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Spontaneous Generation and the Ontology of Forms in Greek, Arabic, and Medieval Latin Sources*

Dag Nikolaus Hasse

When a living being is generated spontaneously, it arises from matter without there being any parents. An example often cited in ancient and medieval texts is the generation of worms from rotting matter. The explanation of phenomena of spontaneous generation is a challenge to natural science. But it also poses more general philosophical problems, which have attracted the attention of many Greek, Arabic, and Latin authors. Two questions are dominant: if an individual is a compound of matter and form, where does the form or the formal nature of the individual come from when there are no parents? And: are there any reasons to assume that not only animals, but also human beings, can be generated spontaneously?

'Spontaneous generation' is a modern term.¹ The usual medieval expression is *generatio per putrefactionem* ('generation through a process of decay'); occasionally, medieval authors also use the term *generatio equivocca*, since the producer and the product are not synonymous in the sense that they do not belong to the same species. Both terms ultimately derive from Aristotle. The present-day discussion of spontaneous generation differs considerably from its ancient and medieval predecessor. Louis Pasteur in a well-known experiment in 1860 demonstrated that the life originating from decay is caused by airborne micro-organisms. From that point onwards, the discussion took a new direction: it turned from the generation of complex organisms to the generation of subcellular living entities, and it turned from the present to the past, i.e. to the first origin of living beings in evolution.² The question is not yet entirely settled. As long as it remains an open question whether there is a principled difference between living and non-living nature, the reality of spontaneous generation remains an issue.

An important difference between the present and the medieval discussion is that in the Middle Ages the dispute was not about the generation of life, but about the generation of form. The reason for this is that the medieval discussion was much influenced by a passage in Aristotle's *Metaphysics*, chapter Z 9, where Aristotle discusses spontaneous generation within the larger context of his ontology of matter and form, as will become apparent below.

Research on Greek, Arabic, and Latin theories of spontaneous generation has pro-

* I am grateful for criticism and advice from Markus Heuft, Friedemann Buddensiek, and Peter Adamson.

1. See M. van der Lugt, *Le Ver, le démon et la vierge: les théories médiévales de la génération extraordinaire*, Paris, 2004, p. 134.

2. J. Farley, *The Spontaneous Generation Controversy from Descartes to Oparin*, Baltimore and London, 1974, p. 7.

fited much from the work of Nardi, Lennox, Genequand, Kruk, Zambelli, Freudenthal, Henry,³ and especially of van der Lugt, who in 2004 published a very useful survey of medieval Latin theories of spontaneous generation.⁴ The present paper, which continues this line of research, has two principal aims: first, to connect the discussions in the Greek, Arabic, and Latin worlds and describe them as a continuous tradition, and second to investigate the ontological context of the various theories of spontaneous generation. The basic assumption is that the gist of the discussion is best understood if we direct our attention to the conflicting ontological positions that form its background.

GREEK

Aristotle's reference to spontaneous generation in *Metaphysics* Z 7–9 and A 3 forms part of an analysis of the processes of generation and of the role played by form in these processes.⁵ Aristotle distinguishes between natural generation, as in human reproduction, and artificial generation, as when a house is built after the model designed in the mind of the architect. In both cases, the product is produced from an individual which is synonymous – that is, which shares its name.⁶ When 'man begets man' – to cite the famous Aristotelian dictum – the new individual is produced from another individual of the same species. When a house is built, it is produced from another house in the sense that the form of the house in the mind of the architect produces the new house (Z 9, 1034^a21–6).⁷

But does the principle of synonymy also hold for products of spontaneous generation? Aristotle's answer is affirmative. He introduces the problem of spontaneous generation by referring to the example of health (at the beginning of Z 9). Health

3. B. Nardi, 'Pietro Pomponazzi e la teoria di Avicenna intorno alla generazione spontanea nell'uomo', in id., *Studi su Pietro Pomponazzi*, Florence, 1965, pp. 305–19; J. G. Lennox, 'Teleology, Chance, and Aristotle's Theory of Spontaneous Generation', in id., *Aristotle's Philosophy of Biology*, Cambridge, 2001, pp. 229–49 (the article was first published in 1982); C. Genequand, *Ibn Rushd's Metaphysics: A Translation with Introduction of Ibn Rushd's Commentary on Aristotle's 'Metaphysics', Book Lām*, Leiden, 1986, pp. 24–32; R. Kruk, 'A Frothy Bubble: Spontaneous Generation in the Medieval Islamic Tradition', *Journal of Semitic Studies*, 35, 1990, pp. 265–82; P. Zambelli, *Una reincarnazione di Pico ai tempi di Pomponazzi: con l'edizione critica di Tiberio Russiliano Sesto Calabrese Apologeticus adversus cucullatos (1519)*, Milan, 1994, pp. 79–88; G. Freudenthal, 'The Medieval Astrologization of Aristotle's Biology: Averroes on the Role of the Celestial Bodies in the Generation of Animate Beings', *Arabic Sciences and Philosophy*, 12, 2002, pp. 111–37; D. Henry, 'Themistius and Spontaneous Generation in Aristotle's *Metaphysics*', *Oxford Studies in Ancient Philosophy*, 24, 2003, pp. 183–207.

4. Van der Lugt, *Le Ver* (n. 1 above), pp. 131–87.

5. On Aristotle's theory of spontaneous generation see the articles by Lennox, Kruk (pp. 268–70), and Henry (pp. 193–8) referred to in n. 3 above. See also G. E. R. Lloyd, 'Spontaneous Generation and Metamorphosis', in id., *Aristotelian Explorations*, Cambridge, 1996, pp. 104–25.

6. The Greek term for 'synonymous' in this context is *ὁμώνυμον* (1034^a22) or *συνώνυμον* (1070^a5). The technical difference between the terms which Aristotle introduces in the *Categories* is not implied here; see M. Frede and G. Patzig, *Aristoteles: 'Metaphysik' Z. Text, Übersetzung und Kommentar*, 2 vols, Munich, 1988, II, p. 158.

7. Compare the different translations and interpretations of this passage by W. D. Ross, in *The Complete Works of Aristotle*, ed. J. Barnes, Princeton, 1984, p. 1633, and by Frede–Patzig, *Aristoteles: 'Metaphysik' Z* (n. 6 above), I, p. 89; II, pp. 155–7.

is normally a product of artificial generation, when it is the result of medical treatment, but, occasionally, it is a product of spontaneous generation, when it comes about without external interference. Even in the latter case, a healthy body is generated from something which shares its name: it is generated from a pre-existing part of itself, i.e. its matter, which has the capacity to be set in motion by itself (1034^a9–14).

This is the background to Aristotle's explanation of the spontaneous generation of living beings. The passage is as follows (Z 9, 1034^b4–7):

The [natural] things which are produced spontaneously [*ἀπὸ ταῦτομάτου*] are produced in the same way as [some artificial things referred to] above; they are those things whose matter can bring about by itself that kind of motion which the seed brings about; but those things whose matter cannot [bring about that kind of motion] cannot be produced otherwise than from [the parent animals] themselves.⁸

The case of the spontaneous generation of animals is parallel to that of artificial products: here, too, the principle of synonymy is saved. The animal which is generated without parents is produced from something which shares its name, namely from its matter, which is a pre-existing part of itself. This part has the capacity to generate that kind of motion which in normal cases of reproduction is introduced from outside through the seed.

In his biological works Aristotle gives several examples of animals that are created spontaneously. The theoretical explanation in these works differs from that in the *Metaphysics* in that its emphasis is on the natural process and the natural factors involved; it is not formulated in the theoretical terms of form, matter, and motion. The most comprehensive passage is in *De generatione animalium*, III.11 (762^a8–763^b16). Here Aristotle explains that spontaneous generation comes about when a corporeal liquid is enclosed and heated, because all liquids contain pneuma, which contains the vital heat.⁹ The same process is also possible with earthy matter, because all earthy matter contains water and water contains pneuma. Despite the obvious differences in emphasis, the metaphysical and biological explanations of spontaneous generation seem compatible, because it is the vital heat in the enclosed matter which is the principle that imparts movement (762^b14–16), so that the details of the biological explanation conform to the metaphysical idea that the new animal arises from a material part which has the capacity to be set in motion by itself.¹⁰

Aristotle's theory of spontaneous generation is placed within the larger context of

8. Aristotle, *Metaphysics*, ed. W. D. Ross, 2 vols, Oxford, 1924, vol. II (my translation). For the translation of this passage compare Ross's commentary, II, p. 193, his translation in *The Complete Works of Aristotle* (n. 7 above), p. 1633, Frede-Patzig, *Aristoteles: 'Metaphysik'* Z (n. 6 above), I, p. 89, II, p. 162, and Henry, 'Themistius and Spontaneous Generation' (n. 3 above), p. 197.

9. On pneuma see *De generatione animalium*, II.3, 736^b33–737^a1, transl. A. L. Peck, Cambridge, Mass., 1942: 'In all cases the semen contains within itself that which causes it to be fertile—what is known as "hot" substance [*θερμόν*, i.e. vital heat], which is not fire nor any similar substance, but the pneuma which is enclosed within the semen or foam-like stuff, and the natural substance which is in the pneuma; and this substance is analogous to the element which belongs to the stars.'

10. For a detailed argument for the compatibility of Aristotle's metaphysical and biological explanations see Henry, 'Themistius and Spontaneous Generation' (n. 3 above), pp. 198–201.

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his ontology of matter, form, and cause. When things are generated, explains Aristotle in Z 7, three factors are involved: they are produced from something, i.e. matter; they are produced by something, namely the moving cause; and they come to be something, which is the form (1032^a16–20, cf. 1069^b36). It is the principal conclusion of chapters Z 7–9 that the form is not generated, even though it is the result of the process: 'It is obvious then from what has been said that the thing, in the sense of form or substance, is not produced, but the concrete thing which gets its name from this is produced' (Z 8, 1033^b17–18).¹¹ The form is present as soon as the particular thing, of which it is the form, has been generated, but it is not generated itself.

This allows Aristotle to reject separately existing Platonic forms as useless for the generation of substances:

Is there then a sphere apart from the individual spheres or a house apart from the bricks? Rather we may say that no 'this' [i.e. no individual substance] would ever have been coming to be, if this had been so. [...] Obviously then the cause which consists of the forms (taken in the sense in which some are accustomed to speak about the forms, if they are something apart from the individuals at all) is useless with regard both to comings-to-be and to substances. (Z 8, 1033^b19–21, 26–8)¹²

They are useless because 'man begets man'.¹³ Both parent and child have a form that belongs to the same species, but the form exists in different individual beings.

On the one hand, it is not a difficult task to integrate spontaneous generation into Aristotle's ontology, because there is no need to explain the spontaneous generation of a form, since forms are never generated. The only task is to explain how a concrete thing, a compound of matter and form, is generated. On the other hand, Aristotle admits in his biological works that in sexual reproduction there is a transmission of the information about the parental form via the semen.¹⁴ This is impossible in spontaneous generation. The difficulty of Aristotle's theory is to explain how it comes about that a specific animal is generated. In the *Metaphysics*, this is due to the specific character of the portion of matter that is able to imitate the role usually taken by the semen. In *De generatione animalium*, Aristotle is more explicit about the problem:

The object which thus takes shape may be more valuable in kind or less valuable; and the differences herein depend on the embracing of the soul principle; and the causes which determine this are the situations where the process takes place and the physical substance which is embraced.¹⁵

11. Transl. Ross, in *The Complete Works of Aristotle* (n. 7 above), p. 1632.

12. Cf. the translations by Ross in *The Complete Works of Aristotle* (n. 7 above), p. 1632, and Frede-Patzig, *Aristoteles: 'Metaphysik' Z* (n. 6 above), I, p. 87.

