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THE FLUIDITY OF A CONCEPT
Auditory *Species* in the *Conimbricenses*, Arriaga and Schelhammer

Abstract

The terminology of "auditory *species*" was prevalent in theories of sound and hearing from Antiquity to the Early Modern period for its use in explaining the intermediary stages of sound propagation and perception. Its very existence, however, was a topic of extensive debate among the scholastics. Each tried to square their account with Aristotle's mention of "sensible forms" in *De an*. II 12, while going far beyond Aristotle's text and looking for opportunities for creative interpretation of the terminology, as Aristotle himself never clearly defined what they are, nor specified their way of generation and existence in the medium and the sense organs. With regard to auditory perception, the most general account holds that auditory *species* proceed from the sounding object to the ears, where they are captured by the sensory faculty. Over the centuries, the terminology and general account have remained in use, yet the specific ideas behind them have changed dramatically. In this paper, I shall point out three distinct ways of putting auditory *species* to use in 16th- and 17th-century authors differently connected to the Aristotelian tradition, namely the Coimbra commentators, the Prager theologian Rodrigo de Arriaga, and the German medical professor Christoph Günther Schelhammer. I argue that the terminology of auditory *species* can be creatively accommodated to an astoundingly wide spectrum of philosophical frameworks that have different takes on the gradation of materiality, the mode of interaction between the material and the immaterial, and the nature of air motion that contributes to sound generation and propagation.

Keywords

Aristotelian Natural Philosophy, Auditory *species*, *De anima*, *Conimbricenses*, Arriaga, Schelhammer

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The term "auditory *species*" belongs to the category of sensible *species* in scholastic philosophy.[1] *Species* is a Latin translation of the Greek term εἶδος,[2] whose most basic meaning is the image, form, or likeness of a thing.[3] With regard to sensible *species*, it means something that causes our perception of a sensible object, be it colour, sound, smell, taste or touch, and bears a likeness to it but is not the object itself.[4] One major difference between a sensible object and its *species* is that the object of perception is a sensible quality that stays or, to use a scholastic term, "inheres" in the thing that has that quality as its subject of dependence,[5] in the same way redness inheres in an apple of that colour, while its *species* is free to depart from the subject of inherence – *species* of redness spread[6] across the room and reach our eyes, thus making the redness visible to us.[7]

There has been much debate among the scholastics about whether the positing of such entities is in fact necessary. While Francisco Suárez embraces them for every sense,[8] Peter Olivi and William of Ockham reject them

[1] Spruit (1994) pp. 1-27. In addition to *species*, other terms can designate the same entity, such as "form," "impression", or "similitude. Peter Auriol, for example, uses different terms to highlight different aspects of *species*. Cf. Lička (2016) p. 10 n. 29.

[2] Spruit points out that the translation of εἶδος into *species* gave rise to scholastic controversies about their nature. Cf. Spruit (2011) p. 1211.

[3] Marmodoro (2014) pp. 80-6. For a brief discussion on both sensible *species* and intelligible *species*, see Spruit (2011) pp. 1211-3; Perler (1996) p. 232.

[4] *Ibid*. For a discussion on Arriaga's understanding of the representational role of *species*, see Leinsle (2016) p. 110.

[5] For a brief discussion on the term "inherence," see Pasnau (2011) p. 53 n. 9.

[6] There is a great diversity in the ways in which authors describe how auditory *species* spread across the medium. Rather than saying that the medium is "actualised" by auditory *species*, authors tend to use terms that are closely related to motion or production, such as "multiplicare" in Suárez, "multiplicare" and "devenire" in the *Conimbricenses*, and "producere" and "spargere" in Arriaga. See Suárez (1635) p. 155; CAJC p. 140; Arriaga (1669) pp. 677, 679.

[7] There is little literature on auditory *species* in particular. For discussions on medieval theories on auditory perception and perception in general see Pasnau (2000) p. 38 and (2011) pp. 53-9; Knuuttila (2008) p. 16.

[8] Heider has several detailed studies on Suárez's theory of perception, see Heider (2018) pp. 78-80, (2016a) pp. 38-66, (2017) pp. 61-84.

categorically,[9] and others like Roger Bacon allow them for certain senses but not others.[10] The problem is partly an exegetical one that tries to make sense of Aristotle's statement in *De anima* II 12: "Sense is that which is receptive of the form of sensible objects without the matter, just as the wax receives the impression of the signet-ring without the iron or the gold."[11] The fact that Aristotle himself never clearly defined these sensible forms, nor specified their way of generation and existence in the medium and the sense organs, left much room for creative interpretation.[12] Indeed, the term "sensible *species*" that is widely used in scholastic commentaries to refer to Aristotle's "sensible form" is a later invention that Aristotle could not have anticipated,[13] and the rich content added to the concept by Latin commentators is a development that goes far beyond Aristotle's text.[14]

For those who believe in sensible *species*, disagreement persists about their ontological status[15] and whether they can be somehow reduced to the purely physical changes that happen in the medium and the sense organ. While the common way of posing the question, asking "whether *species* are spiritual or material," certainly echoes a Neoplatonic tendency to emphasise the division between the material and the intellectual/spiritual,[16] scholastics often find ways of reconciling the two sides by clarifying what materiality or spirituality means.[17] Henry Bate, for example, considers *species* to be "material" in the sense that they arise from the potentiality of matter and change matter,[18] but is also fine with calling them "spiritual" because of their

[9] Lička (2016) p. 10; Heider (2016b) p. 185.
[10] Bacon, *De mult. spec.* I 2.1-29 = Lindberg (1983) pp. 21-3. On the disagreement between Arriaga and Haunold on for which senses sensible *species* exists, see Leinsle (2016) p. 104.
[11] Arist. *De an.* II 12.424a17–22: […] ἡ μὲν αἴσθησίς ἐστι τὸ δεκτικὸν τῶν αἰσθητῶν εἰδῶν ἄνευ τῆς ὕλης, οἷον ὁ κηρὸς τοῦ δακτυλίου ἄνευ τοῦ σιδήρου καὶ τοῦ χρυσοῦ δέχεται τὸ σημεῖον, λαμβάνει δὲ τὸ χρυσοῦν ἢ τὸ χαλκοῦν σημεῖον, ἀλλ᾽ οὐχ ᾗ χρυσὸς ἢ χαλκός […].
[12] For a discussion of different contemporary readings, see Caston (2005) pp. 247-316.
[13] Spruit (2011) p. 1211.
[14] For an excellent catalogue of Latin Aristotle commentaries, see Lohr and Colomba (1988).
[15] For Aquinas's reception of Aristotle's sensible forms, see Cohen (1982); for a comparison between Aquinas's and Giles of Rome's readings, see Trifogli (2019) p. 260.
[16] I am grateful to an anonymous reviewer for pointing out the Neoplatonic influences here.
[17] The problem becomes messy when terms are used in different senses. Aquinas, for example, does not define spirituality explicitly. Trifogli (2019) p. 253.
[18] Guldentops (2001) pp. 82-4.

