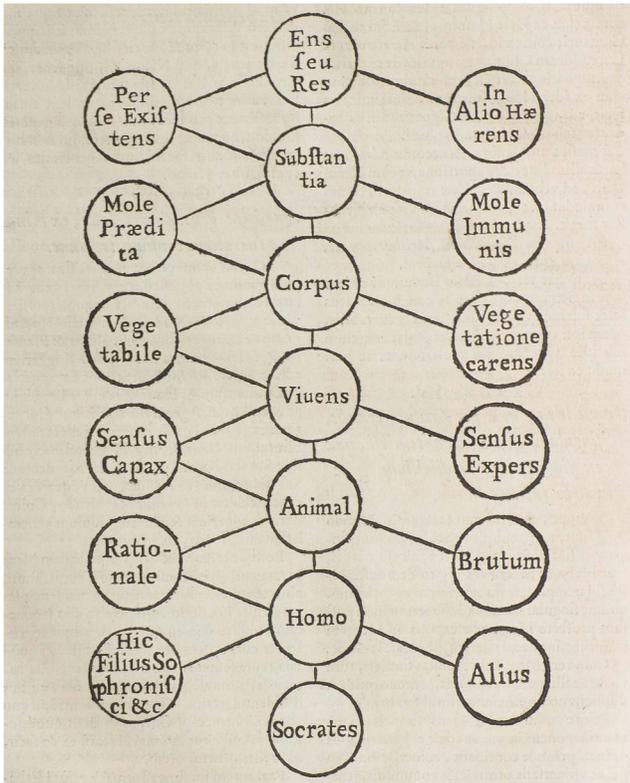


Fig. 1. The series of ideas or things. Gassendi, *Opera omnia* (1658), vol. 1, p. 94. Courtesy of the Library of the Max Planck Institute for the History of Science, Berlin.

moves through the degrees of generality of ideas. What is key, therefore, to the progressive mechanism is the movement of the reasoning faculty along a sequence of ideas, whose property is, Gassendi repeats, that they are mutually coherent. This movement, it appears, is both linear and temporal.

We have seen that the imagination is central to this mechanism because it is involved in the collection of general ideas from sensible particulars, and because it names the mind's capacity to see the connections between its objects. Here we will add a third role of the imagination. Gassendi gives us the picture (*schemata*) of the series of things with the express purpose of helping us visualize it and keep it ready at hand whenever we might need it: "such a series may be visualized by the following schema, so that it might be better committed to memory" (1: 94b).

Illustrations of the Porphyrian tree are not uncommon in scholastic logic textbooks, in which they serve an obvious pedagogical role. A particularly interesting one is in Eustachius’s *Summa*. He calls it a model (*paradigma*) representing the “series” (*series*) of genus and difference, and describes a double movement (up and down) in which the mind observes and compares items (Eustachius 1609, *Logica*, p. 84) (Fig. 2).

Together with the “affinity” between concepts seized by the mind in judgment that Eustachius talks about, his series where the mind moves up and down observing and comparing may have drawn Gassendi’s attention. Yet not only does Gassendi change the ontology of the scholastic series of things, but he makes the movement of the mind central to the account of reasoning; he may therefore have intended the illustration to go beyond the usual scholastic pedagogical purpose and serve as a device for the imagination. Thus, in reasoning based on genus and species, the

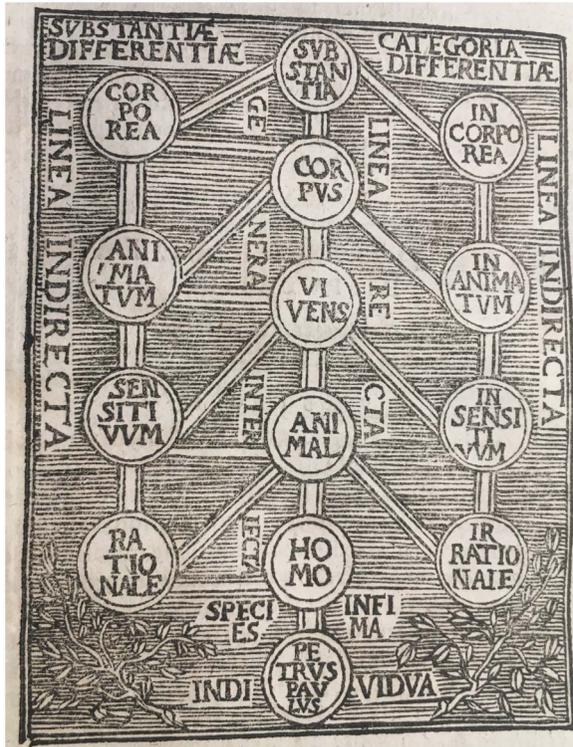


Fig. 2. The series of genus and difference. Eustachius a Sancto Paulo, *Summa philosophiae quadripartita* (1629), *Logica*, p. 51. Courtesy of Roger Ariew.

mind's eye will be able to literally (i.e., visually) move along a figured sequence. The force of inference is translated into the force of a visualized temporal concatenation. The same may have been the reason behind Gassendi's figuration of the forms of the absolute syllogism. Take, for instance, the affirmative variety (Fig. 3).