13. Cf. Aristotle, *Metaphysics*, A 3, 1070^a26–30, transl. Ross, in *The Complete Works of Aristotle* (n. 7 above): 'Evidently then there is no necessity, on this ground at least, for the existence of the ideas. For man is begotten by man, each individual by an individual; and similarly in the arts; for the medical art is the formula of health.'

14. Aristotle, *De generatione animalium*, II.1, 734^b7–735^a4; II.3, 737^a18–23.

15. Aristotle, *ibid.*, III.11, 762^a24–7. The translation is by Peck (n. 9 above); I have changed 'upon the envelope which encloses' into 'on the embracing' for *περίληψις*.

What kind of animal is produced depends upon the enclosing medium in which the generation takes place, and upon the liquid matter which is enclosed.¹⁶ These factors suffice to determine the species of the resulting compound of form and matter.

The metaphysical controversy about spontaneous generation in Arabic and Latin was sparked by a passage in the paraphrase of book *A* of the *Metaphysics* by the Greek commentator Themistius (d. AD 388). The Greek version of this work has not survived. What exists are Arabic quotations in Averroes' Long Commentary on the *Metaphysics*, and a complete Hebrew version, which was translated from the Arabic in AD 1255.¹⁷ Themistius does not agree with Aristotle. In his view, spontaneous generation is a challenge to the Aristotelian rejection of forms which exist separately from the individuals. Themistius argues that in spontaneous generation 'nature does not generate these things from their likes in form'. Hence, one is forced to assume that there exist forms in nature (he calls them 'proportions', *nisab*, or 'forms', *ṣuwar*) that are 'prepared and ready to produce any possible species of animal'. These forms have at some point been put into the natures of each substance by a higher and nobler cause, 'which is the soul that is in the earth'. Themistius then adds a reference to Plato and Aristotle: 'Of this [soul] Plato thought that it had been produced by the secondary gods and Aristotle by the sun and the ecliptic.'¹⁸ The reference to Plato could be to the world-soul in the *Timaeus*¹⁹ or to the souls in the earth mentioned in the *Politicus* which are responsible for the generation of the earth-born race at the time of Kronos.²⁰ Themistius' principal aim is to defend the separate existence of forms, in the sense that they exist separately from individuals in nature, and, in the second place, to argue for the divine origin of these forms. He extends his model of generation to all forms of generation, natural as well as spontaneous. The form of the offspring is not causally linked to the form of the parent, in contrast to Aristotle's theory.

16. Lennox, 'Teleology' (n. 3 above), pp. 232–3; Kruk, 'A Frothy Bubble' (n. 3 above), pp. 268–70.

17. Themistius' critique of Aristotle's theory of spontaneous generation has received a good amount of attention in recent years: see Genequand, *Ibn Rushd's Metaphysics* (n. 3 above); A. Martin, *Averroès: Grand commentaire de la Métaphysique d'Aristote (Tafsir mā b'ad al-ṭabī'a): livre Lam-Lambda*, Paris, 1984, ad comm. 18; Themistius, *Paraphrase de la métaphysique d'Aristote (livre lambda)*, ed. R. Brague, Paris, 1999; and Henry, 'Themistius and Spontaneous Generation' (n. 3 above).

18. The English translation of the Arabic quotations is from Genequand, *Ibn Rushd's Metaphysics* (n. 3 above), pp. 105–7 (I have changed Genequand's 'the world-soul' into the more literal 'the soul that is in the earth'). Cf. the Arabic text in Averroes, *Tafsir mā ba'd al-ṭabī'a*, ed. M. Bouyges, 3 vols, Beirut, 1938–48, pp. 1492–4, the French translation from the Arabic in Martin (n. 17 above), pp. 128–30, and the French translation from the Hebrew in Brague (n. 17 above), pp. 63–4, with notes pp. 135–6. The reference to Aristotle is probably to *Metaphysics A* 5, 1071^a14–16, and *De generatione et corruptione* II.10, 336^a32.

19. As proposed by Genequand, *Ibn Rushd's Metaphysics*, p. 106 n.: Plato, *Timaeus*, 41a ff.

20. As proposed by Henry, 'Themistius and Spontaneous Generation' (n. 3 above), p. 189 n.: Plato, *Politicus*, 272 e, transl. C. J. Rowe, in *Plato: Complete Works*, ed. J. M. Cooper, Indianapolis and Cambridge, 1997, p. 314: 'when [...] all the earth-born race had been used up, each soul having rendered its sum of births, falling to the earth as seed as many times as had been laid down for each'.

ARABIC

In the Arabic world, the phenomenon of spontaneous generation was mentioned in many works of medicine, natural history, alchemy, magic, and philosophy. The influence of ancient Greek traditions is very tangible.²¹ Within the context of philosophy, a major contribution was made by Avicenna (d. AD 1037/AH 428).²² He greatly influenced the discussion of the second of the two dominant questions introduced above: is it animals only that can be generated spontaneously, or is this also true of human beings? As to the phenomenon of spontaneous generation in general, Avicenna simply acknowledges its existence: 'Now some plants are grown from seed and set aside a part of the body bearing the reproductive faculty, while others grow from spontaneous generation [*min tilqā'i nafsihī*: "on one's own accord"] without seeds.'²³ The only theoretical explanation of spontaneous generation in Avicenna's work I am aware of appears in the context of the meteorological discussion of the extinction of species, where Avicenna develops the controversial thesis that human beings can be generated from earth.

In the meteorological part of his philosophical summa *al-Shifā'* [*The Healing*], a small section (chapter II.6, the last of the meteorological treatise) is concerned with 'Great events which happen in this world';²⁴ this section was translated into Latin as a piece on its own around AD 1200, perhaps by Alfred of Sareshel. It became known under the title *De diluviis* [*On Floods*].²⁵ Here Avicenna argues that it is not impossible that animals and plants may be destroyed through catastrophic events and afterwards generated again without reproduction, since there are many animals that are generated both with and without reproduction, and likewise plants. When searching for an explanation for such catastrophes, Avicenna ponders the possibility (he calls it a surmise) that they are dependent upon a conjunction of stars, without explicitly embracing the explanation. For the recurrence of animals and plants after their complete extinction, Avicenna adopts what he calls a Peripatetic explanation:²⁶ their spontaneous generation is due to a specific mixture or complexion (*mizāj*) of elements.²⁷ 'If the first mixture is not suf-

21. See the very helpful survey by Kruk, 'A Frothy Bubble' (n. 3 above).

22. Cf. the short reference to spontaneous generation in al-Fārābī, *The Philosophy of Aristotle*, transl. M. Mahdi, *Alfarabi's Philosophy of Plato and Aristotle*, New York, 1962, p. 128: 'In the case of animals there are some that are not generated from animals, and some plants are not generated from plants.'

23. Avicenna, *al-Najāt*, Cairo, 1938, p. 157; English translation by F. Rahman, *Avicenna's Psychology: An English Translation of 'kitāb al-najāt', Book II, Chapter VI*, London, 1952, p. 24.

24. Avicenna, *al-Shifā'*, *al-Ṭabī'īyyāt*, *al-Ma'ādīn wa-l-āthār al-'ulwiyya*, ed. I. Madkour, Cairo, 1965, pp. 75–9. Cf. also the discussion of the possibility that the entire human race might be extinguished in Avicenna, *al-Shifā'*, *al-Ṭabī'īyyāt*, *al-Ḥayawān*, ed. I. Madkour, Cairo, 1970, p. 386; Latin: *De animalibus*, XV.1, in *Avicenne perhyapatetici philosophi [...] opera*, Venice, 1508, repr. Frankfurt a.M., 1961, fol. 59^{va}.

25. See the list of Avicenna translations in M.-T. d'Alverny, 'Notes sur les traductions médiévales d'Avicenne', article IV in id., *Avicenne en occident: recueil d'articles de Marie-Thérèse d'Alverny réunis en hommage à l'auteur*, Paris, 1993, pp. 337–58 (355). The Latin version was published by Alonso Alonso: *Avicenna, De diluviis*, ed. M. Alonso Alonso, 'Homenaje a Avicenna en su milenario: las traducciones de Juan González de Burgos y Salomon', *Al-Andalus*, 14, 1949, pp. 291–319 (306–8).

26. Avicenna, *al-Ma'ādīn* (n. 24 above), p. 78: 'This [i.e. the claim that such generation is possible only with the participation of uterus and sperm] is not the route taken by the people of the truth among the Peripatetics.'

27. For Avicenna's definition of complexion see *Liber canonis*, Venice, 1507, repr. Hildesheim, 1964,

ficient, then the generation happens as a result of a second or third mixture.²⁸ For this kind of generation, there is no need of a uterus or sperm. In virtue of the mixture, the matter acquires a certain disposition (*isti' dād*) to receive a form from the giver of forms (*wāhib al-ṣuwar*).²⁹ Hence it is not improbable that the generation of any composition is possible which is postulated by the elements, in a way different from reproduction.³⁰

The ontological concept of a giver of forms is an essential feature of Avicenna's explanation of spontaneous generation; we shall return to it below. Apart from the giver of forms, it is the theory of first and second complexion which forms the core of Avicenna's position. Spontaneous generation is not dependent upon the enclosure of a liquid matter containing vital heat, as in Aristotle, or upon proportions and forms once implanted in matter by a divine cause, as in Themistius, but upon a series of continually refined mixtures of the elemental qualities, which result in higher kinds of complexion. This theory of a hierarchical series of mixtures appears also in Avicenna's *Qānūn fi ṭibb* [*Canon of medicine*].³¹

The ontology of forms behind this theory is different from Aristotle's and, as we shall see, from Averroes'. A first difference concerns the concept of matter and especially of prime matter, which for Aristotle is pure potentiality. Avicenna argues that prime matter is informed by a common material form (*forma corporeitatis*), which turns matter into a body in actuality; it is this corporeal substance which is able to receive individual forms.³² The four elements are composed of matter and form. These elementary forms are fixed and unchangeable, even when the elements are mixed. What is changeable is only the qualities that follow upon the forms of the elements – which is a theory criticized by Averroes.³³ A further difference concerns the fact that according to Avicenna the forms are not extracted from matter, but introduced into matter by a separate entity: the giver of forms (*wāhib al-ṣuwar*). The doctrine of the giver of forms appears in

lib. 1, fen 1, doct. 3, cap. 1, first sentence, fol. 2^v: 'Complexio est qualitas, quae ex actione ad invicem et passione contrariarum qualitatum in elementis inventarum provenit, quorum partes ad tantam parvitatem redactae sunt, ut cuiusque earum plurimum contingat plurimum alterius.' Corrected after the 1471 edition, which is cited by D. Jacquart, 'De *crasis* à *complexio*: note sur le vocabulaire du tempérament en latin médiéval', article VI in id., *La Science médicale occidentale entre deux renaissances (XII^e s.–XV^e s.)*, Aldershot, 1997, p. 73. See also N. Siraisi, *Avicenna in Renaissance Italy: The Canon and Medical Teaching in Italian Universities after 1500*, Princeton, 1987, pp. 26–7.