imperceptibility *per se* and their existence in some matter in which the sensible quality they represent does not usually inhere.[19] One popular term scholastics come up with for the ontological status of sensible *species* is "diminished being" (*esse diminutum*), which highlights the fact that *species* cannot independently exist on their own.[20]

Setting aside the controversies, authors who believe in the existence of auditory *species* take it to be something that is in the likeness of the sound produced by a sounding object and has a great mobility that allows it to traverse the medium. It performs one or both of the following two explanatory functions.[21] The first is to bridge the spatial gap between the origin of sound and the ear and explain what happens in between. The kernel of the problem here is that there has to be something to transport the sound over a long distance, yet there is no massive, perceptible motion of the air that seems to be capable of doing so.[22] Moreover, since Aristotle describes the air during sound propagation as a continuous unity, it means that attributing the propagation of air to different parts of the air acting upon and against one another might cause exegetical problems.[23] Here, *species* must fill in. Theophrastus describes the *species* of sound as one unity, disparate from the air but supervening upon it, and so is able to make sound audible to every hearer within a certain distance.[24] Simplicius' view is slightly different: the sounding object endows the air with *species* (συνειδοποιέω) that are passed on to the air further

[19] *Ibid*., pp. 86, 90.
[20] Tellkamp (2012) p. 8.
[21] Note that these two functions are not exhaustive. For other roles auditory *species* play, such as guaranteeing the objective correctness of sensory perception, see Leinsle (2016) p. 103.
[22] Suárez, for example, notes the lack of "violent and sensible motion of air" when we hear sounds. Suárez (1635) p. 155.
[23] Arist. *De an.* II 8.419b34-35.
[24] Prisc. *Metaphr.* 14, 30-33 = Huby (1997) p. 23: "Surely it is because it is necessary for some effect to have occurred and for the air to have been set in motion earlier, and the form of the sound supervenes upon it as a whole later; and the effect and the movement are in time, and the form as a whole supervenes later upon what is happening. In the particular case of sound, therefore, the form of the activity <supervenes> later upon the effect, to the extent that the effect gets through by means of the continuity of the air."

away from the origin by means of the sympathy between parts of the air, while the air remains a unity during the process.[25]

The second function is to bridge the physical-phenomenological gap between a sound external to us and our phenomenological experience of it. How is sound, something that originates in the physical world, able to make itself accessible to our sensory capacities? Auditory *species*, again, come in handy at this point of transition. For Themistius, auditory *species* (τὰ εἴδη τῶν ψόφων) are received by the air congenital with the eardrum, something that serves as the border between the pneuma and the external air and transmits them to the origin of perception.[26] This mediating role of *species* is also found in Augustine and William of Auvergne. Speaking of sensible *species* in general, they consider them to arise from external objects and later get impressed on the organs of the senses, thus functioning as the link between external objects and our sensory powers.[27]

Without a doubt, many ambiguities are lurking in each of the accounts with regard to both functions. It seems rather puzzling, for example, how something supervenient on the air and not affected by air motion is produced, when it is obvious that the generation of sound is closely related to the motion of the sounding object, which, in turn, must have an impact on the surrounding air. The mode of *species*' propagation in the air is also unclear – if there is just one *species*, how is its expansion and ultimate fading in space determined? If there are multiple, are they multiplied from one another,[28] or is there motion involved? Moreover, how *species* get received by the sense and transported further also remains mysterious. This opens up a huge space for later scholastic and early modern authors to fill in.

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[25] Simpl. *De an.* 142, 9-14 = Steel (1997) p. 174: "the latter parts [of the air] are not struck or shaped by former ones, but sympathise and are endowed with the same *species* (συνειδοποιεῖται) by that which strikes and activates in the beginning."
[26] Them. *De an.* 86, 28 = Todd (2013) p. 109.
[27] August. *De trin.* XI 9.16: "[...] from the *species* of the body itself, there arises that which comes to be in the sense of the perceiver; and from this, that which comes to be in the memory; and from this, that which comes to be in the mind's eye of the perceiver." Todd (2000) p. 56: "I have already told you that to sense includes two things in itself, namely, to receive an impression from that which is sensed and to judge concerning it. I mean: to judge its quality and to receive from the external sensible object an impression that is in the organ of the sense and is impressed upon it by the sensible agent."
[28] Suárez (1635) p. 155.

In the following, I shall focus on three early modern works that have dealt with sound and hearing, the *Coimbra Commentaries*, Arriaga's *Philosophical Course* and Schelhammer's *On Hearing*, and discuss how the two functions of auditory *species* play out with different nuances in different philosophical frameworks to which the authors commit. The reason for choosing these authors is that they each capture an important moment in the designation of auditory *species*' explanatory function in the theory of sound and hearing. Auditory *species*, being an immaterial entity in the *Coimbra Commentaries*, fulfils the function of transporting the sensory data across a distance with no air motion, and bringing about perception through a hylomorphist union with the sensory power. Arriaga agrees with the *Conimbricenses* on the first role of the *species*, but rejects its "immateriality" and its union with the sensory power. For him, *species* causes perception upon immediate contact with the sensory power without any need for union with it. Schelhammer, on the other hand, completely mechanises the auditory *species* as the shape of air that contracts and dilates during sound propagation. Inspired by Athanasius Kircher, he assigns auditory *species* a linear propagational path to facilitate a geometrical analysis of sound interface with its surroundings on the same model as light rays.

1. The Coimbran 'Species': Mediated Perception through Union

The *Coimbra Commentaries* provide a good example of how auditory *species* and its functions can be squared with a philosophical framework in which materiality comes in different degrees.

