Aristotle, On the Life-Bearing Spirit (*De Spiritu*)

A Discussion with Plato and his Predecessors on *Pneuma* as the Instrumental Body of the Soul

Introduction, Translation, and Commentary by

Abraham P. Bos & Rein Ferwerda

BRILL

Aristotle, On the Life-Bearing Spirit (*De Spiritu*)

A Discussion with Plato and his Predecessors on *Pneuma* as the Instrumental Body of the Soul

Introduction, Translation, and Commentary by

Abraham P. Bos and Rein Ferwerda

BRILL

LEIDEN • BOSTON
2008

On the cover: Water, by Esther van't Land (2007). Published with the kind permission of the artist.

This book is printed on acid-free paper.

Library of Congress Cataloging-in-Publication Data

Bos, A. P.
Aristotle, On the life-bearing spirit (De spiritu) : a discussion with Plato and his predecessors on pneuma as the instrumental body of the soul : introduction, translation, and commentary / by Abraham P. Bos and Rein Ferwerda.
p. cm.
Includes bibliographical references (p.) and indexes.
ISBN 978-90-04-16458-1 (hardback : alk. paper) 1. Aristotle. De spiritu. 2. Soul. 3. Psychology. 4. Life. 5. Plato. Timaeus. I. Ferwerda, R. (Rein) II. Title. III. Title: On the life-bearing spirit (De spiritu).

B463.B67 2008
128'.1—dc22

2008002439

ISBN 978 90 04 16458 1

PRINTED IN THE NETHERLANDS

The authors are grateful to the Netherlands Organization for Scientific Research (NWO) for providing a grant towards an English translation.

CONTENTS

LIST OF ABBREVIATIONS

Anim.	*De anima*	*On the soul*
E.N.	*Ethica Nicomachea*	*Nicomachean Ethics*
Eudem.	*Eudemus**	*Eudemus or On the soul**
G.A.	*De generatione animalium*	*Generation of animals*
H.A.	*Historia animalium*	*Historia animalium*
I.A.	*De incessu animalium*	*Progression of animals*
Iuv.	*De iuventute*	*On youth and old age*
Long.	*De longitudine vitae*	*On length of life*
M.A.	*De motu animalium*	*Movement of animals*
Metaph.	*Metaphysica*	*Metaphysics*
Meteor.	*Meteorologica*	*Meteorology*
Mund.	*De mundo*	*On the cosmos*
P.A.	*De partibus animalium*	*Parts of animals*
Phaedr.	*Phaedrus*	*Phaedrus*
Philos.	*De philosophia**	*On philosophy**
Pl.	Plato	Plato
Pol.	*Politica*	*Politics*
Probl.	*Problemata*	*Problems*
Resp.	*De respiratione*	*On respiration*
Rhet. ad Alex.	*Rhetorica ad Alexandrum*	*Rhetoric to Alexander*
Sens.	*De sensibus*	*On sense and sensible objects*
Spir.	*De spiritu*	*On the life bearing spirit*
Somn.	*De somno*	*On sleeping and waking*
Tim.	*Timaeus*	*Timaeus*

INTRODUCTION

The Aristotelian Corpus includes a work entitled '*Peri pneumatos*', usually cited by its Latin title '*De spiritu*'. References to this text are rare in the modern era. Aristotle's authorship has been almost generally denied since the 15th century.[1] The only exception to prove the rule is P. Gohlke.[2]

The Greek text of the work, fourteen pages in all, leaves much to be desired. But the subject announced in the opening sentence may arouse the reader's curiosity. We read there: 'The innate *pneuma*, how does it maintain itself and grow?'[3]

The 'innate *pneuma*'[4] is a central subject in Aristotle's biological works. For living creatures this substance is often presented as being crucial to the quality of their life, perception, mental activity, and physiological vigour. According to a famous text in *De generatione animalium* II 3, 736b30–737a1, *pneuma* is already present in semen and is an analogue of the astral element, which is responsible for the fertility and life-generating power of semen. It seems natural to assume that there is

---

[1] Cf. J. Tricot (1951) v and ix; A. Roselli (1992) 17 (see n. 3 below).

[2] P. Gohlke, *Die Entstehung der Aristotelische Prinzipienlehre* (Tübingen 1949) 88; id. *Aristoteles, Kleine Schriften zur Seelenkunde* (Paderborn 1947) 18 and 196. Gohlke does see the work as uncompleted, a sketch, from Aristotle's final phase (21).

[3] *Spir.* 1, 481a1: Τίς ἡ τοῦ ἐμφύτου πνεύματος διαμονὴ καὶ τίς ἡ αὔξησις; Cf. *Motu anim.* 10, 703a10; *Iuv.* 6, 470a22 ff.; *Resp.* 5, 472b7. For *Spir.* see *Aristotelis De animalium motione et De animalium Incessu; Pseudo-Aristotelis de Spiritu libellus*, ed. V.G. Jaeger (Leipzig 1913); *The Works of Aristotle*, transl. into English under the editorship of W.D. Ross, vol. III (Oxford 1931) *De spiritu* by J.F. Dobson (first edition 1914); *Aristotle, On the soul; Parva naturalia; On breath* with an English transl. by W.S. Hett (London 1936); *Aristoteles, Kleine Schriften zur Seelenkunde*, übers. von P. Gohlke (Paderborn 1947; repr. 1953); *Aristote, Parva naturalia suivis du Traité Ps.-aristotélicien* De spiritu, trad. nouvelle et notes par J. Tricot (Paris 1951); *The Complete Works of Aristotle. The Revised Oxford Translation* ed. by J. Barnes (Princeton 1984) vol. 1 (As regards *Spir.* this edition is almost identical to Dobson's 1914 edition); *[Aristotele] De spiritu* a cura di A. Roselli (Pisa 1992), with a revised Greek text based on a collation of additional manuscripts and with a critical apparatus, translation and commentary.

[4] 'Innate' should not be mistaken to mean 'present from birth'. *Spir.* 5, 483a13 notes that though respiration starts at birth, nutrition and growth occur before birth, owing to *pneuma* or vital heat. *Pneuma* is best left untranslated. If we must choose an English equivalent, 'vital' or 'life-bearing spirit' is better than 'vital breath', because the latter term suggests a connection with respiration. For the translation of the title we opted for 'Life-Bearing Spirit'.

more *pneuma* in a fully grown living creature than in the semen through which the creature was formed (or in the menstrual blood fertilized by it). The obvious question then is: what maintains *pneuma* and how does the volume of *pneuma* increase?

A generally acknowledged work by Aristotle also seems to have underlined the interest of this theme. *De motu animalium*, in a section which emphasizes the importance of *pneuma* in living creatures, contains the following remark: 'How this innate *pneuma* is preserved has been set out elsewhere.'[5] The question is whether this refers to any particular part of the Corpus.

Another intriguing feature of the *De spiritu* text is that it seems to say that *pneuma* 'is connected with the soul'.[6] But the author also says that it 'is the vehicle of the soul in a primary sense'.[7] These are remarkable statements which compel us to ask: how does the position of *De spiritu* relate to Aristotle's generally recognized doctrine of soul? In passing the author also suggests that the innate *pneuma* is 'the primary moving cause'.[8] His argument against the position that *pneuma* increases through the process of respiration is completely in line with Aristotle's method. He contends that there are also living creatures which do not