The coherence or congruity between the subject (e.g., 'man') and the attribute (e.g., 'living being') is certified by the way the middle term (e.g., 'animal') itself coheres with both. The drawing figures precisely the linear concatenation and suggests the temporal progression of the mind.

Additional support in favor of the progressive reading of syllogism comes from the part on method. The method of discovery, Gassendi tells us, consists in a method for finding the middle term (as that which helps to solve the initial problem and on which the proof of demonstration rests). The method he proposes is to use a sign that will lead us to the relevant middle term. Gassendi's language here is somewhat confusing, as it looks like he will discuss the inference from signs (of the type that deduces the existence of pores in the skin from the existence of sweat). But here he has something else in mind—which, I believe, is the use of the series of things in the manner discussed above. The "sign" that will lead us to the middle term is either of the extreme terms of our problem. Say, the problem is to prove that "man is a substance." The extreme terms here are 'man' and 'substance'. In their capacity as signs, they need to be taken as starting points of an investigation of the series of things. The series of things is indeed the trail that will lead us from the sign to our prey. Thus, if we start with 'man', the mind will first notice the "immediate agreement" (*immediata cohaesione*) 'man' has with 'animal', then it will proceed up the series until it reaches body and notice the "immediate agreement" this one has with 'substance'. It will thus be able to use 'body' (or any other intermediary, for that matter)



Fig. 3. The affirmative absolute syllogism. Gassendi, *Opera omnia* (1658), vol. 1, p. 108. Courtesy of the Library of the Max Planck Institute for the History of Science, Berlin.

as the middle term in the demonstration. This is the movement of resolution or analysis. If we start from the other end, with ‘substance’, that would be the movement of composition or synthesis (1: 121a).

“Resolution” and “composition” are logical terms of art in the period, which have a complex and complicated history. What often happens is that they make possible an overlap of different types of relationship: between logical cause and effect, between mathematical principle/axiom and unknown, between ontological genus and species, and between physical and metaphysical whole and part (Gilbert 1963, pp. 31–5, 81–92; Jardine 1974, pp. 39–40, 249–50). This is also the case with Gassendi. He reads the series of things (the tree of genus and species) into the structure of the syllogism and, as I have argued, imprints a decisively temporal, progressive dimension to it. Progressive temporality is also implicit in the use of the whole-part relationship in Gassendi’s account of the method of teaching. If, for example, the professor of physical science explains the nature of things to his pupils, he will begin with the whole of the “image of nature,” or the “machine of the world” and will gradually resolve it into increasingly smaller parts until he reaches the “principles of which all things consist”; then he will proceed backwards and show how everything is built through the combination of those principles. Likewise, when the professor of geometry explains magnitude, he starts with the point and gradually constructs lines, surfaces and bodies and thus demonstrates length, width and depth (1: 123a).

Gassendi also compares the method of discovery (with reference to the discovery of the middle term, which makes it in fact an account of syllogistic inference seen under the aspect of a progressive mechanism) with the nature of mathematical analysis (x is posited, from which follows a, from which follows b, from which follows c—where c is an axiom, which proves that x is true) (1: 121b). Now, the mathematical model of the progress of reasoning is the key inspiration behind what came to be called the Cartesian method in the seventeenth century. Its *locus classicus* is Descartes’s understanding of deduction in the *Regulae*, as a sequence of necessary relations terminating in true principles, which the mind intuitively grasps at every step in “a continuous and uninterrupted movement of thought.” The relations are understood on the model of proportional magnitudes and are seized via comparison of “the isolated natures of things.” They will thus produce an ordering of things in a series—of a different kind, though, than the scholastic series of ontological genus and difference—and this is the “secret” of the art of problem-solving (Descartes 1984–91, 1: 15, 21–23; 1996, 10: 369, 381–5). One development of this understanding of deduction is in Malebranche’s “rules to be observed in the search after truth” in his *Recherche de la vérité* (1674–75). The mind will proceed by comparing