The so-called *Comentarii collegii conimbricensis*, or *Cursus conimbricensis* consists of eight commentaries on the Aristotelian Corpus published between 1592 and 1606 under the direction of Manuel de Góis as a collective undertaking to update the Jesuit philosophical teaching in Coimbra.[29] The content most relevant to our topic is the commentary on *De anima* II 8 mostly written by Góis himself.[30]

[29] For the authorship of the *Coimbra Commentaries*, see Carvalho (2018) pp. 7-15; Oliveira e Silva (2022) pp. 73-90.

[30] Carvalho (2019). Although Góis is the main author and compiler of the *De anima* commentary, inconsistencies in the work hint at the fact that it is most likely a collective

1.1 Gradation of Materiality

For Góis, the sensible quality of an object, the sensible *species* of that quality, and the soul that perceives the quality exist on different levels of materiality.[31] Entities at the ends of the spectrum of materiality cannot interact with one another without mediation.

> For from the constitution of nature, and the order between sensitive cognition and the cognised thing, *species* is in the middle: lest a transition should take place without a medium from the sensible thing, which is too material for cognition, to that which approaches immaterial nature, but by the interposition of *species*, which has less materiality than a sensible object. Whence Aristotle teaches absolutely in chapter 12 of this book, in text 121 which immediately follows, that it is common for the senses to receive forms without matter, that is, to receive the images of objects.[32]

What Góis describes here is the gradation of materiality: the sensible object is too material (*nimium materialis*) for cognition, so that something less material is needed to bridge the sensible and the sense. Note that occasionally, there appears to be some confusion in the use of the term *materialis*. When explaining why the souls of living things are superior to the lifeless things, Góis says:

> [...] in their (the soul of living things) operation they make use of simulacra of things, or *species* which, though still material insofar as they emerge in small amounts from matter: for example, the similitude of colour is indeed of a purer and more purified nature than colour itself; and finally that they use images of things no longer inherent in a body, but truly immaterial, and of a higher order.[33]

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enterprise. For example, in the discussion on the organ of touch, the commentators overturn the Aristotelian principle that the temperament of the tactile organ should not be too terrestrial, which they adhere to in one place of the text, but put forward a new principle for locating the sense organ based on daily experience in another place. CAJC pp. 538, 630.

[31] On materiality in other early modern authors, see Äkerlund (2025).

[32] CAJC p. 652: "Namque ex naturae instituto, atque ordine inter cognitionem sensitivam, et rem cognitam media est species: ne a re sensibili, quae nimium materialis est ad cognitionem, quae ad immaterialem naturam prope accedit, fiat transitus sine medio, sed interjectu speciei, quae minus habet materialitatis, quam objectum sensibile. Unde Aristoteles hoc lib. cap. 12. proxime sequenti, text. 121. absolute docet commune esse sensibus formas sine materia, hoc est, objectorum imagines recipere."

[33] CAJC p. 294: "[...] illae operando utantur objectarum rerum simulachris, seu speciebus, quae etsi materiales adhuc sint, aliquantulum a materia emergunt; siquidem purioris, et defaecatioris naturae est similitudo coloris, verbi gratia, quam ipse color; aut denique quod

Here, Góis applies materiality and immateriality to sensible *species* at the same time, which seems to disrupt the hierarchy of materiality. Upon a closer look, however, the sense in which he uses the word *materialis* varies. When he says that *species* are "material," he emphasises the fact that *species* originate entirely from the physical world, namely bodies and their movements; when he says that they are "immaterial," he points to the fact that *species* do not inhere in bodies like sensible objects do. Thus, immateriality, taken in this sense, is clearly distinct from spirituality, which, strictly speaking, only applies to the intellect.

Different degrees of materiality exist also within *species* of different sensible qualities. Auditory *species*, for example, are considered to be more material than visual *species*:

> [...] sound, and auditory *species* are transported not instantly, but in time [...] for just as sound is more material than its *species*, so are (auditory *species* more material) than images of colours.[34]

It is a common experience that we hear a sound a moment later than we see the motion that causes the sound when it takes place far away from us. In this passage, Góis explains the tardiness of the arrival of auditory *species* in comparison to visual *species* by means of the greater materiality of the former than the latter. The criterion by which Góis judges the degree of materiality seems to be how much it has in common with solid bodies, whether it is by being bound by bodies spatially, or by sharing similar characteristics, such as being slow in its movements.

1.2 Union as the Mode of Interaction between the Material and the Immaterial

Because of its position between the sensible object and the sensory faculty in terms of its materiality, auditory *species* plays an important mediating role in the *Coimbra Commentaries* by being the formal principle of a union between

utantur rerum imaginibus non iam corpori inhaerentibus; sed prorsus immaterialibus, atque altioris ordinis."

[34] CAJC p. 516: *Commentarii in III de anima* II 8 q.1, a. 2: "[...] sonum, et species audibiles non instanti, sed tempore deferri [...] quia tam sonus quam eius species magis materiales sunt, quam imagines colorum."

sound and the faculty of hearing, which Góis considers to reside in the "congenital" air[35] that is built into our ears from birth.

> Note, however, that a *species* concurs not only actively for operation, as we have said, but also formally, insofar as it concurs for the specification of an act, by determining the power to this rather than to that kind of operation. Likewise, insofar as it guarantees the union of the object with the power in the being of the cognised thing, which union is the proper effect of a formal cause. And truly, the power is united sensibly with the cognised thing before it tends towards the object; a *species* is a formal principle before it is an efficient principle [...][36]

Góis understands the occurrence of perception in terms of an Aristotelian hylomorphist relationship, which involves three elements: form, matter and the informed object. With regard to perception, the counterpart of form is the sensible quality that its *species* represents, that of matter is the sensory power, and that of the informed object is the perception that arises from the union, an act that is defined in terms of its kind[37] and its direction in which it targets the object.[38] Note that here, *species* is the formal principle, while the union is achieved between the sensible object and the sensory power, which deviates from the usual hylomorphist model in which the formal principle itself is united with the material principle. This irregularity seems to arise from the underlying concern that for perception to reliably render reality, a union has to take place between the cognised thing and the cognising power,

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[35] CAJC p. 538: "[...] the congenital air, or in-built air in the ears, which we said was enclosed by the membrane, lest it should disperse to the outside or be exposed to external injuries, is the true and proper instrument of hearing."