---

[5] *Motu anim.* 10, 703a10: τίς μὲν οὖν ἡ σωτηρία τοῦ συμφύτου πνεύματος, εἴρηται ἐν ἄλλοις. E. Zeller, *Die Philosophie der Griechen in ihrer geschichtlichen Entwicklung*, Zweiter Teil, Zweite Abteilung, 'Aristoteles und die alten Peripatetiker' (Leipzig 4th ed. 1921; repr. Hildesheim 1965) II 96 n. and 937–38 had denied *De motu animalium* to Aristotle on account of this 'reference to *De spiritu*'. The passage is usually regarded as an aside and put between brackets. In Jaeger's view the reference forms an interruption and seems to duplicate 703a16: 'Whether the *pneuma* is always the same or is always changing must be discussed elsewhere' (πότερον μὲν οὖν ταὐτόν ἐστι τὸ πνεῦμα ἀεὶ ἢ γίνεται ἀεὶ ἕτερον, ἔστω ἄλλος λόγος) (art. 1913; repr. 1960, p. 76). Cf. E.S. Forster (1937) 472; M.C. Nussbaum, *Aristotle's De motu animalium*. Text with translation, comm. and interpretive essays (Princeton 1978; repr. 1985) 375. In *De somno* 2, 456a8 Aristotle remarked: 'Nature has supplied both breathing and the power of cooling by moisture with a view to the conservation of the heat in that part. This will later be discussed separately' (τὸ ἀναπνεῖν τε καὶ τῷ ὑγρῷ καταψύχεσθαι πρός γε τὴν σωτηρίαν τοῦ ἐν τούτῳ μορίῳ θερμοῦ ἡ φύσις πεπόρικεν· ῥηθήσεται δὲ περὶ αὐτῆς ὕστερον καθ' αὑτήν). W.D. Ross, *Aristotle, Parva naturalia*. A revised text with introd. and comm. (Oxford 1955) 260 connects this with *Iuv.* 14 and 19. Cf. also *Resp.* 6, 470a20: 'The assistance which plants get through food and the surrounding air is sufficient for the preservation of their natural heat' (τοῖς μὲν φυτοῖς ἡ διὰ τροφῆς καὶ τοῦ περιέχοντος ἱκανὴ γίνεται βοήθεια πρὸς τὴν τοῦ φυσικοῦ θερμοῦ σωτηρίαν).

[6] *Spir.* 1, 481a16: καθαρώτερον γὰρ ὃ τῇ ψυχῇ συμφυές. Cf. also 9, 485b13: 'Therefore it is not incorrect to identify it with them' (διόπερ οὐ κακῶς εἰς ταὐτόν), referring to the unity of the soul and *pneuma* as its instrument.

[7] *Spir.* 5, 483b10: τὸ πρῶτον δεκτικὸν ψυχῆς. Cf. also 3, 482b23.

[8] *Spir.* 2, 481b17: τὸ πρῶτον κινοῦν. Cf. 8, 485a7: τὸ πνεῦμα τὸ κινητικόν.

breathe (but which do possess *pneuma*).[9] Also, 5, 483b24 seems to refer to the *Anatomies*, a source which Aristotle often cites in his biological works.[10] Such references are found only in Aristotle's work.[11] But in 3, 482b8 the author also says: 'Therefore we must, as we said, look at respiration, the purpose for which it takes place and for which parts and how.' The words 'as we said' may well refer back to *De respiratione* 3, 471b26–29.

2. *What was known about* De spiritu *in Antiquity?*

The title of a work 'On *pneuma*' is absent in the Greek lists of Aristotle's writings[12] but it is mentioned in the Arabic catalogue of Ptolemy el-Garib. Some modern authors believe that Galen and Pliny may have referred to *De spiritu*.[13]

---

[9] *Spir.* 2, 482a8; 482a22.

[10] Cf. W.D. Ross, *Parva naturalia* (1955) 264: 'References in A. to ἀνατομαί are frequent. Sometimes the reference is to actual dissections (*De Juv.* 474b9; 478a27; *De Part.* 677a9; *De Gen. An.* 746a22, 764a35, 771b32, 779a8); in other cases the reference is to the record of dissections in a work now lost (e.g. . . . . *Hist. Anim.* 497a32; cf. ibid. 525a9, 566a15, *De Gen. An.* 746a15).' See also n. 11 below.

[11] Curiously, this passage represents the position of others, so that it seems in *Spir.* that Aristotle's opponents are citing material from the *Anatomies*. For W. Jaeger, 'Das *Pneuma* im Lykeion', *Hermes* 48 (1913) 29–74; reprinted in id. *Scripta minora* (Roma 1960) 57–102, repr. p. 62, it is unthinkable that a later pupil of Aristotle would refer to the *Metaphysics*, as in *Motu anim.* 1, 698a7, but he makes light of the idea that such a 'handbook' would have been cited by a later author. Note, however, that 5, 483b22–23 says that the *artèria* contains moisture. This seems to imply that a corpse has been observed. If it is then said that 'ἐκ τῶν ἀνατομῶν is clear', we could specifically relate this to the dissection of corpses.

[12] W. Jaeger (art. 1913; repr. 1960) 77 observes that *De motu animalium* occurs in Hesychius (no. 156) and Ptolemy (no. 41), but *Spir.* does not. However, as A. Roselli (1992) 13 n. 1 indicated, a *De spiritu* in three books is mentioned in the Arabic catalogue ascribed to Ptolemy el-Garib, no. 24 in the numbering according to the new Arabic manuscript found in Istanbul and presented in C. Hein, *Definition und Einteilung der Philosophie. Von der spätantiken Einleitungsliteratur zur arabischen Enzyklopädie* (Frankfurt am Main/Bern/New York 1985) 388–439. P. Moraux, *Les listes anciennes des ouvrages d'Aristote* (Louvain 1951) 294 notes of *Spir.*: 'L'ouvrage (en un seul livre) est bien issu de l'école péripatéticienne, mais il est sûrement postaristotélicien. L'auteur fait montre de connaissances d'ordre anatomique et médical qui permettent de le situer vers le milieu du 3ᵉ siècle avant J.-C.' See also p. 300.

[13] Cf. Galen, *De simpl. med. temp. et fac.* V 9 (XI 730,16 ff., ed. G.C. Kühn): 'But we must recognize that the vital heat is meant, which we also call *pneuma* in all animals. Aristotle has written about this' (ἀλλ' ἡμᾶς χρὴ . . . γιγνώσκειν ἔμφυτον εἰρῆσθαι θερμόν, ὅπερ καὶ πνεῦμα ἑκάστῳ τῶν ζῴων ὀνομάζομεν, ὑπὲρ οὗ καὶ Ἀριστοτέλης ἔγραψεν),

3. *What has been said about* De spiritu *in the modern era?*

In his well-known 1913 article W. Jaeger also discusses *De spiritu*.[14] But first he outlines Aristotle's doctrine of *pneuma*, which he believes to be the earliest identifiable representative of the doctrine of an innate *pneuma* (p. 71): 'Alle Lebewesen besitzen angeborenes Pneuma, in ihm wurzelt ihre Lebenskraft' (p. 74). This also applies to *De motu animalium*.

Briefly summarizing the contents of *De spiritu*, he stresses how incoherent its composition is. The opening question of *De spiritu*—how does the innate *pneuma* maintain itself and grow?—is dealt with rather tentatively in the first two chapters (p. 86). The author then goes on to discuss various issues regarding respiration and the functions of blood. Everything Jaeger considers dissatisfactory here is seen to result from an abridgement of a more extensive discussion. This abridgement was carried out by a person with little talent and expertise (p. 89). Jaeger is nevertheless prepared to assume some coherence for chapters 1 through 8. In his view, however, chapter 9 is a later addition by a Stoic with an interest in the Peripatetic theory of the innate *pneuma*.[15]

In arguing against the work's authenticity, Jaeger follows V. Rose, whom he greatly admires.[16] In his accepted writings Aristotle shows knowledge of two kinds of blood, but only of one kind of blood vessel (*phlebes*). And the Greek word *artèria* means 'windpipe' in Aristotle. According to Jaeger, however, *De spiritu* distinguishes 'veins' (*phlebes*) and *artèriai* to designate the system of veins and arteries.[17] Jaeger believes

---

and Pliny, *Nat. hist.* XI 220, which looks like a quotation of *Spir.* 6, 484a35. Cf. A. Roselli 13.

[14] W. Jaeger, 'Das *Pneuma* im Lykeion', (1913; repr. 1960) esp. 86–100. At the same time Jaeger published a text edition of *De motu animalium*, *De progressu animalium*, and *De spiritu* in the Bibliotheca Teubneriana. The article provides the reasons why Jaeger considers the authenticity of *De motu animalium*, which had been denied since V. Rose, *De Aristotelis librorum ordine et auctoritate* (Berlin 1854) 163, to be absolutely unassailable, but also why *De spiritu* is clearly non-Aristotelian. O. Regenbogen, 'Theophrastos', in *P.W.-R.E.* supplem. vol. VII (Stuttgart 1940) 1354–1562, cols. 1545–1546 agrees with Jaeger.