its ideas and identifying their relations (understood as mathematical relations of equality or inequality), so that they can be ordered in their natural order, from the more simple to the more complex; this will be achieved “either by the mind’s eye alone, or by the movement of the imagination together with the mind’s eye, or by the calculation of the pen joined to the attention of the mind and imagination”—in other words, by the intellect in grasping concepts, by the imagination in tracing geometrical figures or by algebraic notation, all of which express the movement of reasoning (Malebranche 1980, pp. 433–9). Malebranche, in turn, figures as the key reference for the conclusive statement that “algebra is the true logic” in Jacob Bernoulli’s “Parallel Between Logical and Algebraic Thinking” (1685) (Bernoulli 1744, p. 218), a text that seeks to demonstrate the correspondences between the logical composition of ideas—in which the mind “conceives the agreement of ideas,” as signified by the copula (Bernoulli 1744, p. 214)—and the mathematical operations of addition and subtraction, and uses algebraic notation to represent syllogistic inferences. Understanding logical operations in terms of addition and subtraction is of course a Hobbesian idea that Leibniz will also quote approvingly among other sources in his own attempt to connect logical with mathematical analysis as the crux of a renewed art of discovery (Leibniz 2020, pp. 214–15; Mugnai 2010; see further Rabouin 2013).

Gassendi, we have seen, does compare the movement of logical reasoning with that of mathematical analysis, and does offer an interpretation of the process of thinking in terms of computation, although he is distrustful of the use of algebraic notation in mathematics itself, let alone logic (Rochot 1957). And his account of reasoning does include some of the central elements of the mathematically modelled account: the mind’s observation of relations of coherence (or incoherence) through comparison of elements, arranged in a linear progression, as the way to discovery and proof. However, Gassendi’s understanding of the relations is not rooted in the mathematical model, but rather in the reflection on the acts of the mind’s logical compositions, starting from sense perception, which we have reviewed here. It was thus through his own working out of the tradition of the logical and natural philosophical approaches to the three acts that he obtained his own version of the progressive concatenations of the imagination.

This version is probably more directly pertinent to John Locke’s account of the agreement of ideas than the Cartesian model. Locke famously attacked the syllogism in the chapter “Of Reason” in the fourth book of his *Essay concerning Human Understanding* (1690). He did so in virtue of a typically modern insistence on natural logic, understood, as in Gassendi, in terms of the “natural order of the connecting *Ideas*”: “a Man must see the

connexion of each intermediate *Idea* with those that it connects, before he can with Reason make use of it in a *Syllogism*" (IV.xvii.4, Locke 1975, p. 674). As an illustration, Locke asks:

... whether the Mind does not more readily and plainly see that connexion, in the simple and proper Position of the connecting *Idea* in the middle; thus,

Homo—Animal—vivens,

Than in this perplexed one,

Animal—vivens—Homo—Animal.

Which is the Position these *Ideas* have in a Syllogism, to shew the connexion between *Homo* and *vivens* by the intervention of *Animal* (IV.xvii.4, Locke 1975, p. 675).

This looks very much like what I have argued Gassendi did in his account of reasoning. Except that he did it by means of a reinterpretation of the syllogism (as a progressive mechanism matching the formal mechanism) rather than through a refutation of it.²¹ Locke also compared his model of the agreement of ideas with the order of mathematical demonstration (IV.xvii.4, Locke 1975, p. 669), yet its ground was not in mathematical relations, no more than it was in Gassendi.

If this, then, is Gassendi's version of the Thomistic movement of reasoning, now seen as a markedly temporal, gradualist and linear progress of the mind's operations, it is also connected to a distinctly modern understanding of the progress of knowledge through "experience" (i.e., through observation, experiments and instruments). Discovery becomes the key notion here. As we have seen, the notion may be understood as intrinsic to the mechanism of reasoning—as the discovery of the middle term. It may also be understood in mathematical terms—as the discovery of the truth or falsity of a posited unknown in problem solving. A third meaning, which becomes pertinent now, is discovery in an experimental sense. Gassendi's logic makes room for this latter sense in the account of inference and of the "perfect" idea.

The discovery of the middle term and experimental discovery are part of the same account of the building of syllogisms in part three of the *Logic*. Gassendi gives us a standard list of loci, or seats of arguments (e.g., genus, property, definition, parts, species, cause, effect, etc.) and in the illustrations indicates that the minor premise (the one that forms

21. For Locke's closeness to Gassendi, see Yolton 1955; Michael and Michael 1990; Lennon 1993, pp. 149–63. But see Milton 2000 for a reserved view.

a true proposition about the middle term) is one established by experience or induction from experience. For example, say we want to prove that “the earth is habitable.” We will have recourse to the locus ‘parts’ for the middle term and will form the following syllogism:

The earth has five regions.
 Each region is habitable.
 Thus: The earth is habitable.