[36] CAJC p. 384: "Adverte autem speciem concurrere non solum active ad operationem, uti diximus: sed etiam formaliter, quatenus concurrit ad specificationem actus, determinando potentiam ad hanc potius, quam ad illam operationis speciem. Item quatenus praestat unionem objecti cum potentia in esse cognoscibili; quae unio est proprius effectus causae formalis. Et vero, quia prius est potentiam uniri intentionaliter cum re cognita, quam tendere in objectum; prius se habet species ut principium formale, quam ut principium efficiens [...]."

[37] I take the "speciem" in "determinando potentiam ad hanc potius, quam ad illam operationis speciem" to mean kind. Species decides which kind of perceptive activity is turned on – *species* of colour activates vision, *species* of sound hearing, etc.

[38] This role of mediating the material and the immaterial is absent in Suárez, who nevertheless thinks that union is in principle necessary between the sense and the object of perception. Suárez (1635) p. 107: "Unio objecti cognoscibilis cum potentia necessaria est in omni cognitione." Suárez also differs from the *Conimbricenses* in believing that sensible species serves only as the efficient cause and not the formal cause. *Ibid*., p. 112.

yet in the case of auditory perception, the union can only be initiated by *species* since it is the only thing that is able to come into contact with the power. Therefore, the union is a strange one in which the formal principle is not united with the material principle but brings about the union of the latter with something else.

To summarise, auditory *species* in the *Coimbra Commentaries*, being less material than sound and more material than the power of hearing, is able to bring forth a hylomorphist union between sound and the power of hearing. In the Coimbran world, beings exist on a spectrum of different shades of materiality, and things that are far apart in terms of their materiality need intermediaries to interact.

2. Arriaga's 'Species': Immediate Perception without Union

Three decades after the publication of the *Coimbra Commentaries*, Rodrigo de Arriaga, Spanish by birth but devoted to the promotion of wisdom and faith in the Province of Bohemia since 1624, composed a complete philosophical course at the Jesuit College of St. Clement in Prague.[39] Just like the *Coimbra Commentaries*, Arriaga's *Philosophical Course* is a gigantic set of commentaries on Aristotle's works, yet the philosophical framework in which his concepts operate is already quite different.[40] Auditory *species* now functions in a world in which the gradation of materiality is absent and touches the sensory power without initiating any union.

2.1 Clear-cut Boundary between the Material and the Spiritual

Arriaga rejects the gradation of materiality and draws a clear line between the material and the spiritual, avoiding the term "immateriality" that might cause confusion between the strictly material and the spiritual. The trend is already visible in Suárez, who emphasises that sensible qualities, though being quite subtle, are distinguished from the "proper spiritual and immaterial

[39] Hurter (1874) pp. 1-3; Ribadeneira (1576) pp. 728-9.
[40] Arriaga's *Cursus* was first published in 1632, then in 1653 before it was published for the last time in 1669 after substantive revision and augmentation. All passages from the 1669 edition cited in this paper are identical to the earlier editions.

qualities" of the intellective soul.[41] Arriaga takes a step further and draws the line between the spiritual and the material by means of the presence of quantity and impenetrability.

> Let us say, then, that a material thing is, in general, a quantitative being. [...] So by contrast, a spiritual being must be defined as a non-quantitative being. Indeed, we will later explain that quantitative disjunctive, either that which is *per se* impenetrable with another individual similar to itself, or has a commensuration with such an impenetrable thing.[42]

This passage shows a strikingly Cartesian take on the division between materiality and spirituality.[43] A thing is either material or spiritual, and the sole criterion for deciding where it belongs is by its relationship to bodies and quantity. There are two situations in which a thing is material: it is either a body that is impenetrable by another body, meaning that two bodies cannot take up one space at the same time; or it is commensurate with a body and is dependent on it, for example the redness of an apple extends across the flesh of the apple and is dependent on it, yet the redness itself is not a body. A spiritual being is just the opposite and is defined as being entirely constituted through the negation of impenetrability with bodies or a dependence on them.[44] By saying that "the spirituality of the soul does not depend on the intellective power, but on the independence from matter,"[45] Arriaga sharply distinguishes himself from his scholastic predecessors who define spirituality

[41] Suárez (1635) p. 32: "Unde in eodem sensu negatur, animam sensitivam operari per qualitates corporeas; non quia operetur per proprias qualitates spirituales, et immateriales, sed quia per subtiliores formas aliquo modo a crassitudine materiae abstractas operatur."
[42] Arriaga (1669) p. 721: "Dicamus ergo, rem materialem in communi esse ens quantitativum. [...] Postea vero explicabimus illud quantitativum disjunctive, vel quod est per se impenetrabile cum alio individuo sibi simili, vel habet commensurationem cum tali re impenetrabili."
[43] Descartes takes the nature of body to be extension. For him, a body is essentially an extended space and any two bodies cannot penetrate each other, i.e., be co-present at the same time and in one place. Cf. CSM I, p. 224: "the nature of matter, or body considered in general, consists not in its being something which is hard or heavy or coloured, or which affects the senses in any way, but simply in its being something which is extended in length, breadth and depth."
[44] Arriaga (1669) p. 730: "[...] spiritualitas constituitur per negationem impenetrabilitatis aut dependentiae a subjecto materiali."
[45] *Ibid*., p. 767: "[...] spiritualitas animae non pendet ex virtute intellectiva, sed ex independentia a materia."

in terms of the intellect, thus safeguarding the immortality of the soul that remains independent, and thus incorruptible by the decay of bodies.[46]

What category, then, does auditory *species* belong to? Arriaga calls all *species* of the external senses "material *species* (*species materiales*),"[47] and emphasises their dependence on matter by attributing their generation to material causes.[48] Much as auditory *species* are not bound to the sounding bodies or the air immediately around them, the dependency still holds between the *species* and the material objects, since the *species* emerge from matter and corrupt in matter. Therefore, auditory *species* are purely material and are in no way superior to the sensible quality they represent.

2.2 Immediate Perception without Union

Arriaga attributes the cause of sense perception to the concurrence of *species* and the sensory power without any union. For him, *species* are "received" in sensory organs in the same way as they are received in external bodies, such as air or water.