[15] W. Jaeger (repr. 1960) 98–100. On that chapter, see earlier E. Neustadt, *Hermes* 44 (1909) 60–69. Jaeger's chief objection to chapter. 9 is that it assigns such an important role to fire. But the author of *Spir.* 9, 485b9 says quite explicitly that the generation of living entities is not a matter of fire or *pneuma* (in itself), but of the soul which uses fire as its instrument. The theory of *Anim.* II 4, 416a9–18 is not fundamentally different. The fact that the Stoa also talked about a 'creative fire' (τεχνικὸν πῦρ) is entirely irrelevant as an argument against the work's authenticity.

[16] V. Rose, *De Aristotelis librorum ordine et auctoritate* (Berolini 1854) 163 ff.

[17] W. Jaeger (repr. 1960) 89. J. Tricot (Paris 1951) v, regards this argument as

that it depends here on the anatomist Praxagoras of Cos, who developed this notion at the same time as Aristotle or slightly later (p. 89). But this dependence must have been mediated by Praxagoras' pupil Erasistratus, who (unlike Praxagoras) was also a Peripatetic.[18]

J.F. Dobson (1914)

The Works of Aristotle Translated into English, vol. III (Oxford 1931) includes the translation of *De spiritu* which J.F. Dobson published in 1914. In the Preface the author notes: 'This treatise has been rejected as spurious by practically all editors, one of the chief reasons being the confusion of the senses assigned to *artèria*. It is sometimes ascribed to Theophrastus. Its author had certainly studied the Aristotelian Corpus, and analogies may be traced to the *de Respiratione* and some of the zoological treatises.'

The translation used Jaeger's 1913 edition of the Greek text. Despite its countless defects, it was included without any changes in *The complete works of Aristotle* (1984).

W.S. Hett (1936)

W.S. Hett (1936) 484–485 calls *Spir.* 'obviously un-Aristotelian'. He observes 'a general lack of coherence in the thought'. The work's central notions, *pneuma* and *artèria*, are left clouded in obscurity.

Also, the Greek text (which Hett adds in his edition) is uncertain in many places, often making a satisfactory interpretation impossible.

P. Gohlke (1947)

P. Gohlke, always a stalwart defender of the texts attributed to Aristotle, must concede in the Introduction to his translation (1947) 18–21 'dass man wirklich an ihrer Echtheit zweifeln könnte.' (18) The work is clearly incomplete and little more than a compendium of notes. Yet

---

unsound: 'l'auteur, quel qu'il soit, entend par artères, non pas les vaisseaux sanguins, mais des ramifications respiratoires, ce qui enlève toute portée à cette prétendue distinction'. Cf. also 176 n. 4; 181 n. 2.

[18] W. Jaeger (repr. 1960) 90. Cf. C.R.S. Harris, *The Heart and the Vascular System in Ancient Greek Medicine* (Oxford 1973) 97 ff. For Harris's assessment of *Spir.*, see also pp. 164 and 175–176 n. 1.

Gohlke maintains 'dass Aristoteles selber die Schrift in ihrem jetzigen Zustande hinterlassen hat.' (18)

The work's theme, the 'Lebensluft', disappears from view in the last section (19). But the theme does belong to the philosopher's last phase (20).

Gohlke sees the work's statements on *artèriai* as a new insight into the difference between arteries and veins as we recognize it today (20).

The author proposes corrections to the Greek text in twelve places. His own translation of the Greek text needs to be corrected in even more places.

J. Tricot (1951)

De spiritu was first published in French in this translation of the *Parva naturalia* and *De spiritu*. Tricot assigns the work to the oeuvre of the physician Erasistratus of Ceos and dates it to c. 250 BCE (p. v).

Importantly, Tricot notes that the use of the term *artèria* in the work does not indicate the author's familiarity with the distinction between the venous and the arterial systems, as Jaeger and others had claimed.[19] In *De spiritu*, says Tricot, *artèriai* are not blood vessels but branches of the windpipe. *De spiritu* has no knowledge of the distinction between veins and arteries in the vascular system (pp. v; 176, n. 4).

Tricot did not use the translations by W.S. Hett (1936) and P. Gohlke (1947).

A. Kenny (1976)

In 1976 A. Kenny published an article 'The stylometric study of the Aristotelian writings', in which he describes the results of three tests on the language of the treatises in the Corpus Aristotelicum. The article was republished in *Essays on the Aristotelian tradition* (Oxford 2001) 127–149. On p. 147 Kenny shows in Table 10.6 that *De spiritu* emerges from all three tests as a genuine Aristotelian work, though the consensus of the authorities selected by Kenny described the work as inauthentic. Kenny notes on p. 146 that the arguments against the authenticity of

[19] Likewise P. Siwek s.j., *Aristotelis Parva naturalia* (Romae 1963) 353 in n. 144 on *Resp.* He remarks there: 'Whoever the author may be, it is certain that he was thoroughly familiar with the Peripatetic sciences and astutely elaborated and rounded off many matters only hinted at in *De respiratione.*'

De spiritu do not appear to him to be decisive. Earlier he had usefully applied stylometry in his book *The Aristotelian Ethics. A Study of the Relationship between the Eudemian and the Nicomachean Ethics of Aristotle* (Oxford 1978), concluding that the common books of the *Ethica Eudemia* and the *Nicomachean Ethics* should be assigned to the former work.

M.C. Nussbaum (1978)

In her valuable edition with commentary of *De motu animalium*[20] M.C. Nussbaum also makes some remarks on *De spiritu*. She notes that '[V.] Rose denied that the *MA* could be connected with the obviously inferior *De Spiritu*...' 'And in general we have every reason to dissociate this careful and interesting treatise [*MA*] from the messy later work.' (p. 7)

In her commentary on *MA* 10, 703a10–11 she notes: 'The *De Spiritu* is a confused and inferior late work that does not even profess to be by Aristotle and acknowledges its late date by references to the theories of Aristogenes of Knidos, who wrote around the middle of the third century B.C.' (p. 375).

The Revised Oxford Translation (1984)

This new edition of the *Complete Works of Aristotle* assigns two asterisks to *De spiritu*, explaining: 'a pair of asterisks indicates that its spuriousness has never been seriously contested.' (p. XIII)

The translation by J.F. Dobson has been integrally adopted, including mistakes like those in 2, 482a9; 482b6–7; 3, 482b6; 5, 483b31; 484a7 and the gross error in 8, 485a22. However, the footnotes omit some of Dobson's comments.

J.E. Annas (1992)

In her book *Hellenistic Philosophy of Mind* (Berkeley/Los Angeles/Oxford 1992) J.E. Annas supports M.C. Nussbaum in her assessment of *De spiritu* as 'a dismal little work'... 'clearly written in the later Lyceum, since the author knows of Erasistratus' discoveries' (27). On account of this incorrect appraisal she notes on p. 17: 'What is most striking

[20] *Aristotle's De motu animalium*. Text with translation, comm. and interpretive essays by M.C. Nussbaum (Princeton 1978; repr. 1985).

about Hellenistic medical theory, by contrast with Aristotle's work, is the prominence it gives to the notion of *pneuma*...'. Though she believes that Aristotle gave the initial impetus for this, 'Aristotle has no overall coherent view of the biological role of *pneuma*; perhaps he would have developed one if he had lived longer.' (20)

A. Roselli (1992)

A. Roselli published a new edition of the Greek text with translation and commentary of *De spiritu* in 1992.[21] She follows W. Jaeger in concluding that it is a rather early Peripatetic text, but believes that it uses insights developed by the well-known Hellenistic scholar Erasistratus, though his name is not mentioned.[22] The physician Aristogenes, who is mentioned and discussed in *De spiritu*,[23] is said to have been writing around the middle of the third century BCE.[24]

According to Roselli, *De spiritu* owes its name to the work's first two chapters. But the author fails to develop his own position in these. The next two chapters deal with subjects that do have a certain connection with the theme of *pneuma*. Chapters 5 and 6 are the least comprehensible. They reproduce abstracts of texts by others. They are followed by chapters on the bones (chap. 7) of living creatures and on locomotion (chap. 8). The final chapter talks about the role of vital heat in all that lives.

According to Roselli, then, the entire work is fragmentary and fails to tell us anything about the author's own views (p. 5). For this reason she has given up on the idea of finding a coherent series of positions in the work (p. 6). Roselli finds it more useful to compare the treatise with the medical text of the *Anonymus Londinensis* and with the Hippocratic Corpus and the work of later medical authors like Galen.