28. Avicenna, *al-Ma'ādīn* (n. 24 above), p. 77.

29. Avicenna, *ibid.*, p. 78. Cf. the Latin: Avicenna, *De diluviis* (n. 25 above), p. 307: 'si igitur est possibile ut elementa congregentur secundum aliquam proportionem et faciant [?] aliquam complexionem et componentur secundo in aliam proportionem et non obviavit contrario corrumpenti, tunc dator formarum dabit formas ex principiis eternis.'

30. Avicenna, *al-Ma'ādīn* (n. 24 above), p. 78.

31. See M. Stolberg, 'Die Lehre vom *calor innatus* im lateinischen Canon medicinae des Avicenna', *Sudhoffs Archiv*, 77, 1993, pp. 33–53 (48).

32. See the references to *ṣūra jismiyya* (form of corporeality) in A.-M. Goichon, *Lexique de la langue philosophique d'Ibn Sīnā*, Paris, 1938, no. 372 (7), pp. 187–8, and the passage in Avicenna, *The Metaphysics of 'The Healing'*, ed. and transl. M. Marmura, Provo, 2005, ch. II.2, last paragraph, pp. 56–7. See also A. Hyman, 'Aristotle's "First Matter" and Avicenna's and Averroes' "Corporeal Form"', in *Harry Austryn Wolfson Jubilee Volume*, 3 vols, Jerusalem, 1965, I, pp. 385–406, esp. pp. 400–406.

33. See A. Maier, *An der Grenze von Scholastik und Naturwissenschaft*, Rome, 1952, pp. 22–8.

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several works of Avicenna.³⁴ A passage which nicely brings together Avicenna's theory of elementary forms, the sequence of mixtures, and the giver of forms is in the *De generatione et corruptione* section of *al-Shifā'*:

To each of these elements happens, in receiving, augmentation and reduction in its quality, because its natural or accidental quality can be augmented or reduced, while its form and species is retained. But this augmentation and reduction has [two] well-defined limits; when they are exceeded, the entire disposition of the matter towards its form is extinguished, and it becomes completely disposed towards a different form. It is characteristic of matter that when it is completely disposed towards a form, this form flows upon the matter from the giver of forms for matter, and that it receives this form.³⁵

Aristotle had argued that forms are not generated, but exist as soon as a concrete individual is generated. In contrast, Avicenna holds a theory of the generation of forms by a separate entity. In the *Metaphysics* part of *al-Shifā'* he identifies the giver of forms with the lowest of the celestial intelligences (and thus, indirectly, with the active intellect).³⁶ The giver of forms does not deliver the forms at will. Rather, they are delivered automatically the moment the elemental mixture has reached a certain level of balance, which approaches the mean and thus acquires a resemblance to the celestial bodies.³⁷ Avicenna thinks it likely that the preparation to receive a particular form is itself due to an emanation, not from the giver of forms, but from the celestial bodies.³⁸ Avicenna thus acknowledges that the stars have a certain influence on the process of generation,

34. On this concept see D. N. Hasse, *Avicenna's 'De anima' in the Latin West: The Formation of a Peripatetic Philosophy of the Soul 1160–1300*, London and Turin, 2000, pp. 187–9, and J. Janssens, 'The Notions of Wāhib al-ṣuwar (Giver of Forms) and Wāhib al-'aql (Bestower of Intelligence) in Ibn Sīnā', in *Intellect et imagination dans la philosophie médiévale*, eds M. C. Pacheco and J. F. Meirinhos, 3 vols, Turnhout, 2006, I, pp. 551–62.

35. Avicenna, *al-Shifā'*, *al-Ṭabī'īyyāt*, *al-Kawn wa-l-fasād*, ed. M. Qassem, Cairo, 1969, ch. 14, p. 190; Avicenna, *Liber tertius naturalium de generatione et corruptione*, ed. S. van Riet, Louvain-la-Neuve and Leiden, 1987, ch. 14, p. 139.

36. Avicenna, *Metaphysics* (n. 32 above), ch. IX.5, p. 335: 'It follows necessarily, then, that the separate intellects – rather, the last of them, which is close to us, is the one from which there emanates, in participation with the celestial movements, something having the configuration of the forms of the lower world.' For further passages, see the references in Janssens, 'The Notions' (n. 34 above), and Hasse, *Avicenna's 'De anima'* (n. 34 above).

37. Cf. Avicenna, *al-Najāt*, transl. Rahman (n. 23 above), p. 67: 'The more these [elemental] bodies are able to break the absoluteness of contradiction and bring it nearer to the mean, which has no opposite, the nearer they approach a resemblance with the celestial bodies and to that extent they deserve to receive an animating faculty from the controlling separate principle.'

38. Avicenna, *Metaphysics* (n. 32 above), p. 337: 'It seems that the state of affairs [follows] another law and that this matter that comes into being [through] a common [celestial cause is something] on which there emanates from the celestial bodies [...] that which prepares it for [the reception] of a form of a simple body. When it becomes prepared, it attains the form from the giver of forms.' I have changed Marmura's 'a simple body' into the more literal 'a form of a simple body'. On the celestial bodies preparing matter to receive the forms see also Avicenna, *al-Ishārāt wa-l-tanbihāt*, ed. S. Dunyā, 4 vols, Cairo, 1960–68, III, pp. 233–5; in French translation: *Avicenne: Livre des directives et remarques*, traduction avec introduction et notes par A.-M. Goichon, Beirut and Paris, 1951, pp. 432–3.

but he remains very critical of astrology in general, because he is convinced that celestial influences cannot be detected by us.³⁹

In view of this theory of the generation of forms, Avicenna has good reason to argue that spontaneous generation of all living beings is possible, because there are only gradual differences between the generation of the most basic forms implanted in matter and the form of a human being.

Aristotle had discussed the possibility that human beings and quadrupeds once upon a time were 'earth-born': if such a generation were possible, we would expect it to be either from an egg or, more reasonably, from a larva, says Aristotle in *De generatione animalium*.⁴⁰ The hypothetical language of this passage clearly indicates that Aristotle did not share the transmitted belief, which appears also in Plato's *Politicus* and *Timaeus*,⁴¹ that there were moments in history when the human race had been extinguished and generated again from earth. In the *Meteorology* Aristotle clearly dismisses the theory that immense famines and floods point to the fact that the world as a whole is generated: these cataclysms, he says, are local phenomena.⁴² There is no extinction of genera or species in the perennial universe of Aristotle. For Avicenna, the historical reports about floods point to the possibility that catastrophic events may lead to the extinction and subsequent spontaneous generation of animals and plants.

It is in the works of Averroes (d. AD 1198/AH 595) that the various threads of the discussion of spontaneous generation we have surveyed are connected and presented in the form of conflicting positions. The anti-Aristotelian argument of Themistius is cited several times in Averroes' *œuvre*: once in the Epitome of the *Metaphysics*,⁴³ three times in the Long Commentary on the *Metaphysics* (Z 9, comm. 31, and A 3, comm. 13 and 18),⁴⁴ and once, without open reference to Themistius, in the *Tahāfut al-tahāfut* [*The Incoherence of the Incoherence*], ninth discussion.⁴⁵ Related passages on spontaneous generation, which castigate Avicenna, are in the Long Commentary on the *Metaphysics*,

39. See M. A. F. Mehrens's summary of Avicenna's treatise refuting the astrologers: 'Vues d'Avicenne sur l'astrologie et sur rapport de la responsabilité humaine avec le destin', *Le Muséon*, 3, 1884, pp. 383–403, esp. p. 397: 'Bien que les corps célestes exercent une influence sur ceux de la terre, cette action pourtant n'est pas connue.' The opening of Avicenna's text was translated into French by Y. Michot, *Ibn Sīnā: Lettre au vizir Abū Sa'd*, Beirut, 2000, pp. 24*–26*.

40. Aristotle, *De generatione animalium*, III.11, 762^b28–763^b7.

41. Plato, *Politicus*, 269 b ff., 271 a ff.; *Timaeus*, 22 c, 23 a–b. Cf. n. 20 above.

42. Aristotle, *Meteorology*, II.14, 352^a17 ff.

43. *Die Epitome der Metaphysik des Averroes*, transl. S. Van den Bergh, Leiden, 1924, p. 44.

44. See the English translation of Averroes' commentary on *Metaphysics* A 3 in Genequand, *Ibn Rushd's Metaphysics* (n. 3 above), pp. 90–94 and 105–12. Of the commentary on *Metaphysics* Z 9 there is only one translation into a Western language, the Latin version in Aristotle/Averroes, *Aristotelis Stagiritae omnia quae extant opera* [...] *Averrois* [...] *commentarii aliique ipsius in logica, philosophia et medicina libri*, 9 vols, Venice, 1562, repr. Frankfurt a.M., 1962, VIII, ch. VII.31, fols 180^v–181^r. Compare the Arabic text in Averroes, *Tafsīr* (n. 18 above), pp. 881–6 (book VII), pp. 1457–65 and 1491–505 (book XII).

45. Averroes' *Tahāfut al-tahāfut* (*The Incoherence of the Incoherence*), transl. S. Van den Bergh, 2 vols, Cambridge, 1987, I, pp. 245–6.

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a 3, comm. 15,⁴⁶ and in the Long Commentary on the *Physics*, book VIII, chapter 6, comm. 46 (258^b13 ff. in Aristotle).⁴⁷

As Herbert A. Davidson and Gad Freudenthal have shown, Averroes changes his mind on the role of the active intellect in the generation of forms. In his early Epitome of the *Metaphysics* as well as in the first redaction of the commentary on *De animalibus*, Averroes states – following Avicenna – that the active intellect gives forms to the elements and to all composite bodies, including plants and animals.⁴⁸ In later writings, especially in the Long Commentary on the *Metaphysics*, Averroes rejects this position. He groups Themistius together with his own arch-enemy, Avicenna, and attributes to them the concept of the giver of forms,⁴⁹ explaining that this position is fundamentally Platonic.⁵⁰ Nevertheless, Averroes acknowledges the value of Themistius' claim that spontaneous generation is a counter-argument against Aristotle's rejection of separate forms. It is, as Averroes puts it, 'the strongest argument with which Plato reasons against Aristotle'. Averroes gives the following phrasing to the argument in the Long Commentary on *Metaphysics* Z 9:

Because of the fact that [...] we have seen many animals and many plants which turn from potentiality to actuality without a seed which is generated from something similar to it in form, it is thought that it is necessary that there are substances and forms which equip these generated beings among the animals and plants with the forms in virtue of which they are animals and plants.⁵¹

What kind of alternative does Averroes propose? In corrections to his early Epitome of the *Metaphysics*, which are meant to extinguish the active intellect as a factor in the generation of forms, Averroes argues that two factors are needed to explain sexual reproduction: an ultimate mover, i.e. the father or the male bird, and a 'principle from without'.

46. Aristotle/Averroes, *Aristotelis Stagirite* (n. 44 above), VIII, ch. II.15, fol. 35^v. Compare the Arabic text in Averroes, *Tafsīr* (n. 18 above), pp. 45–9.