> The material *species* of the external senses, both in man and in animals, are received in prime matter alone. This I approve openly, because those *species* are of the same reason as those which are produced by air or crystal; but these are received in matter alone, and not in the form of air or crystal, as everyone admits: therefore they are received only in matter also in the pupil itself.[49]

Arriaga uses sight here as an example to show that sensible *species* interact with our sense organs in no way differently than with lifeless objects such as air and

[46] *Ibid*., p. 749: "Probanda ergo est animae spiritualitas ex independentia quam habet a materia et quantitate, quae independentia probatur ex immortalitate ipsius [...]."
[47] Suárez also takes this position. Suárez (1635) p. 111: "Species intentionales in solo intellectu sunt spirituales, et individibiles; in allis autem potentiis cognoscitivis sunt materiales, et divisibiles."
[48] Arriaga (1669) p. 823. Again, Arriaga is similar to Suárez on this point. Suárez (1635) p. 32: "Si vero per qualitates materiales intelligamus qualitates extensas in materia, et ab illa pendentes, etiam anima sensitiva per qualitates tantum materiales operatur [...]."
[49] *Ibid*.: "Species materiales sensuum externorum tam in homine quam in brutis in sola materia prima recipiuntur. Hanc probo aperte, quia illae species sunt eiusdem rationis cum his, quae per aërem vel crystallum producuntur; sed hae in sola materia, et non in forma aëris aut crystalli recipiuntur, ut omne fatentur: ergo etiam in ipsa pupilla solum recipientur in materia."

crystals.[50] *Species* of the colour of a red apple, for example, can spread across the air and be imprinted on a mirror, and then become reflected by the mirror and get "received" by our pupil. The pupil, though being part of our organ of vision, is essentially a surface just like the mirror where *species* land.

Correspondingly, there is no union of any sort either between the *species* and the power, or the sensible quality and the power. The *species* acts solely as the effective cause that brings about perception. In fact, Arriaga no longer admits the *species* of smell, taste and touch because of the immediacy of these senses. Indeed, for these senses, the sensible quality alone can trigger perception without mediation.

> Next I add, that *species*, in order to concur with power, does not require the union of itself with it, but it is sufficient that it be contiguous to the power: for just as (as many teach, and we together with them in the following) a contiguous object concurs for the cognition of itself immediately, as in touch, smell, and taste; why a contiguous *species* received in a contiguous subject penetrated with power, will not be able to concur for the cognition of its object? Especially since the cause for operation in whatever view does not require a greater approximation than contiguity.[51]

Arriaga argues for a much less strict condition for *species* to bring about perception than Góis. For him, the contiguity of *species* and the sensory power is sufficient to generate perception. The keyword here is "concurrence" (*concurrere*) rather than union, which means that two or more causes work together to produce a certain effect, which alone does not indicate any union between the causes that contribute to the effect. The underlying reason for Arriaga's position, I suggest, is that since there is no transition between the material and the spiritual, beings from the two sides of the dichotomy must be able to interact without mediation to achieve a certain effect.

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[50] It is puzzling why Arriaga says that *species* are received in prime matter, though the word fades out in the sentences that follow.

[51] Arriaga (1669) p. 763: "Addo deinde, speciem ad concurrendum cum potentia non requirere unionem sui cum illa, sed sufficere, eam esse contiguam potentiae: sicut enim (ut docent plurimi, et nos infra cum illis) objectum contigua concurrit ad cognitionem sui immediate, ut in tactu, olfactu, et gustu; cur etiam species contigua recepta in subjecto contiguo, vel penetrato cum potentia, non poterit concurrere ad cognitionem sui object? Praesertis cum causa ad operandum in quacumque sententia non requirat majorem approximationem, quam contiguitatis."

In arguing for the superfluousness of the *species* – power union, Arriaga offers an argument from the cognition of angels:

> [...] indeed the most common and most true opinion is that an object proportionate and present, even if it is not united with the power, can concur with it for its cognition, just as in fact God concurs with the intellect of a blessed one, and one angel with another, and in touch and taste – this will be proven below. [...] if Gabriel, for example, having the spiritual *species* of some object, were to be penetrated with another angel lacking those *species*, that other angel with those *species* of Gabriel is able to bring about the cognition of the object of which they are (*species*).[52]

With the example of angelic cognition, Arriaga aims to show that there can be cognition without the union of *species* and sensory power. The spiritual *species* of some object in one angel can be cognised by another when two angels penetrate each other, but without any union taking place between the spiritual *species* of the object and the cognising angel. The reasoning is that, if no union is needed for spiritual *species*, the same applies to sensible *species*.

In short, bridging the spatial distance between the origin of sound and the ear is the only role Arriaga's auditory *species* takes on. For him, sensible *species*, just like spiritual *species*, can cause perception without being united with the cognising power.

3. Schelhammer's 'Species': Shape of the Air and Sound Rays

At the end of the 17th century, Günther Christoph Schelhammer, a member of the medical faculty of the University of Helmstedt and a scholar of the *Academia naturae curiosorum*, made a curious attempt to reconcile scholastic terms with the mechanical philosophy that was gaining ground at the time.[53] His approach stands in stark contrast with that of mechanistically-minded scholars like Galileo, Mersenne, Descartes and Emmanuel Maignan, who

[52] *Ibid*.: "[...] etenim communissima, et verissima sententia est, objectum proportionatum,et praesens, etiamsi non uniatur potentiae, posse cum illa concurrere ad cognitionem sui, ut concurrit de facto Deus cum intellectu beati, et unus angelus cum altero, et in tactu, et gustu infra probabitur. [...] Unde valde arbitror probabile, si Gabriel verbi gratia habens species spirituales alicujus objecti, penetraretur cum altero angelo carente eis speciebus, posse illum angelum alterum cum illis speciebus Gabrielis efficere cognitionem objecti cujus illae sunt."
[53] Zedler (1742) p. 1178; Gurlt *et al.* (1884) p. 214; Günther (1980) pp. 3-8.

distanced themselves from the use of the scholastic term *species* and replaced it with descriptions of the motions involved in the auditory process.[54] Maignan, for example, thinks that sensible *species* should be called "images" or "pictures" only metaphorically, since they are in fact "expressions of motions" communicated to the brain.[55] In his explanation of auditory perception, he totally avoids using the term auditory *species* for sound, which he considers to be "not some superadded quality, but the motion of vibration itself."[56]

Compared to Maignan, Schelhammer holds a much deeper respect for scholasticism, although he shares the same mechanistic viewpoint of seeing sound in terms of vibration, elasticity and wave-like motions of air.[57] His unique contribution in reconciling early modern mechanistic philosophy and scholasticism consists in pouring new wine into old skin by attributing to auditory *species* a brand-new sense, namely the purely physical form of the air.