Roselli notes an ambivalent use of the term *artèria* in the work, sometimes linking up with the older anatomical tradition, sometimes following the newer (p. 10).

---

[21] See R. Sharples's review in *Classical Review* 43 (1993) 254–255.

[22] A. Roselli (1992) 18 and 10.

[23] *Spir.* 2, 481a28 ff.

[24] Cf. W. Jaeger (repr. 1960) 91 and 101; A. Roselli (1992) 76–78. A man by this name who came from Cnidos was supposedly a pupil of the physician Chrysippus, who was also Erasistratus' teacher.

Likewise the term *neuron* sometimes occurs in the early sense of 'sinew' and sometimes in the newer, Alexandrian sense of 'nerve' (p. 11).

Remarkably, Roselli rejects the view of E. Neustadt (1909) and W. Jaeger (1913) that the final chapter is much later than the rest and moves outside the Peripatetic tradition (p. 12).

According to Roselli, the work is important because it allows us to reconstruct some of the discussions following from the anatomical discoveries by Alexandrian physicians (p. 12).

Roselli did not use P. Gohlke's German translation (1947).

4. *Critical evaluation of the modern debate*

It is astonishing how confidently Jaeger spoke in his 1913 article and how since then every student of *De spiritu* has followed in his footsteps, while on the other hand many other scholars have neglected the work, because they accepted Jaeger's authority without question. Jaeger is convinced that Aristotle is not the author of *De spiritu*. Virtually the only arguments he adduces are those which support this position. But we should look at the other side of the picture as well: if the work is later than Aristotle's time, which facets of the work can be seen to sit uncomfortably with this date?

Thus the work mentions an Aristogenes who defended a theory of *pneuma* that is rejected by the author of *De spiritu*. Aristogenes' position seems to have been that respiration increases the volume of the innate *pneuma* during the growth of an individual. Each of the arguments marshalled against this view in *De spiritu* can be found in Aristotle's recognized work. Another view attributed to the opponents is that fishes have a respiratory system.[25] As in Aristotle's generally recognized works, the author of *De spiritu* argues that water does not contain air.

The question urges itself: isn't the theory attributed to Aristogenes rather naïve and simplistic and could it have been defended a hundred years after Aristotle's death? First of all we need to examine whether the theory which Aristotle disputes in *De respiratione* 6 is the same as that of 'Aristogenes' in *De spiritu* 2. *De respiratione* 6 dismisses a theory which holds that respiration serves to 'feed' the 'internal fire' of a

[25] *Spir.* 5, 483b34. It would be interesting to point out examples of such a position from the time around 250 BCE.

living creature, in the sense that the inhaled air provides fuel for the vital heat. Jaeger was convinced that the 'Aristogenes' of *De spiritu* came from Cnidos and lived in the time of Erasistratus and King Antigonus Gonatas, whose physician he was.[26] But there is no indication of this in the work itself. There was probably more than one Aristogenes.[27] And it is doubtful whether an opponent criticizing an Aristogenes who lived a hundred years after Aristotle could have awarded the special kind of mediatory role to *pneuma* as 'Seelenorgan'[28] which *pneuma* possesses in *De spiritu*.

Modern authors who date *De spiritu* after Aristotle's death should also explain why this text, like the *Parva naturalia*, mainly conducts a debate on theories like those of Empedocles (who is mentioned three times) and Democritus, whereas (apart from the name 'Aristogenes') it fails to mention (contemporaries of) Praxagoras or Erasistratus.[29]

Rose and Jaeger are doubtless right when they point to a difference in terminology between most of Aristotle's biological works and *De spiritu*, particularly in regard to the term *artèria*. In the work this term sometimes seems to denote an air passage and sometimes a blood vessel. But it is unclear what consequences should be attached to this. We know that the distinction between two parts of the vascular system was familiar to Aristotle in *De generatione animalium*.[30] But there is no indication that he connected this with a distinction between oxygen-rich and oxygen-poor blood.

Jaeger also regards Erasistratus as the source of *De spiritu*, because he believes that the work no longer assigns a role to the soul: nature has

---

[26] W. Jaeger (repr. 1960) 91.

[27] M. Wellmann, 'Aristogenes', *P.W.-R.E.* II 1 (Stuttgart 1895) cols. 932–933 mentions four more people with the same name. And, of course, the claim that the work cannot be Aristotelian because the name of Aristogenes occurs in it is just as strong as the claim that the Aristogenes in question must have lived before 322 because he is mentioned in a work by Aristotle.

[28] Cf. W. Jaeger (repr. 1960) 83–84: after Aristotle 'bricht die kunstvolle Synthese des Aristoteles notwendig einmal wieder auseinander'.

[29] A. Roselli (1992) 76 notes: 'la menzione di Aristogene fornisce l'unico elemento esplicito per la datazione di *Spir.*'

[30] P. Siwek s.j. (1963) 353 wrongly states that Aristotle was unfamiliar with this distinction. Cf. *Gener. anim.* II 4, 738a11: 'Higher up in the body the two blood-vessels, the Great Blood-vessel and the Aorta branch out into many fine blood-vessels, which terminate in the uterus' (transl A.L. Peck) (σχιζομένων ἄνωθεν τῶν δύο φλεβῶν, τῆς μεγάλης καὶ τῆς ἀορτῆς, πολλαὶ καὶ λεπταὶ φλέβες τελευτῶσιν εἰς τὰς ὑστέρας). A.L. Peck in *Aristotle, Generation of animals*, with an English translation (London 1942) 180 n. a comments here: 'the *vena cava* and the whole venous system, and the aorta and the whole arterial system'. See also 740a28.

taken its place and a blind mechanism of *pneuma*-matter seems to be posited.[31] We should note, though, that the author of this work, though focusing on *pneuma*, most certainly knows that *pneuma* is only so important because it is the primary vehicle and instrument of the soul![32]

5. *Vital heat as the soul's multifunctional instrument in chapter 9*

In view of the foregoing, it may be useful to look in somewhat more detail at chapter 9, which concludes *De spiritu*. The author enters into a debate there with those who refuse to attribute any productive activity to 'fire', but are willing only to award it one power: the power to cut.[33] A striking point here is that the author uses the term 'to bring about', 'to produce'. This term also featured in Aristotle's criticism of Plato's theory of Ideas in *Metaphysics* A 9, where Aristotle blamed Plato for distinguishing only between the Ideas and that which receives the Ideas. According to Aristotle, 'a productive factor' was lacking in Plato's system.[34]

The term had also featured in *De anima* II 4, where Aristotle states that fire by itself cannot be 'the productive principle', but 'fire-under-the-soul's-direction' can.[35]

The author of *De spiritu* disputes the views he rejects by pointing out that heat has very different effects on different substances: it can condense and rarefy, dissolve and harden substances.[36] Aristotle had mentioned the same variation in effects of *pneuma* in *De motu animalium* 8.[37]

---

[31] W. Jaeger (repr. 1960) 96.

[32] Cf. *Spir.* 1, 481a17 and all of chap. 9.

[33] *Spir.* 9, 485a28: 'Our opponents who hold that it is not the vital heat which is the efficient principle in bodies, or that fire has only one direction of movement and only a power to cut, are wrong' (Οἱ ἀναιροῦντες ὡς οὐ τὸ θερμὸν τὸ ἐργαζόμενον ἐν τοῖς σώμασιν, ἢ ὅτι μία τις φορὰ καὶ δύναμις ἡ τμητικὴ τοῦ πυρός, οὐ καλῶς λέγουσιν). A. Roselli (1992) 123 notes that Arist. *Cael.* III 5, 304a12 and 8, 307a26 urges this criticism against Plato's *Tim.* 56a.

[34] *Metaph.* A 9, 991a22: 'What is the entity which produces while contemplating the Ideas?' (τί γὰρ ἐστι τὸ ἐργαζόμενον πρὸς τὰς ἰδέας ἀπόβλεπον;) Aristotle repeatedly criticizes his teacher for the lack of a 'third principle'; cf. *Metaph.* A 9, 991b3–5; *Gener. corr.* II 9, 335a30; 335b8. Ambrose, *Hexaëmeron* I 1, 1 had therefore attributed to Aristotle not only the principles of 'species' and 'materia' but also a third principle, which he called 'operatorium'.