47. Extant only in Latin: Aristotle/Averroes, *Aristotelis Stagirite* (n. 44 above), IV, ch. VIII.46, fols 386^r–388^r.

48. H. Davidson, *Alfarabi, Avicenna, and Averroes, on Intellect: Their Cosmologies, Theories of the Active Intellect, and Theories of Human Intellect*, New York and Oxford, 1992, pp. 232–42; Freudenthal, 'Medieval Astrologization' (n. 3 above), and again Freudenthal, 'Averroes' Changing Mind on the Role of the Active Intellect in the Generation of Animate Beings', forthcoming.

49. In ch. XII, comm. 18, he differentiates between Avicenna on the one hand and Themistius and al-Fārābī on the other, by saying that Themistius and al-Fārābī restrict the influence of a separate agent to the cases of non-reproductive generation (Genequand, *Ibn Rushd's Metaphysics* (n. 3 above), p. 109; Arabic text *ibid.*, pp. 1498–9). This, however, is a misrepresentation of Themistius, who had extended his theory of implanted proportions to include the reproduction of human beings, as seen above.

50. Averroes is not surprised that Avicenna took this erroneous position, but he is particularly annoyed about the fact that al-Fārābī did too, or at least did not sufficiently distance himself from the Islamic theologians who assume that an incorporeal cause is responsible for the generation of life. For al-Fārābī see n. 22 above. For the historical consequences of Averroes' characterization of the thesis as Platonic see D. N. Hasse, 'Plato Arabico-Latinus: Philosophy – Wisdom Literature – Occult Sciences', in *The Platonic Tradition in the Middle Ages: A Doxographic Approach*, eds S. Gerst and M. J. F. M. Hoenen, Berlin and New York, 2002, pp. 31–65 (42–5).

51. Averroes, *Tafsīr* (n. 18 above), ch. VII.31, p. 881.

The latter is the celestial bodies in Aristotle's view, which is the correct one, or the active intellect in the view of many of the later philosophers [e.g. Avicenna]. As for animals and plants that are generated spontaneously, the ultimate mover is, in Aristotle's system, the celestial bodies through the mediacy of soul-powers emanating from them, or else the active intellect as the later philosophers interpret [Aristotle].⁵²

This point of view, that not the active intellect, but the celestial bodies are the crucial factor in explaining generation, is spelt out in more detail in Averroes' Long Commentary on the *Metaphysics*. According to the commentary on Z 9, it is the celestial bodies (*al-ajrām as-samāwīyya*) which assume the place of the seed in spontaneous generation and which take the place of the power that is in the seed.⁵³ It is clear that Averroes thought that this is an Aristotelian position, although he admits, in the Epitome of the *Metaphysics*, that there is uncertainty about Aristotle's position on spontaneous generation.⁵⁴

Averroes seems to have taken his cue from a sentence in Aristotle's *Physics*, ch. II.2 (194^b14): 'Man is begotten by man and by the sun' [ἄνθρωπος γὰρ ἄνθρωπον γεννᾷ καὶ ἥλιος]. It is probable that Aristotle wished only to say – with his reference to the sun – that the period of gestation and lifespan are dependent upon the movements of the sun and the moon.⁵⁵ Averroes in his Long Commentary on A 3, comm. 13 and 18, explains that in natural generation the power 'in the seed comes from a being possessing seed and from the sun', whereas in 'putrescent matter it comes from the sun only'. The heat of the sun and that of the stars are mixed and thus generate heat in water and earth. The heat generated by the stars varies in power, and this is the reason for the fact that different species of animals are produced spontaneously. The variation in heat in turn depends on the amount 'of the motions of the stars and their reciprocal proximity or remoteness [*ḥarakāt al-kawākib wa-l-aḥwāl ba'dihā 'inda ba'din fi-l-qurb wa-l-bu'd*]'.⁵⁶ This means that what kind of animal is produced spontaneously depends upon astrological constellations.⁵⁷ Note that Avicenna had never explicitly adopted astrological theories of spontaneous generation, even if, as in *De diluviis*, he found them worthy of consideration. Averroes appears to have had fewer reservations about astrology.⁵⁸

52. Quoted from Davidson, *Alfarabi* (n. 48 above), p. 239.

53. Averroes, *Tafsīr* (n. 18 above), ch. VII.31, pp. 883–4.

54. *Die Epitome* (n. 43 above), p. 44.

55. Henry, 'Themistius and Spontaneous Generation' (n. 3 above), p. 203 n.

56. Averroes, *Tafsīr* (n. 18 above), ch. XII.13, pp. 1465–6, and XII.18, p. 1502; transl. by Genequand, *Ibn Rushd's Metaphysics* (n. 3 above), pp. 94 and 111.

57. Cf. Freudenthal, 'The Medieval Astrologization' (n. 3 above), p. 125: 'We have here a clear instance of what I have elsewhere called the "astrologization" of the Aristotelian philosophy of nature in the Middle Ages.' On the same topic see also G. Freudenthal, 'Providence, Astrology, and Celestial Influences on the Sublunar World in Shem-Tov Ibn Falaquera's *De'ot ha-filosofim*', in *The Medieval Hebrew Encyclopedia of Science and Philosophy*, ed. S. Harvey, Dordrecht etc., 2000, pp. 335–70, esp. p. 343.

58. Averroes' attitude towards astrology remains to be studied in detail. While there are passages in his works in which he appears to distance himself from astrology (see C. A. Nallino, *Raccolta di scritti editi e inediti*, vol. V, Rome, 1944, p. 30), in other passages he elaborates on the influence of the stars upon the processes on earth. H. Eichner argues (in contrast to Freudenthal, 'Providence' [n. 57 above]) that Averroes' theories on the influence of the stars continue Peripatetic teaching and do not necessarily betray the influence of contemporary astrological doctrine: see H. Eichner, *Averroes' Mittlerer Kommentar zu Aristoteles' 'De generatione et corruptione'*, Paderborn etc., 2005, p. 245.

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Averroes' theory of spontaneous generation is part of an attempt to return to Aristotle's ontology of form. In other contexts, for instance, Averroes attempts to develop a concept of prime matter as pure potentiality, thus repudiating the theory of a general 'form of corporeality' which according to Avicenna is joined to prime matter.⁵⁹ And he rejects the idea that elementary forms are not subject to change.⁶⁰ His position on spontaneous generation is explicitly linked to the attempt to safeguard another Aristotelian principle: that it is not forms that are generated, but compounds of matter and form.⁶¹ The form is only actualized. The heat which is contained in the seed, or in water or earth in cases of spontaneous generation, is endowed with a potential form. The agents, who actualize these forms, are man and the sun in sexual reproduction, or the sun only (and the other stars) in spontaneous generation.

This explanation of spontaneous generation proved to be very influential in the Latin West. The same is true of Averroes' position on the second issue: on the question whether all animals can be generated spontaneously. On this topic, Averroes directly turns against Avicenna and the theory that, as Averroes puts it, men can be produced from earth. In the Long Commentary on *Metaphysics* α 3,⁶² and in the Long Commentary on the *Physics*, VIII.6, Averroes argues that Avicenna violates the principle that form and matter are related to each other in the sense that the form is proper to the matter. Hence, if it were possible that a human being could be generated from the earth, which is not a matter proper to the form of a human being, this human being would not be a human being in the proper sense, but only equivocally. Averroes concludes that spontaneous generation, as in the case of worms, is not a natural but an abnormal phenomenon. The passage runs in Latin (the Arabic original of the Long Commentary on the *Physics* is lost): 'et ideo nulla species invenitur casu [i.e. spontaneously], sed illa quae inveniuntur casu, sunt monstruosa, non naturalia.' In the end, he scolds Avicenna for his thesis that human beings can be generated spontaneously: 'For a person who devotes himself to science, this is a very stupid statement' ('et iste sermo ab homine qui dat se scientiae est valde fatuus').⁶³

In these passages Averroes attempts to demonstrate two theses at the same time: on the one hand, he argues that spontaneous generation of human beings is impossible; on the other hand, he holds that spontaneous generation in general does not produce natural, but abnormal species. The reason he gives – that a specific form is proper to a specific matter – supports the second thesis, but not the first. It shows that spontaneously created animals are not true animals, because they are produced from

59. See *Historisches Wörterbuch der Philosophie*, eds J. Ritter et al, Basel etc., 1971–, s.v. 'Form und Materie', II, cols 992–3.

60. Averroes, *Commentum magnum super libro De celo et mundo Aristotelis*, ed. F. J. Carmody and R. Arnzen, Leuven, 2003, ch. III.67, p. 635. Cf. Maier, *An der Grenze* (n. 33 above), pp. 28–31.

61. Averroes, *Tafsir* (n. 18 above), ch. XII.18, pp. 1499–501; transl. Genequand, *Ibn Rushd's Metaphysics* (n. 3 above), pp. 109–10. See especially p. 109: 'The third doctrine is the one we have borrowed from Aristotle and it is that the agent produces only the compound from matter and form by moving matter and changing it to educe the potentiality it has for the form into actuality.'

62. As in n. 46 above.

63. Aristotle/Averroes, *Aristotelis Stagirite* (n. 44 above), IV, ch. VIII.46, fol. 387^{va}.

improper matter, but it does not explain why animals can be generated spontaneously and human beings cannot.

LATIN

In late medieval metaphysics, Averroes' core thesis that the main factor in spontaneous generation is the celestial bodies was very successful. A central figure in the medieval discussion was Thomas Aquinas, who followed Averroes on this point. With respect to the spontaneous generation of human beings, Thomas introduced a *media via* between Avicenna and Averroes by arguing that spontaneous generation was possible, but not of more perfect beings such as horses and human beings. Thomas's standpoint became the mainstream position on spontaneous generation in the medieval and Renaissance Latin world. The following survey of the discussion is centred on Thomas Aquinas, but does not attempt to demonstrate his great influence. Rather, its interest is in those authors who differ from Thomas: what were the alternative explanations of spontaneous generation proposed by the scholastics?

The following key positions are treated in rough chronological order: William of Auvergne makes God responsible for the creation of spontaneously generated animals; Albertus Magnus defends Avicenna's position on the spontaneous generation of human beings; Henry of Langenstein rejects Averroes' theory of celestial influence because of its astrological character; Blasius of Parma radicalizes Averroes' astrological theory by extending it to the generation of human beings; the commentators Alexander Bonini of Alexandria and Paul of Venice return to the Aristotelian theory of self-moving matter; John Buridan (under the influence of Duns Scotus) contends that all forms in the world are produced by a separate divine entity and that this is strongly suggested by the phenomenon of spontaneous generation; Agostino Nifo accepts Averroes' theory, but points out that it is in conflict with the truth of Christian faith; Pietro Pomponazzi gives an astrological twist to the Avicennian theory of the spontaneous generation of human beings.