3.1 Species as the Shape of the Air

When talking about sound, Schelhammer does not use the term *species* in any way differently from when he uses it to talk about the form of bodies. When citing Falloppio's anatomical observation, Schelhammer refers to the form of an auditory foramen as its *species*:

> Gabriele Falloppio and others who came after him noted that the foramen which the (auditory nerve) enters, and through which it is carried into the ear, is shorter and has the form (*species*) of a certain vaulted cave or portico in children, but receives completely the form of a passage and a tunnel in adults, with the bone enlarged and with the previous form (*species*) changed [...][58]

[54] Downing and Nolan (2011); Shea (1970).
[55] Maignan (1673) p. 532. I am grateful to an anonymous reviewer for suggesting to incorporate Suárez and Maignan into the narrative.
[56] *Ibid*., p. 545: "[...] sonum non esse qualitatem superadditam, sed esse ipsummet motum vibrationis [...]."
[57] LSB VIII 3, p. 90.
[58] Schelhammer (1684) p. 71: "De foramine vero quod ingreditur, ac per quod fertur in aurem, notavit Gabriel Fallopius et post eum alii, in pueris brevius esse, et cujusdam fornicati antri vel porticus speciem habere, in adultis vero, adaucto osse, mutataque priori specie, meatus ac cuniculi formam penitus recipere [...]."

Just as the *species* of the foramen is just its form, the *species* of sound, for Schelhammer, is quite literally the form of the air in motion.

Schelhammer's understanding of the form of air is deeply influenced by Leibniz, who was working on a theory that explains the generation of sound "entirely mechanically (*plane mechanice*)"[59] around the same time as Schelhammer was composing *De auditu*.[60] Both men knew of each other's work and shared their thoughts on the topic with much collegial spirit and little reservation. Schelhammer writes: "I confess that this discovery is not due to me alone but to a great extent to a most ingenious man equipped with various doctrines and erudition."[61]

In a letter addressed to "the most brilliant men in Germany and France,"[62] obviously including Schelhammer, Leibniz explains the origin of sound by describing how motion is communicated from the sounding body to the surrounding air to make sound (see fig. 1):

> But it must be explained more clearly how one portion of the air receives the tremor from a sounding body. Let the string LM be extended[,] fig. 3, and let the body AB be attached to it, hitting the air while the string is vibrating (by this body we mean the parts of the string themselves, according to the thickness which is here considered not unless in AB at the moment). Therefore, when the vibrating string from LAM proceeds into L(A)M, then the attached body proceeds from AB into (A)(B), and expels and strikes the air positioned in place B(B), and at the same time when the vibrating body occupies the place B (B) leaves place A(A), hence it happens that just as the anterior air BC is compressed by the blow, so the posterior air AF is dilated in turn to fill the empty space [...]. But the extended air, that is compressed or dilated (for I generally take the word "tension"), restores itself by its elastic force (the cause of which I will not now touch upon) and, in the same way as other extended bodies, produces a great number of vibrations of the same duration as the first one if nothing hinders it.[63]

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[59] LSB VIII 3, p. 91.

[60] It is hard to track down the precise authors who influenced Leibniz's theory of sound, as Leibniz was in touch with so many advocates of physico-mechanics. One known influence is from the French Jesuit mathematician Ignace-Gaston Pardies. Cf. Beeley (2007) p. 64.

[61] LSB VIII 3, p. 125: "Hoc autem inventum non mihi soli deberi fateor, sed magna ex parte viro ingeniosissimo ac varia doctrina atque eruditione instructissimo."

[62] LSB VIII 3, p. 94.

[63] LSB VIII 3, pp. 98-9: "Sed explicandum est distinctius quomodo una aliqua aeris portio tremorem a corpore sonoro accipiat. Sit chorda LM tensa[,] fig. 3, annexumque ei corpus AB vibrante chorda aerem feriens (quo corpore designatae intelligi possunt ipsae partes chordae, secundum crassitiem quae hic non nisi in AB nunc consideratur). Cum ergo chorda vibrans ex LAM procurrit in L(A)M, tunc corpus annexum ex AB procurrit in

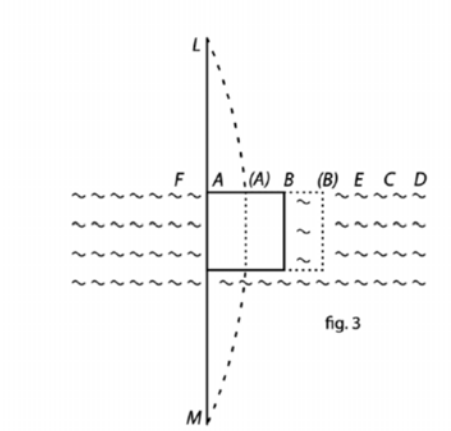

Fig. 1: Leibniz's drawing that shows how he imagines the air to be compressed and dilated. LSB VIII 3, p. 99.

There are a few things worth noting here. First, the vibrating string represents bodies capable of producing sound by trembling. Second, the body AB that looks like an attachment or extension of the string represents the string itself that has a certain thickness. The advantage of representing the thickness of the string in this way is that one can, for the time being, ignore the change in size of the elastic string that occupies a larger space when it is extended and arched, while still conveying the same idea with the rectangle staying the same size and simplifying the issue. Rectangular shapes also allow us to see the change in space more clearly. The main idea is this: when the string slashes the air, the air that used to occupy B(B) has nowhere to go but proceed towards C, so that in a very short time what used to occupy the area BC has to occupy only (B) C, thus compressing itself. The opposite happens to the air that comes after the string. The air AF now has to occupy (A)F, thus dilating itself. This is all because air is elastic.

(A)(B), aeremque in loco B(B) positum expellit et percutit, et cum eo tempore quo corpus vibrans occupat locum B(B) deserat locum A(A), hinc fit ut quemadmodum ictu comprimitur aer anterior BC, ita vicissim dilatetur aer posterior AF ad locum desertum implendum [...] Aer autem tensus, hoc est compressus vel dilatatus (generaliter enim tensionis vocem accipio), sese vi sua elastica (cujus causam nunc non attingo) restituit et more tensorum aliorum vibrationes plurimas peragit primae aequidiuturnas, si nihil impediat."