[35] *Anim.* II 4, 416a9–18. Cf. also *Iuv.* 4, 469b6–13.

[36] *Spir.* 9, 485a32: 'some things it condenses, others it rarefies, others it dissolves, yet others it hardens' (τὰ μὲν πυκνοῖ, τὰ δὲ μανοῖ, καὶ τήκει, τὰ δὲ πήγνυσιν).

[37] *Motu anim.* 8, 702a9–10: 'changing as they do from solid to liquid and from liquid

In *De generatione animalium* II 1 he had also presented these qualities as being caused by vital heat and its decrease.[38] But he was quick to add that the 'exact proportion', the *logos* of these qualities, was not a result of heat but of the governing principle![39]

As regards production in living creatures, we should assume the same state of affairs, and try as it were to discern 'the fire of nature', like the fire of craft (in the cases mentioned earlier).[40] Looking at the various crafts, we can observe the different effects of fire which melts gold and casts bronze and dries brick and cooks food. Or, rather perhaps, the crafts have these different effects. But they have these effects while using fire for their various purposes. For they use fire as an instrument for melting, for casting, and for drying, but in some cases for purposes of shaping.[41]

Just as we can say of these craftsmen that, besides their specific tools, they use fire as *sôma organikon*, so Aristotle argued in *De anima* I 3 that the soul uses its *sôma* as an instrument.[42] *De spiritu* makes it perfectly clear that the soul's 'instrumental body' is not the visible body but *pneuma* (or its analogue).

---

to solid, and from soft to hard and vice versa' (μεταβάλλοντα ἐκ πεπηγότων ὑγρὰ καὶ ἐξ ὑγρῶν πεπήγοτα καὶ μαλακὰ καὶ σκληρὰ ἐξ ἀλλήλων).

[38] *Gener. anim.* II 1, 734b31: 'As for hardness, softness, toughness, brittleness and the rest of such qualities which belong to the parts that have soul in them—heat and cold may very well produce these' (σκληρὰ μὲν οὖν καὶ μαλακὰ καὶ γλίσχρα καὶ κραῦρα καὶ ὅσα ἄλλα τοιαῦτα πάθη ὑπάρχει τοῖς ἐμψύχοις μορίοις, θερμότης καὶ ψυχρότης ποιήσειεν ἄν). For this work, see also *Aristoteles, Over voortplanting*, vertaald, ingeleid en van aantekeningen voorzien door R. Ferwerda (Groningen 2005). See also *Part. anim.* II 2, 648a20–649b8.

[39] *Gener. anim.* II 1, 734b33–735a4.

[40] *Spir.* 9, 485a33: 'We must therefore assume that the same situation applies to ensouled creatures, when we inquire into what can be called the fire which nature uses, as into the fire which craft uses' (ἐν δὲ δὴ τοῖς ἐμψύχοις οὕτως ὑποληπτέον, ὥσπερ φύσεως πῦρ ζητοῦντα, καθάπερ τέχνης).

[41] *Spir.* 9, 485b1: 'For they use fire as an instrument to soften or melt or dry things, and also to shape some things' (χρῶνται γὰρ ὥσπερ ὀργάνῳ μαλάττουσαι καὶ τήκουσαι καὶ ξηραίνουσαι, ἔνια δὲ καὶ ῥυθμίζουσαι). It is interesting to compare the argument of Arist. *Pol.* I 2, 1252b1–3, where Aristotle reasons that nature does not try to produce a kind of Swiss army-knife with dozens of functions: 'Nature is not niggardly like the smith who fashions the Delphian knife for many uses; she makes each thing for a single use' (οὐδὲ γὰρ ἡ φύσις ποιεῖ τοιοῦτον οἷον οἱ χαλκοτύποι τὴν Δελφικὴν μάχαιραν πενιχρῶς, ἀλλ' ἓν πρὸς ἕν).

[42] *Anim.* I 3, 407b25: 'each craft must employ its own tools, and each soul its own body' (δεῖ γὰρ τὴν μὲν τέχνην χρῆσθαι τοῖς ὀργάνοις, τὴν δὲ ψυχὴν τῷ σώματι).

'The natural vital principles (of living creatures) do the same. Hence their products differ,' says the author of *De spiritu*.[43] These vital principles play the same role in nature as the crafts in human production. That is to say, they provide the *logos* for the effect of fire.[44]

'And this is not problematical, but rather it is hard to understand that nature herself uses the vital heat, and that, together with the visible qualities, nature also produces the form. For this is no longer a matter of fire or *pneuma*.'[45] This observation, too, is entirely Aristotelian, as we can particularly infer from the passage in *De generatione animalium* II 1 cited above.[46] The author then continues: 'It is clearly remarkable that such a power should be combined with these matters [i.e. 'fire' and '*pneuma*']. And the case is just as remarkable with the soul. For it is present in them.'[47]

In any case the author of *De spiritu* is saying in plain words here that the soul is present in 'fire' and in '*pneuma*'. In 5, 483b11 he had also said that *pneuma* is the primary vehicle of the soul. Thus *De spiritu* uses the same authentically Aristotelian system as *De motu animalium* 10: *pneuma* is the vehicle of the soul, the visible body is animated by the presence of *pneuma*.

This is followed by a few lines of which it is very difficult to determine what the author exactly means.[48]

---

[43] *Spir.* 9, 485b3: Τὸ αὐτὸ δὴ τοῦτο καὶ αἱ φύσεις· ὅθεν δὴ καὶ πρὸς ἄλληλα διάφορα. (The Greek manuscripts read διαφοραί and διαφοράν.)

[44] Cf. *Gener. anim.* II 1, 734b37–735a4: 'Heat and cold make the iron soft and hard, but the movement of the tools that contains the essential form of craft makes this into a sword. For craft is the origin and the form of the object that is made, but it lies in something else; by contrast, the movement of nature lies in the thing itself, though it comes from a different nature which possesses the form in actuality' (σκληρὸν μὲν γὰρ καὶ μαλακὸν τὸν σίδηρον ποιεῖ τὸ θερμὸν καὶ τὸ ψυχρόν, ἀλλὰ ξίφος ἡ κίνησις ἡ τῶν ὀργάνων ἔχουσα λόγον [τὸν] τῆς τέχνης· ἡ γὰρ τέχνη ἀρχὴ καὶ εἶδος τοῦ γιγνομένου, ἀλλ' ἐν ἑτέρῳ· ἡ δὲ τῆς φύσεως κίνησις ἐν αὐτῷ ἀφ' ἑτέρας οὖσα φύσεως τῆς ἐχούσης τὸ εἶδος ἐνεργείᾳ).

[45] *Spir.* 9, 485b8: Οὐ δὴ τοῦτο χαλεπόν, ἀλλὰ μᾶλλον τὸ τὴν φύσιν αὐτὴν νοῆσαι τὴν χρωμένην, ἥτις ἅμα τοῖς αἰσθητοῖς πάθεσι καὶ τὸν ῥυθμὸν ἀποδώσει. τοῦτο γὰρ οὐκέτι πυρὸς οὐδὲ πνεύματος.

[46] *Gener. anim.* II 1, 734b36. Cf. *Anim.* II 4, 416a13–18.

[47] *Spir.* 9, 485b11: τούτοις δὴ καταμεμῖχθαι τοιαύτην δύναμιν θαυμαστόν. ἔτι δὲ τοῦτο θαυμαστὸν καὶ περὶ ψυχῆς· ἐν τούτοις γὰρ ὑπάρχει.