At the beginning, two scholastic positions will briefly be mentioned which Thomas might have known, but which he did not follow. The first is from William of Auvergne (d. AD 1249).⁶⁴ It would be absurd to assume, says William in *De anima*, that animals which originate without parents are generated from matter, since matter is entirely dead. In principle, it is God the Creator who infuses life or soul into an animal as soon as its matter is prepared to receive it. This is also true of spontaneously generated animals: they are infused by the Creator.⁶⁵ William then proceeds to castigate Aristotle and his followers Avicenna, Algazel, and al-Fārābī for attributing the role of the creator

64. Van der Lugt, *Le Ver* (n. 1 above), p. 149, has drawn attention to this passage.

65. William of Auvergne, *De anima*, in *Opera omnia*, 2 vols, ed. F. Hotot, with *Supplementum*, ed. B. Le Feron, Orléans and Paris, 1674, repr. Frankfurt a.M., 1963, II, chs V.1 and V.2, p. 112^{a-b}: 'et hoc apparet evidenter in generationibus animalium; ubicumque enim materia parata est ad recipiendum vitam vel animam, statim eam illi creator infundit [...] quapropter manifestum est animas illas videlicet praedictorum animalium [i.e. which are generated spontaneously] a virtute omnipotentissima creatoris in locis generationis ipsorum creari.'

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to a separate active intellect.⁶⁶ William's position, despite its criticism of Avicenna, is a theological version of Avicenna's doctrine of the giver of forms. It is also a simplified version, because it does not adopt the theory of a hierarchy of complexions. What is remarkable about it is the fact that it makes the Creator responsible for the creation of the forms not only of human beings, as most scholastics would agree, but also of animals – which is a rare position.

The second position that stands out is that of Albertus Magnus (d. AD 1280). Albertus' theory of spontaneous generation is complex, because it connects many different traditions: medical and biological traditions as well as the metaphysical discussion of the Aristotelian tradition and the concept of *inchoatio formae* inherited from Augustine.⁶⁷ According to this latter doctrine, the form pre-exists, in an undeveloped condition, in the matter. For present purposes, attention will be drawn only to an argument which does not have many parallels in medieval thought. Albertus is not convinced of Averroes' thesis that human beings cannot be subject to spontaneous generation. Averroes' criticism of Avicenna, says Albertus, is not entirely appropriate ('non convenientem generaliter'), because if the disposition and property of the semen can be fully acquired from the stars, then there is no reason why a human being cannot be produced without parents. Remember that Aristotle had said: 'those things whose matter cannot [bring about that kind of motion] cannot be produced otherwise than from [the parent animals] themselves'. For Aristotle, it depends upon the matter whether spontaneous generation is possible or not. For Averroes, the power in the matter results from the motions of the sun and the stars. If Averroes' position on celestial influence is accepted, it is reasonable to conclude that it is possible to generate any natural kind from putrescent matter.⁶⁸

As has been pointed out, Thomas Aquinas (d. AD 1274) belongs to a large group of scholastic authors who accept Averroes' basic idea that the main factor in spontaneous generation is the stars. But within this group he was the most influential, in at least two respects: he based his discussion on the principle that 'forms are extracted from the potentiality of matter' ('formae educuntur de potentia materiae'), and he proposed a *media via* between Avicenna and Averroes by distinguishing between imperfect and perfect animals. The following analysis places Thomas's theory within the ontology of his later works,⁶⁹ with particular reference to the following texts: the *Quaestiones*

66. On William's views concerning the active intellect see Hasse, *Avicenna's 'De anima'* (n. 34 above), pp. 45–6 and 211–14.

67. See Albertus Magnus, *Metaphysica*, ed. B. Geyer, Münster i.W., 1964, ch. II.1.8, pp. 468–71; id., *De animalibus libri XXVI*, ed. H. Stadler, Münster i.W., 1916, ch. VI.3.3, pp. 494–5; id., *De XV problematibus*, ed. B. Geyer, Münster i.W., 1975, ch. VI, p. 38. For further passages and discussion see the classic article by B. Nardi, 'La dottrina d'Alberto Magno sull' "inchoatio formae"', in id., *Studi di filosofia medievale*, Rome, 1960, pp. 69–101; van der Lugt, *Le Ver* (n. 1 above), pp. 140–43 and 172–6; Zambelli, *Una reincarnazione* (n. 3 above), pp. 79–81. Cf. Snyder's criticism of Nardi's interpretation of Albertus, in S. C. Snyder, 'Albert the Great, *inchoatio formae*, and the Pure Potentiality of Matter', *American Catholic Philosophical Quarterly*, 70, 1996, pp. 63–82.

68. Albertus Magnus, *Physica*, ed. P. Hossfeld, Münster i.W., 1987, ch. VIII.2.10, p. 613.

69. For an early passage on spontaneous generation see Thomas Aquinas, *Scriptum super sententiis*, lib.

disputatae de potentia of 1265–6, *Prima pars Summae theologiae* of 1265–8, and the Commentary on Aristotle's *Metaphysics*, of 1270–72.⁷⁰

Thomas's standpoint is clearly influenced by his reading of Averroes' Long Commentary on the *Metaphysics*. Just like Averroes, he explicitly adopts and defends the Aristotelian principle that forms, properly speaking, are not generated. Instead, they are extracted from the potentiality of matter.⁷¹ An exception to this rule is the rational soul, which cannot be extracted from the potentiality of matter, because its operations do not involve the body,⁷² as Aristotle had argued in *De generatione animalium*, II.3.⁷³ But in all other cases the forms pre-exist in the potentiality of matter.⁷⁴ It is because of this ontological premiss that Thomas argues against the existence of separate forms which are the causes of generation:⁷⁵ one reason why the Platonists assumed the existence of separate forms was that these forms could be the cause of generation in things. The basic problem of this Platonizing position, argues Thomas, is that it ignores the fact that forms are not generated and hence runs into difficulties with respect to the origin of forms. Thus, some have been forced to assume that all forms – not only the forms of human beings – are created (note that this remark could refer not only to Avicenna, but also to William of Auvergne). These people reason: forms are generated, but matter is not a part of the form, hence the forms are generated *ex nihilo*.⁷⁶ Plato calls this supernatural agent *dator formarum*, Avicenna says it is the last of the intelligences.⁷⁷ Others, such as Albertus Magnus and Anaxagoras, have claimed that the forms pre-exist in the matter in actuality⁷⁸ – this is a reference to the theory of *inchoatio formarum*.

III, q. 1, dist. 8, q. 1, art. 1 ad 7: 'ad septimum dicendum quod in animalibus generatis ex putrefactione virtus solis et aliorum corporum caelestium supplet vicem virtutis formativae quae est in semine.' Further passages are collected and analysed by T. Litt, *Les Corps célestes dans l'univers de saint Thomas d'Aquin*, Louvain and Paris, 1963, pp. 130–43.

70. On the dates I follow J.-P. Torrell, *Magister Thomas: Leben und Werk des Thomas von Aquin*, Freiburg i.Br. etc., 1995, pp. 345–73; English translation in J.-P. Torrell, *Saint Thomas Aquinas, I: The Person and his Work*, Washington, 1996, pp. 330–61.

71. Thomas Aquinas, *In duodecim libros Metaphysicorum Aristotelis expositio*, Turin and Rome, 1950, §1423: 'forma enim proprie non fit, sed compositum [...] formae enim proprie non fiunt, sed educuntur de potentia materiae, inquantum materia quae est in potentia ad formam fit actu sub forma, quod est facere compositum'; cf. the translation by J. P. Rowan, *St. Thomas Aquinas: Commentary on Aristotle's 'Metaphysics'*, Notre Dame, 2001, §1423.

72. Thomas Aquinas, *Quaestiones disputatae*, eds P. Bazzi et al, 2 vols, Turin and Rome, 1953, II: *De potentia*, ch. 3.9, pp. 65–6: 'tertia ratio est quia omnis forma quae exit in esse per generationem vel per virtutem naturae, educitur de potentia materiae, ut probatur in VII Metaph. anima vero rationalis non potest educi de potentia materiae. formae enim quarum operationes non sunt cum corpore, non possunt de materia corporali educi; [...] et haec est ratio Aristotelis.' Cf. Thomas Aquinas, *Summa theologiae*, Turin, 1988, ch. I.118.2.

73. Aristotle, *De generatione animalium*, 736^b27–8, transl. Peck (n. 9 above): 'It remains, then, that reason [*voûs*] alone enters in, as an additional factor, from outside, and that it alone is divine, because physical activity has nothing whatever to do with the activity of reason.'

74. Thomas Aquinas, *De potentia*, q. 3, a. 11 ad 10.

75. Thomas Aquinas, *In libros Metaphysicorum*, §1427.

76. Thomas Aquinas, *ibid.*, §§1429–30.

77. Thomas Aquinas, *De potentia*, q. 3, a. 8.

78. Thomas Aquinas, *In libros Metaphysicorum*, §1430.

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In Thomas's view, there are good reasons for rejecting the concept of a giver of forms. First, the forms in question exist only in union with matter, and hence it is necessary that they are produced by an agent which is able to transform matter. A supernatural agent, however, would not be able to transform matter. Second, since these forms do not exceed the limits of natural agents, there is no necessity to assume that their origin lies in higher principles.⁷⁹ These two arguments do not apply to the rational soul: because, first, it is a substance which subsists by itself and is not dependent upon a union with the body; and second, the intellect, when it is in actuality, exceeds all corporeal nature. The rational soul is created by God.

Spontaneous generation is recognized by Thomas as a possible counter-argument against the rejection of a giver of forms. Some people argue, he says, that it is clear that in spontaneous generation the forms derive from separately existing forms, because they evidently do not derive from any forms similar in species;⁸⁰ moreover, as animate beings they cannot be produced from inanimate nature.⁸¹ A fortiori, this applies to nobler creatures such as human beings.⁸² Thomas's response is that animals which are generated spontaneously do not derive from separate forms because they are so imperfect that not much is required for their production: the celestial power alone suffices. For more perfect beings, as for instance horses and human beings,⁸³ the celestial power needs to be accompanied by the power of the semen. Hence, both Avicenna and Averroes were wrong, argues Thomas: Avicenna was wrong in extending spontaneous generation to all living beings, and Averroes was wrong in restricting it to miraculous cases of generation. This position, which Thomas attributes to Aristotle,⁸⁴ became known among later writers, such as Pietro d'Abano⁸⁵ and Paul of Venice,⁸⁶ as the *media via*.

79. Thomas Aquinas, *De potentia*, q. 3, a. 11; id., *Summa theologiae*, I.118, a. 1 and a. 2.

80. Thomas Aquinas, *In libros Metaphysicorum*, §1455.

81. Thomas Aquinas, *De potentia*, q. 3, a. 8.15.

82. Thomas Aquinas, *ibid.*, q. 3, a. 11.10.

83. Thomas Aquinas, *In libros Metaphysicorum*, §1454: 'illa autem quorum materia non potest moveri a se ipsa eo motu quo a spermate movetur, impossibilia sunt fieri aliter quam ex ipsis seminibus, sicut patet de homine et equo et aliis animalibus perfectis. patet autem ex his quae dicuntur quod neque omnia animalia possunt generari et ex semine et sine semine, ut Avicenna ponit, neque nulla generantur utroque modo, ut ponit Averroes.'