Crucially, after formulating the minor premise, Gassendi adds a note on its being grounded in natural historical observation:

Each region is habitable (this, indeed, in contrast with what the ancients believed, has been observed through navigation and voyages). (1: 117a)

In these cases, the minor premise (which Gassendi calls the assumption) is itself in need of proof. According to him, as we have seen, any proof needs to conform to the two criteria of judgment: the evidence of sense and reasoning based on the evidence of sense. The premises of a syllogism will thus ultimately be legitimated by “the evidentness [*evidentia*] of sense itself (than which nothing is greater, and on which all other knowledge depends either mediately or immediately)” (1: 116a–b). The force of inference which the formal mechanism of the syllogism establishes needs to be complemented by the epistemological force of evidence that only sense can provide. This account allows for the relevance to logical reasoning of the experimental progress of knowledge. With new knowledge acquired through experience, new true propositions may be formed and new inferences produced. Or, looking at it from the perspective of the mind’s operations, the mind moves along the inferential chain while at the same time seeking to uncover as much content with which to fill the inferential chain as possible.

It is telling, from this point of view, that Gassendi not only came to admire Francis Bacon’s *New Organon* (1620) (see Garau’s contribution to this issue), but saw it as organized by the schema of the three acts: the way Bacon derives new notions from experiments is equivalent to simple apprehension; his derivation of axioms from particular truths along a gradual scale is a form of judgment; and his induction from particular to universal truths, a form of reasoning (1: 90a).²² Thus, Baconian literate

22. Gassendi also comments that Bacon neglected syllogistic reasoning (which he shouldn’t have done, since it alone can offer proof, and in fact induction itself must involve syllogistic reasoning if it wants to prove anything); or, he also offers, perhaps Bacon only rejected syllogisms not constructed from sufficiently clear and solid propositions.

experience and induction are integrated by Gassendi into his conception of logic (see further Cassan 2012). This is further evidence that for Gassendi the progress of knowledge and the progress of the mind's reasoning are facets of the same logical process.

Our reasoning moves along with new discoveries, new theories and new instruments. Our inference from signs (which is the only way we have of bringing hidden truths to light) depends on principles derived by induction from sense perception (as discussed above in relation to the inference to pores in the skin). But sense perception is apt to bring in new knowledge and develops in time. Our principles may change, and so will our conclusions. Sense perception may also be refined or even replaced by instruments, and the instruments will be able to confirm or to disprove our previous inferences—for example that to the animal nature of a skin mite confirmed by a reflecting microscope (1: 82a). Sense perception may also disprove a theory and invite the formation of a new theory—for example that of the trajectory of an arrow shot from a moving ship (1: 122a). In other words, for Gassendi logic cannot be impervious to the notion that knowledge progresses through time—an idea that should not be understood in the Enlightenment sense of a triumphalist “progress of the human mind” but rather in the modest, fallibilist sense embraced by Gassendi, of an increase in the quantity of observations and probable insights they afford us (Bloch 1971, pp. 73–4).

All of this feeds into Gassendi's conception of the perfect idea. Ideally, we recall, the wise man simply possesses perfect ideas, and has no need of discursive reasoning, since all of the idea's parts, adjuncts and relations are contained in the idea itself. The mere inspection of the idea by the mind would reveal in the same instant the whole web of knowledge. But ignorant (that is to say, non-wise) men do need to follow the process of reasoning. The end and term of this process is the “rest” of the perfect idea. But along the way, the movement consists not only in the progress of the mind, but also in the progress of knowledge. Hence the importance of the arts and sciences to the building, in time, of perfect ideas:

For this reason anatomy, chemistry, and the other arts should be more valued, as they distinguish and reveal to us many parts and qualities of things other than those that are ordinarily accessible, and therefore bring it about that we arrive at more perfect ideas (1: 95a–b).

Ultimately, therefore, Gassendi's perfect idea is a progressive notion that governs both his experimental conception of the progress of knowledge and his temporal, gradualist interpretation of the movement of reasoning. With this in mind, it also becomes clear that Gassendi's “series of things” is no longer the fixed ontological map of the scholastics and is to be

understood as a dynamic map, in which general ideas depend on the revisable work the mind performs in time.

5. Conclusion

I have described a line of development within the logic of the sixteenth and seventeenth centuries, which crossed the divide between late scholastics and moderns, and for which logic was both about structures of formal validity and about what the mind does in knowing things. The moderns became increasingly interested in the latter and claimed to redefine logic accordingly. Yet what they were doing, it seems to me, was still responding to Thomas Aquinas's original call to look at logic from the point of view of the acts involved in reasoning. Once open to the movement of reasoning, logic also opened up to the nature of the mind (of humans and beasts) and to the nature of scientific knowledge (including the empiricism and the experimentalism that Gassendi embraced). The distinctive Gassendist take on these things, I have argued, was to bring out the temporal, gradualist dimension of thinking and knowledge and to pair their progressive mechanisms with the formal logical structures. The result was partly similar to the direction imprinted to the new logics by mathematics, yet only partly so. It was instead a type of approach that may have shaped the Lockean take on logic as an analysis of the human understanding.

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