[48] *Spir.* 9, 485b13: διόπερ οὐ κακῶς εἰς ταὐτόν, ἢ ἁπλῶς ἢ μόριόν τι τὸ δημιουργοῦν, καὶ τὸ τὴν κίνησιν ἀεὶ τὴν ὁμοίαν ὑπάρχειν ἐνέργειαν· καὶ γὰρ ἡ φύσις, ἀφ' ἧς καὶ ἡ γένεσις. W.S. Hett 515 translates here: 'Therefore the fact that its motion always exerts a similar activity may reasonably be referred to the same agent, either absolutely or to some definite effective part: for nature, from which they are generated, remains the same.' Perhaps this should be read as: 'Therefore it is not incorrect to identify them

The final problem tackled by the author is the question of the differences in the effects of vital heat in various species. Differences in fire are differences of more and less. These in turn are related to the degree to which fire is mixed with something else. The purer fire is, the more fire it is.[49]

Again he locks horns with Empedocles, who assumed the same mixture of flesh for all species of creatures. The author of *De spiritu*, like Aristotle elsewhere in the Corpus, considers this too rough and ready. In his view, the specific *logos* of horse-flesh and of ox-flesh is determined by vital heat led by the natural principle of a horse and an ox respectively. The effect of vital heat[50] results in different end products owing to the natural principle.

6. *Brief outline of the contents of* De spiritu

Chap. 1

The work starts by clearly indicating its subject: the innate *pneuma*, how does it maintain itself and grow?

The answer to this is: by the supply of food. Next, 481a6–7 proposes two options: this supply may result from respiration or from concoction of ordinary food. The author seems to opt for the second possibility. But he immediately goes on to formulate two theories of which he is harshly critical.

Theory B, which is best viewed as depending on Empedocles' theory, argues that the innate *pneuma* results from the addition of food and the concoction of this food thanks to the process of respiration.

Theory A sees the innate *pneuma* as being boosted by the inhaled air and concocted by the motion of the lungs. The result of this treatment of the inhaled air is to increase the innate *pneuma*. This theory is best

---

[fire/*pneuma* and the soul], either as a whole or one of its parts, the part [of the soul] that forms and that causes the motion always to be actually the same. For that is also the case for the natural principle of life, to which generation is due.' D. Furlanus and W. Jaeger suggest a correction here: ἐνεργοῦν. Perhaps ἐνεργείᾳ (A. Roselli) should be preferred.

[49] *Spir.* 9, 485b17: πυρὸς γὰρ διαφοραὶ κατὰ τὸ μᾶλλον καὶ ἧττον. τοῦτο δὲ σχεδὸν ὥσπερ ἐν μίξει καὶ ἀμιξίᾳ· τὸ γὰρ καθαρώτερον μᾶλλον.

[50] Cf. *Spir.* 9, 485b22: τῇ κράσει διαφέρειν (with D. Furlanus) and 485b23: τοῖς λόγοις ἂν διαφέροι.

understood as reproducing the passage in Plato's *Timaeus* on respiration and the nutrition of living creatures (see section 10 below).

Both theories are based on the principle that respiration is the central phenomenon in all life processes.

Chap. 1 lodges three objections to theory B, all of which can be understood against the background of well-known Aristotelian positions.

Chap. 2

Theory A, attributed to 'Aristogenes', runs up against at least eight objections applying to living creatures with respiration.

The author also considers the problems of theories A and B for insects (which do not possess a respiratory system) and for fishes (in water, where respiration is impossible).

The clear structure and tight approach of chapters 1 and 2 are emphasized by a constant repetition of the problem that forms the work's starting-point. The key words 'maintenance' (or 'nutrition') and 'growth' in the opening sentence 1, 481a1 recur throughout. 1, 481a27 concludes the discussion of theory B in this way. 2, 481a28 indicates clearly that theory A will now be dealt with. 482a8 repeats the question for breathless creatures and 482a21 for aquatic animals. 482a27 clearly marks the end of chaps. 1 and 2 as a whole. 2, 481b29 refers to the objections already given in 1, 481a22–27 (2, 481b1 mentions that theory A has more objections than theory B). The order of discussion of (a) animals with respiration, (b) insects, and (c) fishes also plays a role in 5, 483b1 and in chap. 8 (and is also familiar from the *Parva naturalia*).

Chap. 3

Because the disputed theories see respiration as the central phenomenon in all vital processes, the author continues with this subject. His opponents hold that all parts of a creature's body benefit from respiration for their nutrition and refrigeration. The author adduces objections to both facets of the theory on the basis of positions familiar from parts of the *Parva naturalia*.

But in passing he also raises the point that for instance the bones of a living creature depend for their nutrition and for supply of the innate *pneuma* on the processes which are initiated by respiration (482b7). The author wants to contest this and so is forced in chaps. 6, 7, and 8 to

deal with the topic of bone and its functions and, in turn, with sinew, and with the question what the real principle of motion of a living creature is. This will also clarify what purposes respiration serves and what parts of the body it benefits.

He also casually mentions that plants possess life and are nourished. Evidently they need no system of respiration for this.

Chap. 4

In chap. 4 he discusses how (a) respiration is related to (b) the pulsatory motion and (c) the introduction of nutriment. According to the disputed theory, all three are connected with the breath in the *artèria*. He demonstrates that respiration cannot be primary but, in the development of an individual creature, begins only after the pulsatory motion and the introduction of food. He also proves that the pulsatory motion is due to the blood in the heart, and therefore cannot be located in the *artèria*. This chapter, too, helps to provide a clearer picture of respiration than that offered by his opponents, and to indicate that there are vital processes which are independent of respiration.

Chap. 5

The following chapter deals with the distribution of food to all parts of the body as a result of respiration. The *artèria* is given priority here. It alone contains breath/*pneuma*. The *artèria* system is a dense network that distributes the innate *pneuma*, as bearer of vital heat and the perceptive faculty, throughout the body of the living creature. The opponents hold that this dense network runs parallel to the system of blood vessels. The author makes much of their view that the bones, but not the sinews, are directly connected with the *artèriai*. This raises the question whether *pneuma* acts directly on the bones to set them in motion.

This, too, is a matter in which he wants to underline his very different position (as he does in chaps. 7 and 8).

Again in this chapter (as in 4, 482b22–25) it seems as if Aristotle's opponents have been unable to explain their view of the soul and its role in the process of respiration (5, 483a24–28). In 5, 483a28–29 he seems to suggest that his opponents, like Plato, have failed to integrate the various 'parts' (functions) of the soul.

A recognizable link with chapter 4 can be noted in 5, 483a23. The author says here that the exhalation of breath can be empirically

established. In 4, 482b19 he had said that this system of respiration is 'perceptible only to a certain extent'.

In this chapter the author observes once again that, according to his opponents, fishes must also possess respiration to live. He rejects this utterly.

The key word in the opening sentence of chapter 1, 'maintenance', is once again a striking feature here in 484a8.

Chap. 6

In the sixth chapter the author asks whether semen passes through the *artèriai* and he looks in detail at the relation between sinews and bones, and how they receive nutriment. Because his opponents posit a close link between the system of the *artèriai* with *pneuma* and the vascular system with blood, he points to the fact that birds, snakes, and fishes have no blood at all.

Chap. 7

The author goes on to enumerate various functions of bones and then illustrates them systematically. They do form parts of members that can move, but movement is not the primary function of bones. For there are members which do move but do not contain bones (the heart; the abdomen and the intestines in it). He also formulates the thesis that all movement needs an unmoved starting-point.

Chap. 8

Keenly analyzing the final cause of things, the author concludes that the sinews bring about the movement of a living creature's members. So they must primarily contain the cause of movement, *pneuma*. The author illustrates this by speaking about the movement of bipeds, quadrupeds, birds, bats, and many-footed insects and shellfish, from a fund of knowledge that immediately brings to mind *De incessu animalium*.

Chap. 9

In the final chapter the author administers the *coup de grâce* to his opponents. Since chapter 1 the subject has been 'the innate *pneuma*'. But his opponents took this in the sense of 'the vital breath' of (higher)

living creatures, and they added fishes. The author has developed an entirely different interpretation. For him it is 'the innate vital heat' which is active not only in seed and in plants but in all species of animals, from their very first beginning, under the direction of their form of life or soul.

The opening sentence of chapter 9 characterizes the opponents as 'those who hold that it is not the vital heat that is the efficient principle in bodies' and so characterizes the supporters of theory A and the rejected variant of theory B from chapter 1 as those who assume a different 'efficient principle'. Though these opponents talk about a life-bearing *pneuma*, they see respiration as a more original and efficient principle.

Chapter 9 is an ode to the varied activity of this life-bearing and life-producing fire or vital heat. In this chapter the author underlines the close bond between the soul and its instrumental vital heat. And entirely in line with *De generatione animalium* and the (rest of the) *Parva naturalia* he describes how this one instrument of the soul brings forth a great variety of results in the whole of natural reality.