84. Thomas Aquinas, *ibid.*, §§1400–1401: 'sententia Aristotelis videtur esse media inter has duas opinionones, quod scilicet aliqua possunt et sine semine generari et ex semine, non tamen omnia [...] quia quanto aliquid perfectius est, tanto plura ad eius completionem requiruntur. et propter hoc ad plantas et ad animalia imperfecta sufficit ad agendum sola virtus caelestis. in animalibus vero perfectis requiritur cum virtute caelesti etiam virtus seminis. unde dicitur in secundo Physicorum quod homo generat hominem et sol.'

85. It is in full accordance with Thomas Aquinas (whom he does not name) when Pietro d'Abano in the *Conciliator* describes Aristotle's position as the *media via* between Avicenna and Averroes. He also adopts the *animalia perfecta* argument. What is missing, however, is the Aristotelian point that spontaneous generation depends on the suitability of matter. In Pietro d'Abano's view, less perfect animals, such as fish and mice, can be produced from putrescent matter by the force of the stars only, whereas the more perfect animals 'are in need of additional [causes] for their generation' ('cum plura expetant in sui productionem'). He is clearly thinking of the formative power in the semen. See Pietro d'Abano, *Conciliator*, Venice, 1565, repr. Padua, 1985, diff. 29, ppt. 2 and 3, fols 44^v–45^r.

86. Paul of Venice uses the *media via* theory in the phrasing of Pietro d'Abano: Averroes is wrong in

When animals are generated spontaneously, the celestial power takes the place of the power which is in the semen.⁸⁷ But how is it that the stars are able to create an animal of a certain species? Averroes had argued that this is due to the constellation of the stars. Thomas suppresses the astrological part of the theory:

[If the process of spontaneous generation] is referred to the celestial power, which is the universal power regulating generation and corruption in these lower bodies, then [this generation] is not accidental but is directly aimed at [*per se intenta*], because its goal [*intentio*] is that all forms existing potentially in matter should be brought to actuality.⁸⁸

The problem of the individuation of species in spontaneous generation has been a challenge to all authors surveyed. Aristotle had explained the generation of specific animals by the properties of the enclosing medium and of the enclosed liquid matter. Themistius' solution was to assume that bits of matter contain information previously implanted by higher causes. Avicenna had proposed a theory of increasingly refined elementary mixtures. Thomas's solution is less detailed. He assigns the differences in generation to the general function of the celestial bodies as the rulers of growth and decay in the sublunar world.

Thomas admits that the celestial bodies are not similar to the generated animals in species. This is a problem, because it means that Aristotle's principle of synonymy is violated. However, Thomas argues, there is a similarity between producer and product in that the effect pre-exists *virtualiter* in the active cause.⁸⁹ It is true that the similarity is not perfect, but there is as much similarity as possible.⁹⁰ Averroes, in fact, had also been aware of this disadvantage of the theory of celestial bodies. His solution was to say that the synonymy exists between the potentiality in the putrescent matter proper to each animal on the one hand and the result of the generation process on the other hand.⁹¹ This explanation does not account for the central role played by the stars in Averroes' model. In Aristotle's theory, the principle of synonymy is more easily saved, because the new living being is generated from a pre-existing part of itself.

The wide influence of Thomas's theory in later medieval metaphysics cannot be demonstrated in this paper. Instead, I shall concentrate on philosophers who deviate from this

restricting the cases of spontaneous generation to non-natural beings, and Avicenna is wrong in extending the cases to all animals. See Paul of Venice, *Expositio*, lib. VII, cap. II, paragr. 11, MS Pavia (n. 96 below), fol. 270^b.

87. Thomas Aquinas, *In libros Metaphysicorum*, §1402; see also the quotation in n. 84 above.

88. Thomas Aquinas, *ibid.*, §1403: 'sed si referatur ad virtutem caelestem, quae est universalis regitiva virtus generationum et corruptionum in istis inferioribus, non est per accidens sed per se intenta, quia de eius intentione est ut educantur in actu omnes formae quae sunt in potentia materiae.' The translation is based on that of Rowan, *St. Thomas Aquinas* (n. 71 above). Thomas here draws on Averroes, *Tafsīr* (n. 18 above), lib. XII, comm. 13, pp. 1463–4.

89. Thomas Aquinas, *De potentia*, q. 3, a. 11 ad 12.

90. Thomas Aquinas, *In libros Metaphysicorum*, §1433.

91. Averroes, *Tafsīr* (n. 18 above), lib. XII, comm. 13, p. 1464, transl. Genequand, *Ibn Rushd's Metaphysics* (n. 3 above), p. 94: 'What results from the potentiality contained in the putrescent matter proper to each animal must result from its synonymy.'

mainstream position. Van der Lugt has pointed to two examples: Henry of Langenstein and Blasius of Parma.⁹² Henry of Langenstein (d. AD 1397), the founder of Vienna University and fierce critic of astrology, argued against any participation of the stars in the phenomenon. In his view, the generation probably results from 'some accidental coincidence of elementary causes in a specific place'.⁹³ Blasius of Parma (d. AD 1416), in contrast, radicalizes the astrological side of Averroes' theory by pointing out that the beneficial effect of the stars and the disposition of the matter can be improved without limits. Hence, there is no reason why matter should not receive the form of a human being. This form does not come from without; it is extracted from the potentiality of matter.⁹⁴ For Blasius, the spontaneous generation of human beings is an argument for the more general thesis that the intellective soul is subject to generation and corruption. Blasius' theory departs from Thomas's *media via* and approaches Avicenna's by arguing in favour of the spontaneous generation of human beings. But it greatly contrasts with Avicenna's in that it negates the existence of a giver of forms, extends the generation from matter to all human beings, and makes spontaneous generation completely dependent upon astrological factors.

Another deviation from mainstream opinion occasionally appears in the commentary tradition on the *Metaphysics*. Some commentators choose to discuss the phenomenon solely within the conceptual framework of Aristotle's *Metaphysics*. Spontaneous generation is then explained, as in Aristotle, as resulting from the disposition of the matter and its capacity for self-movement. There are no references to Averroes' theory of the influence of the stars or to Aristotle's biological theory of the contribution of the surrounding element and of vital heat contained in portions of matter. Examples of such theories of self-moving matter appear in the commentaries of Alexander Bonini of Alexandria (d. AD 1314)⁹⁵ and Paul of Venice (d. AD 1429)⁹⁶ within the context of book Z. Whether Alexander and Paul continue this line of explanation in other parts of their large *œuvre*, I cannot tell at present.

That the commentary tradition on the *Metaphysics* is by no means unanimous on the issue is apparent when we turn to the position which John Buridan (d. after AD 1358),

92. Van der Lugt, *Le Ver* (n. 1 above), pp. 146–9 on Henry of Langenstein, and pp. 176–81 on Blasius of Parma.

93. Quoted in van der Lugt, *Le Ver* (n. 1 above), p. 148 n.: 'inchoatur ab aliquo accidentali concursu elementarium causarum in determinato situ'.

94. Blasius of Parma, *Quaestiones de anima*, ed. G. Federici Vescovini, Florence, 1974, p. 79: 'ultima conclusio: quod anima intellectiva hominis sit educta de potentia materiae, generabilis et corruptibilis, habet quilibet de plano concedere. patet, postquam contingit hominem generari ex putrefactione sola influentia astrorum concurrente.'

95. Alexander Bonini of Alexandria, *In XII libros Metaphysicorum Aristotelis expositio*, Venice, 1572, ch. VII.9, fols 214^a–218^a. On this commentary see F. Amerini, 'Thomas Aquinas, Alexander of Alexandria, and Paul of Venice on the Nature of Essence', *Documenti e studi sulla tradizione filosofica medievale*, 15, 2004, pp. 541–89, with further literature. I thank Fabrizio Amerini for sharing his typescript version of Alexander's commentary on VII.9 with me.

96. Paul of Venice, *Expositio super libros Aristotelis Metaphysicorum*, lib. VII, cap. 2, paragr. 6–11, MS Pavia, BU Aldini 324, fols 268^a–270^b. I thank Prof. Francesco del Punta of the Scuola Normale di Pisa for providing me with a typescript of the edition of the seventh book which is being prepared in Pisa.

the Parisian Master of Arts, takes in his *Quaestiones in Metaphysicen*.⁹⁷ The ninth question on book Z of the *Metaphysics* runs: 'Whether because of the generation of sense-perceiving [i.e. animal] substances it is necessary to posit separate substances.'⁹⁸ According to Plato, says Buridan, we have to posit separate incorporeal substances because otherwise the principle of similarity between producer and product would be violated in cases of spontaneous generation. Buridan clearly says that he sides with Plato against Aristotle on this matter. His only qualification is that the sentence ought to be reformulated: it is because of the separate substances that the animal substances exist, and not the other way round.⁹⁹ Note that the problem discussed is not the form of human beings, but of animals. Thomas Aquinas and many other scholastics would agree that the form of human beings comes from without, but not that of animals, as Buridan claims.

The phenomenon of spontaneous generation 'is a very fundamental argument' ('ratio est valde principalis')¹⁰⁰ for the conclusion that we have to posit a separate and incorporeal substance. In order to support this position, Buridan turns against the dominant explanation of spontaneous generation. His example is the spontaneous generation of a frog:

If you say that the celestial bodies play a part in this kind of generation, I say that these bodies are far away and very distant, and hence that they act upon the matter of a frog only through the disposition of the frog and through the influences by which they have previously acted upon bodies joined with matter, such as water or air, and [that] likewise these dispositions or tendencies or influences are only accidents, which do not have the degree of perfection which the substantial form has, i.e. the sense-perceiving soul, which is generated. These influences, therefore, do not suffice. Hence it is necessary to posit an incorporeal substance, which is nobler than the sense-perceiving soul and which is the first principle of generation [*principale generans*].¹⁰¹

Since this separate substance is able to act upon the entire world and each part of it, Buridan believes (*credo*) that it is God himself.¹⁰² The reasons for positing such a substance, he says, are derived from Avicenna and Themistius, or Plato, according to

97. There also exists an *Expositio libri Metaphysicae* by Buridan in eight manuscripts; see C. H. Lohr, 'Medieval Latin Aristotle Commentaries: Authors. Jacobus-Johannes Juff', *Traditio*, 26, 1970, pp. 135–216 (166).

98. John Buridan, *In Metaphysicen Aristotelis questiones argutissimae*, Paris, 1518, repr. [with the wrong date 1588 on the title-page] Frankfurt a.M., 1964, lib. VII, qu. 9, fol. 46^{ra}: 'quaeritur nono utrum propter generationem substantiarum sensibilium necesse sit ponere substantias separatas.'

99. Buridan, *ibid.*: 'ad questionem respondendum est quod sicut mihi videtur ratio maxima ad concludendum substantias separatas vel saltem substantiam separatam potest sumi et argui ex generatione substantiarum sensibilium [...]. immo econverso substantia separata est causa substantiarum sensibilium, et sic concederetur quod propter substantiam separatam sunt substantie sensibiles et earum generationes.'

100. Buridan, *ibid.*: 'una enim ratio est valde principalis de animalibus generatis per putrefactionem.'

101. Buridan, *ibid.*, fol. 46^{a-b}: 'et si dicas corpora celestia concurrere ad huiusmodi generationem, dicam quod illa sunt remota et multum distantia, ideo non agunt in materiam rane nisi per illam dispositionem rane et per influentias per quas prius agunt in corpora materie coniuncta, ut aquam vel aerem, sicut et ille dispositiones seu inclinationes vel influentie non sunt nisi accidentia, que non habent tantum gradum perfectionis sicut forma substantialis, scilicet anima sensitiva que generatur. ideo ille influentie non sufficiunt. ergo necesse est ponere substantiam incorpoream nobiliorem anima sensitiva que est principale generans.'