What Schelhammer creatively gets from this is a mechanical way of understanding the concept of *species* that was so elusive in the scholastic tradition. For Schelhammer, *species* is both the form of the string and of the air being pushed out of place when the former "impresses" its form on the latter:

> But since the air is a compressed fluid body, and therefore endowed with elasticity, and apt to be moved into tremor, it is evident that this can happen in no other way, than because once the *species* of sound has been impressed, one small part running into another, with the whole air trembling together, propagates the same by itself [...] For it is not unlike when we see a string moved, and by reciprocal blows run hither and thither, and the whole air also seems to be moved; hence one small part of air continuously imparts to another its impressed *species*, until at last, owing to the reaction of the small parts, all force and motion ceases, and the sound ceases to be propagated.[64]

The air, having been impressed upon, takes on (*induit*) the form or *species* of the sounding bodies.[65] Different instruments, such as the violin, the cello, and trumpet and the flute, have different figures that are impressed on the air, thus producing sounds of different timbres that "differ not in their magnitude or pitch, but in *species*."[66] Once pressed upon, the part of air gets compressed, then dilates again and pushes back on the neighbouring air because of its elastic nature, in the same way as the vibrating string runs in the opposite direction when it tries to restore itself. By doing so, it impresses the same *species* on its neighbouring air. This back-and-forth vibrating motion goes on

[64] Schelhammer (1684) pp. 124-5: "Cum vero aër sit corpus fluidum compressum, indeque elastro praeditum, ac in tremorem agi aptum, patet non alio modo id fieri, quam quia impressam semel speciem soni, una particula in aliam decurrente, totoque aëre contremente, per se ipsum idem propaget [...] Non secus enim ac videmus chordam commoveri, ac reciprocis ictibus huc illuc decurrere, aër quoque commoveri totus videtur; hinc una aeris particula alteri impressam speciem perpetuo communicat, donec ob reactionem particularum vis tandem ac motus omnis elanguescat, et sonus propagari desinat."

[65] Schelhammer (1684) p. 166: "[...] for then the air takes (*induit*) on the species of the solid, and so reacting upon the thing that was acting upon it [...]."

[66] *Ibid*., pp. 124-5: "[...] therefore, sound is very different in what they call the violin, whose body is hollow and is composed of two wooden boards [...], (sound is) very differently formed in the cello, yet differently in the trumpet, yet differently in the wooden flute, and so on for the rest. This is to be attributed not only to the size of the bodies, but also to the shape, by which the air is much affected: for these sounds differ not in magnitude, or in pitch, but in species."

until it gradually ceases because of the resistance of parts pushing one another in opposite directions.

3.2 Species as Sound Rays

In the foregoing account, auditory *species* are the impressions made on the air by sounding bodies. Schelhammer's next strategy is to identify auditory *species* with sound rays:

> Can we not say that those sonorous rays are nothing else than an impression made upon the air by the first violent collision of two bodies, and is then propagated perpetually by very small corpuscles touching one another, until the force of all resistance and reaction of those corpuscles perishes: in the same way as a thrown stone retains the impression made on it by the arm for some time?[67]

What then, are these sonorous rays? Almost directly taking from Athanasius Kircher,[68] Schelhammer considers them to be similar to the light rays which are straight lines stretching from centre of the source to the circumference:

> For as from an illuminated object, e.g. near the sun, there are straight lines, which from the circumference of the circle to the centre, diffusing light, converge into one, and are called visual rays, so also necessarily from the sonorous circles to the phonic point or point of sounds there is an in-between (space) full of sound, with a straight line running from the circumference to the centre: and that is what we call sonorous rays.[69]

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[67] *Ibid*., p. 119: "Annon radios illos sonoros possumus dicere nihil esse aliud, quam impressionem a prima duorum corporum violenta coitione in aërem factam, et deinde per minima ejusdem se contingentia corpuscula perpetuo propagatam, donec vis omnis renitentia et reactione corpusculorum illorum pereat: pari modo ut lapis projectus impressionem a brachio sibi factam aliquandiu retinet?" The title under which the above passage is written is: "The sonorous ray is not sound itself, but only its *species*." It is not clear what this title means, for if sound rays are not sound, but are *species* of sound, it follows that *species* of sound are not sound. Yet in Schelhammer's account, sound as it exists in the external world is just the air being compressed and dilated as different parts of the air impress *species* upon each other. It could be that by "sound," Schelhammer means something more than the *species*, namely the air together with the *species* or forms that they take on.

[68] Van der Miesen (2020) pp. 3-5; Asmussen (2016).

[69] Schelhammer (1684) p. 115: "Ut enim ab objecto illuminato verbi gratia ad solem, dantur lineae directae, quæ a circumferentia circuli ad centrum, lucem diffundentes, in unum concurrunt, et radii visivi appellantur, sic etiam necessario a circulis sonoris ad punctum phonicum seu sonorum datur intermedium sono plenum, recta linea ad centrum a circumferentia decurrente: atque illud ipsum est, quod radios sonoros appellamus."

The circle of sound is the circular area where sound spreads, as according to our daily experience that we can hear sound from all sides. By invoking the sound-light analogy, Schelhammer is determined to create a linear sound path by modelling sound rays after straight light rays. These sound rays, just like those in Kircher's *Phonurgia nova*,[70] obey the rule of reflection and map neatly onto different acoustic experiences, such as the passing of rays at a certain location maps onto the perception of sound at this particular place, and the intersection of rays at a certain point or the concentration of rays inside a certain space maps onto the perception of increased amplitude (see fig. 2).

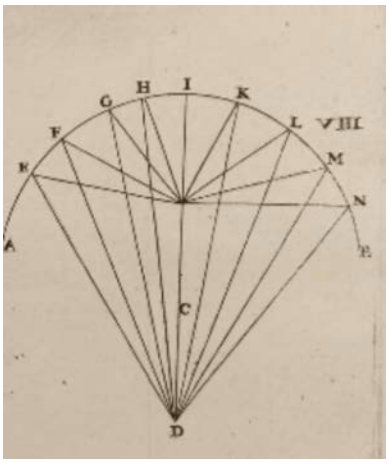

Fig. 2: Sound rays gather at point D, where sound is amplified. Schelhammer (1684) Tab. II.