If *De spiritu* had received more attention and therefore been better understood, the fatal misinterpretation of Aristotle's psychology by Alexander of Aphrodisias, in which Aristotle regarded the soul as the entelechy of the visible body, could never have taken root.[51]

7. *What positions are held by the author of* De spiritu *himself?*

In the course of his critical inquiry into the two theories which he rejects, we find several positions which the author of *De spiritu* himself holds.[52]

He is convinced that the concoction of food received by a living creature not only produces building materials for the parts of the visible body but always residues (*perittômata*) as well—1, 481a19–20; 481b27–28.

---

[51] Cf. A.P. Bos, *The soul and its Instrumental Body. A Reinterpretation of Aristotle's Philosophy of Living Nature* (Leiden 2003).

[52] It would be useful to compare these with the description of 'Die pneumatische Theorie des Aristoteles' which W. Jaeger (art. 1913; repr. 1960) gives on pp. 70–78. But that would take up too much room here.

The respiration of living creatures is not characteristic of all living entities and not even of all animals, and therefore is not the central and most fundamental vital process, but serves to cool living creatures with high vital heat—2, 482a16; 3, 482a31; b1; 5, 483b6; 484a9–10.

A related position is that insects (which have no respiration) do have a cooling system, but one which works via their diaphragm—2, 482a17.

Water does not contain air (and so fishes cannot possibly have a respiratory system)—2, 482a23.

The pulsatory movement noticeable in many living creatures is not a phenomenon connected with respiration and the inhaled *pneuma*, but of the blood in the heart region—4, 482b36.

All living creatures, including those which possess no respiratory system, have a principle of vital heat. That is why they need an opposite principle that provides the right balance in temperature—5, 484a7.

Everything that is moved starts from a state of rest—7, 484b19. J. Tricot (1951) 189 n. 3 calls this a 'principe fondamental de la Physique et même de la Métaphysique aristotéliciennes.'

Bones have a glutinous fluid surrounding them which can be regarded as blood that has not been fully concocted. They do not receive their nutriment via respiration or the *artèriai*—6, 484a32.

In natural inquiry it is most useful to determine accurately what a thing's final cause is—8, 485a4–6.

An interesting detail is that the author of *De spiritu* states in 8, 485a21 that shellfish do have feet, but not for the purpose of movement but to support their weight, as *De incessu animalium* 19, 714b14 also argues.

A fundamental starting-point in natural inquiry is: comparable effects have the same causes in the same way—2, 482a10–11; 482a24–25; 6, 484b7–8; 8, 485a11–12.

All these are positions that Aristotle developed and/or defended, like the very important position on 'the soul' held in *De spiritu*.

8. *The position of the author of* De spiritu *on the soul*

While discussing the two theories which he reports in chap. 1, the author of *De spiritu* makes various remarks which build up an increasingly clear picture of his position on the soul.

In 1, 481a16 he asks: can *pneuma* arise from nutriment, if it is itself primary (*prôton*)? Because that which is connected with the soul is 'purer'

(481a17), one would not expect it to arise from something like nutriment. This already sheds light on the view underlying the entire work that *pneuma* is a *sôma* which is connected with the soul in a very special way and is the instrument of this soul. (For 'purer', cf. also 481a24.)

In 2, 481b15–17 he opposes 'Aristogenes' when the latter states that breath derives its heat from the movement of the lungs. The author objects that in that case the vital breath is not 'the primary moving cause'. Clearly for the author *pneuma* does constitute 'the primary moving cause' (directed by the soul-principle).

In 4, 483a3 the author distinguishes somatic disorders from fears, hopes, and tensions of the soul, which affect the frequency of the pulsatory movement of the blood in the heart. To anyone familiar with Aristotle's biological works, this passage makes it clear that in *De spiritu*, too, he posits a close relation between the soul and a *sôma*, not however the visible, coarse-material body, but the fine-material soul-*sôma* or *pneuma*, which forms an indissoluble unity with the soul. This soul-*sôma* is also the 'prime mover' of all vital activity, including the pulsatory movement.

In 5, 483a23–27 the soul comes up in a discussion on perception. The author states that, according to his opponents, only the *artèria* possesses perception. He asks whether this is due to the inhaled air which flows through the *artèria*; or whether his opponents see the inhaled air as subordinate and serviceable to the soul, and so really regard the soul as the subject of perception. The starting-point of this question seems to be Aristotle's own theory of perception as a matter of the soul assisted by its instrumental *pneuma*.

In 483a27–30 he raises the issue that, besides the nutritive activity of the soul, there is also the rational and the conative activity. The underlying question here seems to be: what guarantees the unity of the soul? This is a question which Aristotle often poses as a challenge to Plato.

In 483b10 he talks about inhaled air in the view of his opponents as 'that which is the primary vehicle of the soul'. Again he uses his own terminology here and concludes that such a substance would have to be of the finest quality.

In chap. 9 the author finishes off the opponents whose theory he contests throughout *De spiritu*. He states there that nature uses the vital heat to produce living creatures (485b6–9). The soul is active in the vital heat or *pneuma*. And it can be viewed as forming a unity with *pneuma* (485b13–15). It is the theory of the soul and its instrumental

body which Aristotle uses extensively in *De generatione animalium* II 1, as in all his biological writings.[53]

9. *What is the position of 'Aristogenes' that the author of* De spiritu *contests?*

If the author of *De spiritu* thinks and writes from the scientific perspective of Aristotle and nobody else, we must accurately determine what position he criticizes so persistently.

This position awards a dominant place to respiration (and pays no or insufficient attention to life forms which do not have respiration).

This view assigns a special place to inhaled air as the vehicle of all vital processes.

The inhaled air also possesses vital heat as a result of the movement of this air in the lungs—2, 481b12–15.

As a result of the respiratory process, blood is distributed via the veins and breath via the *artèriai* throughout the visible body of a living creature—5, 483a18–22; 483b25.

Veins and *artèriai* are always situated side by side—5, 483b30–31. They are not two parts of one system, in the sense of blood vessels with oxygen-rich blood and blood vessels with oxygen-poor blood, but separate systems which need each other.

The heat of the *pneuma* in the *artèriai* is responsible for the heat and the liquidity of the blood in the veins—5, 483b19–22.

A living creature has perception because it possesses the vital *pneuma* which is found in the *artèriai* throughout the visible body—5, 483a24–27.

The alternating movement of respiration ensures that the vital *pneuma* is distributed through the *artèriai* and blood through the veins to the other parts of the visible body, for instance to the bones.

Bones are set in motion through the effect of the vital *pneuma.*

The process of respiration is a process that also brings about refrigeration of certain parts of the living creature—3, 482a31.

The relation of vital breath to the soul remains remarkably unclear in the discussion of the theory ascribed to 'Aristogenes'. In one place we

---

[53] G.S. Claghorn, *Aristotle's Criticism of Plato's* Timaeus (The Hague 1954) does contain an entire chapter (chap. 7) on 'Aristotle's criticism of soul', but not a single word about *Spir.* and about what could be regarded as the most extensive criticism of Plato's *Timaeus.*

are given the impression that he distinguishes three 'parts' of the soul, but does not indicate how their unity is to be seen (5, 483a28–30).

10. *Who are the opponents in* De spiritu *and who is 'Aristogenes'?*

The author of *De spiritu* thinks entirely in line with Aristotle's biological writings and his *De anima*. There is no position occupied by the author of *De spiritu* that cannot be explained with reference to parts of Aristotle's surviving and generally recognized work.

The debate in *De spiritu* is also conducted with Empedocles and Democritus from the time before Aristotle, as in the *Parva naturalia*.

The author speaks here with the self-confidence of a teacher before an audience that recognizes him as such—2, 482a33; 6, 484a32. He also has the same tendency to deal with subjects as a related whole, and therefore holds over a detailed discussion of the distribution of food to the parts of the body—3, 482b12–13—, just as Aristotle often does in his generally recognized writings.

His criticism is mainly directed at the 'Aristogenes' mentioned in chap. 2, but also at supporters of 'Aristogenes', who seem to form a clearly identifiable group—2, 481b14; b18; 5, 483a27.

Nothing in their views decisively indicates a late date. On the other hand, all the themes of *De spiritu* figure prominently in Plato's *Timaeus*.