102. Buridan, *ibid.*, fol. 46^b: 'et credo quod illa substantia separata est ipse deus omnipotens.'

Themistius. In Buridan's view, Plato was rightly censured by Themistius for claiming that there are as many separate substances as there are kinds of concrete substance, such as the idea of men, the idea of donkeys, and so forth.¹⁰³ Buridan does not follow Plato, but argues that it is sufficient if two agents participate in the generation of a human being: the sperm of the father and a universal generating principle, i.e. God, and similarly in the generation of animals. It is superfluous to postulate the existence of Platonic ideas. Buridan attributes his own conclusion, rather daringly, to Aristotle: 'But what Aristotle has refuted in Plato is not that he has posited a separate substance, but that he has posited these special ideas.'¹⁰⁴

Buridan's standpoint comes close to Avicenna's. The counterpart to Avicenna's giver of forms in Buridan is a divine entity which is responsible for the generation of all forms in the world. God, however, acts at will, which contrasts with the quasi-automatic emanation of forms, which is prompted by a specific elemental mixture in Avicenna's theory. But how does Buridan solve the problem of individuation of species in spontaneous generation? He does not relegate the problem to God's will, but assumes that two factors are involved in the process – a universal and divine principle of generation and a number of particular and corporeal agents, namely the stars and the qualities of putrescent matter:¹⁰⁵ 'through a certain influence of the stars and through the qualities of [other] particular agents, the universal generating principle [*universale generans*], i.e. God, is determined to produce now a frog, now a fly'.¹⁰⁶ With this addition, Buridan again approaches the Avicennian standpoint. The concept of God which Buridan uses in this context is that of a mere generating principle reacting upon material dispositions. With respect to ontology, Buridan's position implicitly entails the abandoning of the Aristotelian principle that concrete substances, but not forms, are generated. I am not aware of a discussion of these consequences in Buridan's *œuvre*.¹⁰⁷

It seems that Buridan's conclusion was influenced by John Duns Scotus (d. AD 1308). According to Scotus, Aristotle's arguments against Plato demonstrate that ideas are not necessary for generation, but they rule out only Platonic ideas as causes of generation, not God. Scotus admits, however, that Aristotle and Averroes insist that God, in prin-

103. Buridan, *ibid.*: 'et istas rationes adducunt ad istud propositum Avicenna et Themistius. et dicit Themistius illas fuisse rationes Platonis, sed bene dicit Themistius Platonem in hoc defecisse quia multiplicavit substantias separatas secundum multiplicationem specierum substantiarum generabilium.'

104. Buridan, *ibid.*, fol. 47^{ra}: 'Aristoteles autem non improbat Platonem ex eo quod posuit substantiam separatam, sed ex eo quod posuit illas ideas speciales.'

105. Buridan, *ibid.*, fol. 46^{va}: 'aliqua materia putrida'.

106. Buridan, *ibid.*, fols 46^{vb}–47^{ra}: 'sufficit ad appropriationem ita quod universale generans, scilicet deus, cum sparmate viri determinatur ad producendum formam humanam [...] ita etiam cum determinata influentia celi et qualitatibus particularium agentium determinatur ad agendum modo ranam modo muscam.'

107. On Buridan's attitude towards Plato and for an interpretation of book VIII, question 9, of the *Metaphysics* commentary, see A. M. de Rijk, 'John Buridan on Universals', *Revue de métaphysique et de morale*, 97, 1992, pp. 35–59, esp. pp. 44–5. On Buridan's ontological views in general see C. Normore, 'Buridan's Ontology', in *How Things Are: Studies in Predication and the History of Philosophy and Science*, eds J. Bogen et al, Dordrecht etc., 1985, pp. 189–203.

ciple, cannot cause any effect in the material world without mediation. On this matter, says Scotus, the Christian theologian is in conflict with the philosopher.¹⁰⁸

At the beginning of the sixteenth century, Agostino Nifo (d. AD 1538) attacks a standpoint which bears many similarities to Buridan's. He refers to 'some people' who follow Plato, Alexander of Aphrodisias, Themistius, and Avicenna in holding that a separate form generates all animate forms:

With respect to the intention of Aristotle, [these people] say that Aristotle wanted [to show] that particular ideas are not necessary for particular generations, but that he did not deny that a single idea common to everything, such as God, can produce all forms.¹⁰⁹

Nifo objects that this position is not in accordance with Peripatetic principles. It is in conflict with Aristotle's theses that all souls apart from the intellective soul are transmitted via the semen, and that man is generated from matter and the sun. Not surprisingly, Nifo, in various works of his, adopts Averroes' theory of spontaneous generation. He asserts repeatedly that spontaneous generation is due to the power in the matter which is moved by the celestial bodies.¹¹⁰

Nifo would qualify as a representative of the mainstream explanation of spontaneous generation if he had not added an important qualification. In contrast to many previous Aristotelian philosophers, such as Thomas Aquinas or Jean de Jandun, Nifo very pointedly declares that Averroes' position is not true from a Christian point of view. The following quotation is from a passage in the later of his two commentaries on the *Metaphysics*:¹¹¹

But whether these things are true may be settled by consulting the *Dilucidarium*, where we have affirmed that these things that Averroes says are not true, even if they appear to be Peripatetic. For there we have explained in which way the form can be produced by the intelligences and by God himself without the mediation of a celestial body.¹¹²

The truth referred to in this quotation is the truth of Christian faith, according to which

108. John Duns Scotus, *Quaestiones quodlibetales*, in Ioannes Duns Scotus, *Opera omnia, editio minor*, ed. G. Lauriola, vol. II/1, Alberobello, 1999, qu. 7, pp. 1252–3. Cf. John Duns Scotus, *Quaestiones super libros Metaphysicorum Aristotelis, libri VI–IX*, ed. R. Andrews et al, St Bonaventure, NY, 1997, lib. VII, qu. 11, pp. 186–7.

109. Agostino Nifo, *Metaphysicarum disputationum dilucidarium* [...], Venice, 1559, repr. Frankfurt a.M., 1967, lib. VII, disp. 10, p. 194^a: 'pro mente tamen Aristotelis dicunt Aristotelem voluisse non esse necessarias ideas particulares ad particulares generationes, non tamen negat unam communem omnibus ut deus posse omnes formas producere.'

110. Agostino Nifo, *In via Aristotelis de intellectu libri sex*, Venice, 1554, lib. I, cap. 30, fol. 15^{rb}; id., *Expositiones in Aristotelis libros Metaphysices*, Venice, 1559, repr. Frankfurt a.M., 1967, lib. VII, tex. 31, p. 431^b: 'ex his igitur patet solutio a[d] obiecta [...] ad primum quidem quoniam animatum quod fiet ex putri materia fit a virtute quae continetur in huiusmodi materia, a sole stellisque mota atque ad eius generationem instituta.'

111. The two *Metaphysics* commentaries belong to the later phase of his career; the *Dilucidarium* in question format was finished in 1510 at Naples, and the later *Expositiones*, a normal running commentary, towards the end his life in the 1530s in Salerno and Naples.

112. Agostino Nifo, *Expositiones* (n. 110 above), lib. VII, tex. 31, p. 431^b: 'sed haec an vera sint, petenda sunt a Dilucidario, ubi declaravimus haec quae Averroes ait non esse vera, licet videantur Peripatetica. il-

spontaneous generation can be explained as resulting from the direct interference of God. In the earlier *Dilucidarium metaphysicarum disputationum*, Nifo had already spelt out the opposition between a Peripatetic view and a Christian view in greater detail. From the Peripatetic vantage-point, two principles are fundamental for a theory of the generation of form: firstly, that corruption and generation always involve bodies; and secondly, that nothing can be generated from nothing, *nihil de nihilo*.¹¹³ This is the basis, says Nifo, for Averroes' opposition to Plato, Themistius, and Avicenna: because in Averroes' view a pure form, such as the *dator formarum*, can never change matter. 'Thus, Averroes' arguments are valid if his principles are presupposed. But if we speak in a Christian manner, all these principles are false', says Nifo:¹¹⁴ because it is sufficient for a principle of change that it has the power of changing, as is the case with God, who encompasses in his power all singular causes and thus can change whatever is subject to inferior causes. Moreover, God is able to create *ex nihilo*.

The Christian caveat, or *declaratio fidei*, is a feature typical of Renaissance Aristotelianism (the most famous example is the last chapter of Pietro Pomponazzi's *Tractatus de immortalitate animae*), but in Nifo's case it is also a prolongation of a late medieval tradition, which probably originates with Scotus. As has been mentioned above, it was Scotus who clearly differentiated between a theological and an Aristotelian position on God as the cause of generation; the question which divides these groups is whether God is able to cause any generation in the material world at will and without mediation.

Our survey closes with an author who deviates from the *media via* theory on the generation of human beings: Pietro Pomponazzi (d. AD 1524). Pomponazzi returns to the topic of spontaneous generation several times in his academic career: in a lecture on book VIII of the *Physics* in Padua, c. 1503; in a lecture on book A of the *Metaphysics* held in Bologna in 1511–12; and in a new lecture on the *Physics* in Bologna in 1518.¹¹⁵ One can witness Pomponazzi slowly approaching Avicenna's position over the years. In the earliest lecture of c. 1503, he still distances himself from Avicenna by saying that his theory is 'false and heretical, as the theologians say'. For if it were true, the incarnation of Christ could be explained in purely natural terms, i.e. as resulting from celestial influences upon the menstrual blood of Mary ('sanguis menstruus Marie ex influxu celesti concurrente generaret Xpistum').¹¹⁶ Note that Avicenna would not agree

lic enim explicavimus quonam modo ab intelligentiis et ab ipso deo effici possit forma sine interventu corporis coelestis.'

113. Agostino Nifo, *Dilucidarium* (n. 109 above), lib. VII, disp. 10, p. 194^b.

114. Ibid., p. 195^a: 'et sic rationes Averrois sunt valide suppositis principiis eius. sed si loquimur catholice, omnia haec principia sunt falsa.'

115. Parts of the two *Physics* lectures of c. 1503 and 1518 (the latter is extant in two recensions) have been edited by Bruno Nardi in 'Pietro Pomponazzi' (n. 3 above), pp. 305–19. The lecture on *Metaphysics* A (1511–12) is extant in MS Paris, BN lat. 6537, fols 167^v–173^v, among other manuscripts. For the 1518 lecture I have consulted MS Paris, BN lat. 6533, fols 515^v–521^r. For the manuscript tradition of the three lectures see C. H. Lohr, *Latin Aristotle Commentaries, II: Renaissance Authors*, Florence, 1988, pp. 347–62 (nos. 2, 14, 18).

116. Nardi, 'Pietro Pomponazzi' (n. 3 above), p. 312: 'de opinione Avicene dico quod illa opinio est falsa et heretica, ut dicunt theologi; quia, secundum istam opinionem, posset dici Xpistum non fuisse

with this account of his standpoint. Avicenna had held that the stars prepare matter for the reception of a form and that its perfect elementary mixture is the model for the less perfect mixtures in the sublunar world;¹¹⁷ but the form does not come from the celestial bodies, which are material, but from the lowest of the celestial intelligences.