Since these straight sound rays follow "infallible laws of mathematics,"[71] they inspire Schelhammer to investigate the interaction of sound with the inner

[70] Kircher (1673) *Preface*, pp. 4-5.

[71] Schelhammer (1684) *Preface*: "You see that I have divided it into three parts, the first of which instructs you about the organ, the second about the object, sound, and the last of these, as if it draws conclusions from two premises [...]. In the conclusions, however, I have followed only the correct reason, and have been mindful of nature in describing the organ, of experience and the infallible laws of mathematics in describing the object, so that the whole work may be seen as demonstrative, since indeed it teaches by what means nature

structure of the ear by imagining and illustrating how the sound rays inside it are reflected and concentrated at the exact right places to be amplified and transmitted to the next structure until they reach the auditory nerves. For example, Schelhammer considers the shape of the auditory canal to be most suitable for promoting hearing by offering images that demonstrate the influence of the shape of the auditory canal on the direction of sound rays.

> Let the external ear be A. The auditory canal B. Its internal mouth C. The auditory cavity DEF. It is obvious that if the auditory canal were directly opposed to the surface D, the sonorous rays would return to him, and no doubt they would be confused with each other so that nothing at all would be perceived, as is clear from the figure. Now, not only does the canal itself run obliquely, but it is also inserted obliquely, so that this cannot be more so, as is clear from the other figure, that the rays E are not reflected in themselves but into the subject cavity.[72]

By juxtaposing two figures (see fig. 3) in which the auditory canal is shaped differently, Schelhammer makes a sharp contrast between the sound-propagating effect of a straight canal and that of an oblique canal. The figure on the left shows an imaginary scenario in which the auditory canal has a straight shape. The straight lines that are parallel to one another represent the sound rays that go from the external ear A into the tympanic cavity DEF, but are then reflected back along the same route. By contrast, the figure on the right shows the real scenario in which the auditory canal runs obliquely so that the rays go through a series of reflections both inside the canal and the cavity and do not get reflected back. The visual rhetoric used here is that the sound rays are arranged intentionally parallel to one another, and the cavity DEF is shaped regularly to ensure that the rays stay on the same paths after being reflected upon it.

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itself uses to project, stop it, amplify or suppress it, and applies everything faithfully to the little cavities of the ear."

[72] *Ibid*., p. 199: "Sit externa auris A. Meatus auditorius B. ejus internum os C. cavitas auditoria D. E. F. Manifestum est, si meatus auditorius directe opponeretur superfici D; radios sonoros in illum esse regressuros, et haud dubie inter se ita confusum iri, ut nihil prorsus perciperetur. Uti ex figura patet. Nunc autem non modo oblique decurrit ipse meatus, sed etiam oblique inseritur, ut id fieri amplius nequeat, uti ex alter figura manifestum sit, ubi radii E. non in se reflectuntur sed in subjectam cavitatem."

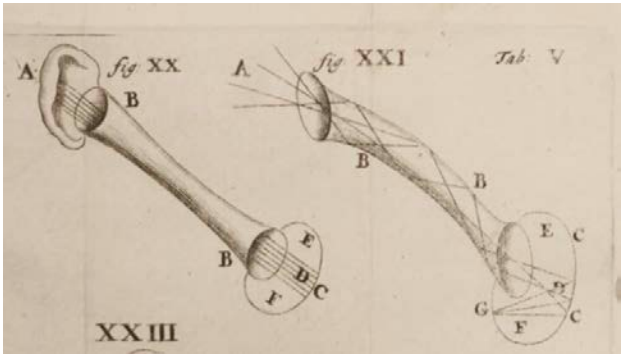

Fig. 3: Schelhammer shows that the auditory canal is designed to prevent sound rays from reflecting back to where they come from. Schelhammer (1684) Tab. V.

To summarise, auditory *species* is transformed by Schelhammer into something completely different from its usual meanings and functions in scholastic commentaries. This shows impressively how a scholastic concept can be creatively updated by later developments in mechanics and can still play important roles in a philosophical framework quite alien to that in which it originated.

Conclusion

In this paper, I have demonstrated the remarkable fluidity of the concept of auditory *species* and its ability to fit different philosophical frameworks with three examples from 16th and 17th-century authors[73] who entertained different ideas about the division between the material and the spiritual, the generation and propagation of sound, and how auditory perception takes place. In the *Coimbra Commentaries*, Góis describes a world in which there are different grades of materiality, and auditory *species* serves as the intermediary between the material and the spiritual, uniting the faculty of hearing with sound by acting as the formal cause of auditory perception. Arriaga, on the other hand, is in favour of a clear-cut dichotomy of the material and the spiritual, and considers auditory *species* to be purely material beings that only

[73] For more discussions on the transformation of Aristotelian terminologies in the early modern period, see Omodeo (2025).

serve as the efficient cause of hearing upon immediate contact with the sensory power. Schelhammer fully mechanises the generation and propagation of sound and defines auditory species as the shape of the air during condensation and rarefaction. He goes further to assign a linear path to sound rays to explain the inner workings of the ear in a visually comprehensible way.

The greater inference to be drawn is that scholastic vocabulary and early modern mechanics often evolved hand-in-hand. Terms like auditory *species* were never fixed to Aristotelian scholasticism in their use, but took on different meanings and functions as they became absorbed into the fabric of mechanistic explanation. While the particular focus of this paper on just three authors who had distinct understandings of auditory *species* might make the shift of the term seem rather discontinuous, further research that sheds light on the historical context that underlies the shift will certainly enrich our understanding of the intricate processes of the transformation of early modern Aristotelian terminology.

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Abbreviations

CAJC = *Curso Aristotélico Jesuíta Conimbricense. Tomo IV: De Anima*. (2022) Eds. M.C. Camps, M.S. de Carvalho and T.S. de Pinho. Coimbra: Coimbra University Press.

CSM = Cottingham, J., Stoothoff, R., and Murdoch, D. (trans.) (1984). *The Philosophical Writings of Descartes*. Vol. 1. Cambridge: Cambridge University Press.

LSB VIII = Knobloch, E. (ed.) (2021) *Leibniz Sämtliche Schriften und Briefe*. Reihe VIII, Bd 3. Berlin: De Gruyter Akademie Forschung.

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