In 1518 Pomponazzi does not repeat the rhetoric of heresy. Instead, he argues that Avicenna cannot be refuted philosophically:

What the Latin authors say, namely that man is the most perfect being and that man cannot be generated from decay, is a probable argument, but does not at all demonstrate that [the generation] is impossible. Even though [the effect of spontaneous generation] appears in extremely long time periods [and thus is difficult to witness], we should not rule it out. For I do not have a [decisive] argument either against or for Avicenna [...]. I therefore hold the opinion of the Latin authors, but I do not think that they have conclusive arguments against Avicenna.¹¹⁸

How does Pomponazzi arrive at this conclusion? He contrasts two positions, that of Averroes and that of Plato and Avicenna. The latter standpoint is characterized by the thesis that everything generated through reproduction can also be generated from decay. Pomponazzi claims that Avicenna had become convinced of the thesis by experience and reason (*experimento et ratione*). The reason is astronomical (or astrological: the terms are not clearly distinguished), because Avicenna was a great astrologer, says Pomponazzi, much more excellent than Aristotle himself.¹¹⁹ As we have seen above, this is incorrect historically; even though Avicenna admitted that the stars influence the sublunar world in a manner unknown to us, he remained a fierce opponent of astrology.¹²⁰

Avicenna's astronomical proof (in *De diluviis* and *De animalibus*, 15), in the eyes of Pomponazzi, is that in world history, as a result of conjunctions of the planets, there appear great catastrophes and deluges which extinguish all human life. In Pomponazzi's interpretation, it is due to the reappearance of felicitous conjunctions (*bone coniunctiones syderum*) that animals are generated again from putrescent matter.¹²¹ In these cases, even human beings are generated spontaneously. This theory is supported by experience, says Pomponazzi, and he relates dozens of examples

incarnatum ex spiritu sancto ex Maria virgine, quia diceretur quod sanguis menstruus Marie ex influxu celesti concurrente generaret Xpistum, in via Avicene, in puris naturalibus.'

117. See nn. 36 and 38 above.

118. Nardi, 'Pietro Pomponazzi' (n. 3 above), p. 319: 'quod autem dicunt Latini quod homo est perfectissimus et non potest generari ex putredine, ista est ratio probabilis, sed non demonstrat omnino quin istud non possit; licet in longissimis periodis hoc videatur, tamen non debemus negare hoc. non enim ego habeo rationem contra Avicennam neque pro ipso [...]. opinionem ergo Latinorum teneo; non tamen teneo quod rationes eorum contra Avicennam concludant.' Cf. the different wording of the text in MS Paris, BN lat. 6533, fols 520^r-521^r.

119. Nardi, 'Pietro Pomponazzi' (n. 3 above), p. 317: 'Avicenna igitur motus est experimento et ratione, scilicet quod omnia genita ex propagine possint generari ex putredine [...]. ipse enim fuit magnus astrologus et longe excellentior fuit in astrologia quam Aristoteles ipse. per rationes astronomicas ibidem probat quod sunt diluvia universalis et per ignem et per aquam.' Cf. MS Paris, BN lat. 6533, fol. 516^r.

120. See n. 39 above.

121. Nardi, 'Pietro Pomponazzi' (n. 3 above), pp. 317-18: 'et veniunt iterum bone coniunctiones syderum et producunt homines, pisces et cetera animalia. cum ergo viderit per astrologiam quod dantur

of generation without sexual reproduction (some quoted from Albertus Magnus): women giving birth without conception, or women giving birth to animals, etc. He concludes that Averroes' reasons against Avicenna's theory are nothing but weak and futile.¹²²

Among the authors mentioned in this survey, only Albertus Magnus, Blasius of Parma, and Pomponazzi defend the position that human beings can be generated spontaneously. Albertus and Blasius had argued that the spontaneous generation of human beings follows necessarily from Averroes' theory of the influence of the stars – against Averroes' own intention – if the full force of his astrological theory is realized. In the eyes of Albertus, it follows from Averroes' thesis that the properties of the semen can be fully acquired from the stars. For Blasius of Parma, it follows from the fact that both the constellation of the stars and the disposition of the matter can in principle be improved without limitation. Pomponazzi has a different approach. He bases his reasoning on a premiss drawn from natural science, namely from a principle of the most popular branch of Renaissance astrology, the theory of the great conjunctions, which links the recurring but rare conjunctions of some planets (Jupiter and Saturn, or, as in 'the great year', of all planets) with catastrophic or revolutionary events in world history.¹²³ It is noteworthy that two pupils of Pomponazzi, Paolo Ricci and Tiberio Russiliano, follow their teacher in defending Avicenna's theory of the spontaneous generation of human beings, but do not take over the pieces of conjunctionist astrology which Pomponazzi had introduced.¹²⁴

Since many of Pomponazzi's lectures are unpublished, it remains unclear how he explains the details of the process of spontaneous generation and how he accounts for the individuation of species in this process. From what has been said, it is certain that the celestial influence (*influxus celestis*) plays a major role. From a lecture on *De anima*, II.59 (417^b16–18), of the years 1517–18, i.e. of the same period as the lecture on the *Physics*, we know that the stars play a part in normal generation too, since God uses the celestial bodies as instruments in the production of all animate and inanimate forms;¹²⁵ in this process, the other intelligences and particular agents (such as the spirit in the

diluvia universalis, ideo non fit operatio nisi per virtutes stellarum etc., et demonstrat experimento quod hoc sit rationabile.' Cf. MS Paris, BN lat. 6533, fol. 516^r.

122. Nardi, *ibid.*, p. 318: 'convinctus ergo Avicenna his experimentis et rationibus posuit omne quod generatur ex propagine posse generari etiam ex putredine. et advertendum quod rationes adducte a Commentatore non sunt nisi debiles et futes et nihil concludunt contra Avicennam.' Cf. MS Paris, BN lat. 6533, fol. 517^r.

123. On the theory of the great conjunctions in the Renaissance see the old but informative account in A. Thorndike, *A History of Magic and Experimental Science*, vol. V, New York, 1941, pp. 178–233, and the brief chapter in E. Garin, *Astrology in the Renaissance: The Zodiac of Life*, London etc., 1990, pp. 1–28. The latest state of research is in S. Vanden Broecke, *The Limits of Influence: Pico, Louvain, and the Crisis of Renaissance Astrology*, Leiden and Boston, 2003.

124. See Paolo Ricci, *In apostolorum simbolum Pauli Ricii oratoris philosophi et theologi oculatissimi a priori demonstrativus dialogus*, Augsburg, 1514, esp. sig. i3^r, and Tiberio Russiliano, *Apologeticus adversus cucullatos*, ed. P. Zambelli, Milan, 1994, disp. 5, pp. 170–83.

125. B. Nardi, 'Origine dell'anima humana', in *id.*, *Studi su Pietro Pomponazzi*, Florence, 1965, pp. 231–46 (236): 'sed ad productionem animae utitur deus pro instrumento proprio corpore caelesti.'

seed) co-operate. Pomponazzi in this context explicitly refutes Avicenna's concept of the giver of forms and Scotus' position that the intellective soul is generated directly by God.¹²⁶ Neither concept is therefore likely to play a role in Pomponazzi's theory of spontaneous generation. But the relative importance of the other agents – God, the stars, the intelligences, and the particular agents – remains unclear at present.

In conclusion: what are the main lines of argument in the scholastic discussion? We have ended the above survey with a group advocating the spontaneous generation of human beings (Avicenna, Albertus, Blasius, Pomponazzi, Paolo Ricci, Tiberio Russiliano). This view was in conflict with the most popular scholastic position, the *media via* theory, which exempts complex animals from spontaneous generation (a tradition inaugurated by Thomas Aquinas). Only very few scholastic authors accepted Averroes' original theory that spontaneously generated animals are not true, but abnormal, animals (van der Lugt has pointed to the exceptional cases of John Vath and John of Jandun).¹²⁷ On the question of the causes of spontaneous generation, Averroes' theory of celestial influence became mainstream. The opponents of this theory can be classified as follows. There is one group of scholastic authors who chide the astrological tone of the theory (Henry of Langenstein), or decide not to mention the celestial bodies in this context at all (Alexander of Alexandria, Paul of Venice). Another group of authors deviates from the thesis of celestial bodies by making God responsible for generation in general and for spontaneous generation in particular (William of Auvergne). This is a theological position in the eyes of Duns Scotus, Nifo, and Pomponazzi, since it is based on the premiss that God is able to produce changes in the material world without mediation. A philosophical alternative is the Avicennian concept of the giver of forms. Apparently, it was embraced by some authors, but in a truncated form (John Buridan): Avicenna's theory of ever more refined mixtures of elementary qualities which trigger subsequent emanations of forms was not accepted by the authors surveyed. As to Themistius, I am not aware of a medieval supporter of his original idea that a divine entity has at some moment in time impregnated matter with forms and 'proportions'.

It has become clear that the choice of positions was much influenced by ontological preferences. The following questions have framed the history of the controversy over spontaneous generation from Aristotle to Pomponazzi: can forms be generated or is it concrete things that are generated? Do forms exist in concrete things only or do they exist separately from the individuals? Are species eternal or can they be destroyed and regenerated? Where is the ontological place of the formal information that ensures the generation of a new concrete being – in the parental form or in a separate form or in matter? And in particular: where is the ontological place of such information in cases

126. Nardi, *ibid.*, pp. 237–8: 'ideo dico aliter quod Aristoteles loco allegato loquitur de intellectu nostro possibili. talis enim dicitur venire de foris, non quia creetur anima nostra a deo, ut solvit Scotus, aut [a] colcod[e]a, ut voluit Avicenna, quia, ut supra dictum est, hoc mihi non videtur stare cum mente Aristotelis; sed intelligit Aristoteles quod intellectus possibilis veniat de foris per quandam appropriationem et assimilationem [...] sicut hic dicit Commentator quod anima intellectiva producatur ab intelligentia per quandam appropriationem.'

127. Van der Lugt, *Le Ver* (n. 1 above), p. 173.

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of spontaneous generation when there is no parental form? If it is said that matter is the origin of such spontaneous generation, two questions arise: first, is this generation due to the self-movement of matter or is it due to some external material cause such as the celestial bodies? And second, is it possible that all forms, including very complex forms, can be extracted from matter? If it is said that there is a separate immaterial entity which is responsible for the generation of forms, the question arises whether this entity is determined by material causes (as the giver of forms is determined by elementary mixtures) or whether, as a divine principle, it is independent of any causes. If it is a divine principle, does this entail that the generation of forms happens at will, without mediation, and *de nihilo*?

These questions are central to Greek, Arabic, and Latin metaphysics. It is therefore not surprising that the phenomenon of spontaneous generation received such a degree of attention. It hit a nerve of the world-view of the classical tradition.¹²⁸

128. I explore the modern continuation of the discussion of spontaneous generation, with particular reference to Pierre Gassendi and Louis Pasteur, in D. N. Hasse, *Urzeugung und Weltbild: Aristoteles — Ibn Ruschd — Pasteur*, Hildesheim, 2006.