Plato describes the body of a living creature as being provided throughout with ducts by which food is conveyed (77c7).

This food, after being processed and dissected by the internal fire (78e6—τὸ πῦρ ἐντός), is transferred from the abdomen to the veins thanks to the process of respiration (78e5), and distributed through these veins (cf. 70d2; 80d).

The respiratory system not only serves the purpose of nutrition but also cools the heart (70c5).

De spiritu 5, 483b34 attributes to 'Aristogenes' the view that fishes breathe. This is also the position of Plato, *Timaeus* 92a7–b6.

What Plato says in *Timaeus* 77d3 and 73b2 but particularly in 91a4 about the central importance of the marrow is a plausible explanation for the question in *De spiritu* 6, 484a14 whether semen is pressed through the *artēria*, a question which at first sight seems to come out of the blue.

In the *Timaeus* Plato also holds the view that the natural effect of fire is separation and cutting (cf. *De spiritu* 9, 485a29).

In the *Timaeus* Plato also awards sinews the function of holding bones together (75d4).

The writer seems to identify 'Aristogenes' with Plato. He may have permitted himself a literary joke here, with 'Aristogenes' as a sly allusion to Plato, whose father was in fact called Ariston.[54]

11. *Conclusions*

Certainly *De spiritu* has places where the Greek text is corrupt.[55] But these do not prevent us from following a large part of the author's argument and establishing that he is attacking two theories with which his own position is fundamentally at odds.

The two theories place respiration at the heart of all vital processes. For Aristotle, respiration is not a primary process, not even for living creatures which possess such a system. Aristotle knows that all kinds of vegetative processes start in the seeds of a plant and the eggs of fishes and birds and the semen of blooded animals long before there can be any question of animal processes like respiration. Aristotle took pride in explaining the possibility and purposiveness of these processes by means of his theory of the soul as (first) entelechy in an indissoluble unity with its instrumental body, *pneuma* or vital heat.

Crucial to an understanding of the argument of *De spiritu* is the insight that this work talks about *artèriai* as 'vessels' which contain *pneuma*, but which also extend throughout the body and ensure concoction and distribution of the food. This was also essential to the theories of

---

[54] Cf. the way Heracles is referred to as 'Kadmogenes' in Sophocles, *Trachiniae* 118 and Xerxes as 'Dareiogenes' in Aeschylus, *Persians* 6 and 146. It might be objected that 'Aristono-genes' would be the expected form. However, we do know quite a few people called 'Apollodorus', 'Apollophanes', 'Apollothemis', 'Artemidorus', 'Isidorus' but not many called 'Apollonophanes', 'Apollonodorus', etc. Cf. F. Bechtel, *Die historischen Personennamen des Griechischen bis zur Kaiserzeit* (Halle 1917; repr. Darmstadt 1964). Plato himself was originally called 'Aristocles', after his grandfather. Cf. Diogenes Laertius III 4.

[55] Invaluable support for restoration of the text in several places was provided by Prof. D. Holwerda of the University of Groningen. We would like to thank Patrick Macfarlane, Ph.D. student at Duquesne University, Pittsburgh, for a number of valuable remarks.

Empedocles and Plato disputed by Aristotle, as we can establish from Aristotle's own statements about these predecessors elsewhere in the Corpus.[56]

If we read *De spiritu* as a preliminary 'shorthand' study by Aristotle, in the style of the *Problemata* but also many parts of the *Parva naturalia*, we find no compelling reason in the discussion to regard any part of it as post-Aristotelian. The author defends Aristotle's positions against Aristotle's opponents. It therefore seems justified to substitute 'Aristotle' for the designation 'Anonymus' in Jaeger's text edition.

Aristotle did not need to set out in detail the alternative doctrine of an innate *pneuma* (which is not identical with the inhaled air), given that this theory was familiar enough from his *Parva naturalia* and other biological works (and from the *Eudemus* and *De philosophia*, we might add).

It is striking, though, that he does not give a detailed answer to the question with which the treatise opens: 'The innate *pneuma*, how does it maintain itself and grow?'

But if our explanation of chap. 1 is correct, the author, though the thrust of his work is critical, also gives a clear indication of his own position. We opt for the reading that Aristotle supports the proposition of 1, 481a10–14 and then immediately goes on to criticize a view which comes close to his own, but which assigns a central place to respiration. In that case we could suppose that Aristotle saw the original *pneuma* of the embryo as providing for its own increase owing to the fact that *pneuma* is present in all things (*De generatione animalium* III 11, 762a18–21) and the process of digestion causes *pneuma* to be added to the original *pneuma*.

What he achieves in any case in this work is to demonstrate convincingly that respiration cannot be the fundamental principle of life and that this role should be awarded to the innate heat.

12. *The place of* De spiritu *in the Aristotelian Corpus*

There are sound arguments for the place assigned to *De spiritu* in I. Bekker's edition, viz. directly after the series of *Parva naturalia*. It is

[56] Cf. Arist. *Resp.* 7, 473b1–474a6 on Empedocles, and *Hist. Anim.* III 3, 664b6, where most scholars assume an allusion to Pl. *Tim.* 70c6–7.

preceded by discussions of youth and old age, life and death, and the respiration of living creatures. Aristotle consistently emphasizes here the importance of the heart (or its analogue) at the centre of the living creature, as the primary location of the vital heat or *pneuma* and of the intimately connected (immaterial) soul, including all the 'parts' or 'faculties' which belong to a certain kind of soul.

Because in this context Aristotle repeatedly links life and death of the living entity to the presence and activity of the vegetative soul-principle,[57] it is natural to ask how the enduring presence of the vegetative principle can be explained.

In the final chapter of this part of the *Parva naturalia* Aristotle speaks without any hesitation about 'the growth' of the vital heat in which the nutritive soul-principle is present.[58] And he explains this growth by referring to the '*nutrition*' of the vital heat. This vital principle has an even greater need for nutriment than the other parts of the living creature, since it is itself the cause of nutrition for those parts.[59] In this context he therefore speaks freely about an 'increase' of the vital heat.[60]

Following on from this discussion, the author needs to refute all theories in which the vital principle is presented as somehow connected with and resulting from respiration.

The fact that the Arabic list of Aristotle's works mentions a treatise *De spiritu* in three books may suggest that the treatises *De iuventute*, *De respiratione*, and *De spiritu* were, at some point in time, taken (by Andronicus?) to be closely connected.

---

[57] Cf. *Iuv.* 24 / *Resp.* 18, 479a29–30: 'Generation is therefore the very first contact of the vital heat with the nutritive soul, and life the continuation of this contact' (Γένεσις μὲν οὖν ἐστιν ἡ πρώτη μέθεξις ἐν τῷ θερμῷ τῆς θρεπτικῆς ψυχῆς, ζωὴ δ' ἡ μονὴ ταύτης).

[58] *Iuv.* 27 / *Resp.* 21, 480a16: 'Respiration arises because the vital heat, in which the nutritive principle is present, increases' (Ἡ δ' ἀναπνοὴ γίνεται αὐξανομένου τοῦ θερμοῦ ἐν ᾧ ἡ ἀρχὴ ἡ θρεπτική).

[59] *Iuv.* 27 / *Resp.* 21, 480a17: 'This part requires nutrition, like the other parts, and even more so. For it is also the cause of nutrition for the others' (καθάπερ γὰρ καὶ τἆλλα δεῖται τροφῆς, κἀκεῖνο, καὶ τῶν ἄλλων μᾶλλον· καὶ γὰρ τοῖς ἄλλοις ἐκεῖνο τῆς τροφῆς αἴτιόν ἐστιν).

[60] *Iuv.* 27 / *Resp.* 21, 480a19: 'It is necessary that when this increases' (Ἀνάγκη δὴ πλέον γινόμενον, ..).

13. *From life-bearing breath to life-bearing spirit*

The Greek word *pneuma*, 'wind', obviously derives from the verb πνεῖν (*pnein*), 'to blow'. As such it is synonymous with ἄνεμος (*anemos*), which is also a standard word for 'wind'.[61]

But the process of 'in-halation' (ἀναπνοή, ἀνάπνευσις) and 'ex-halation' (ἐκπνοή, ἔκπνευσις) also derives from the verb *pnein*. Aristotle compares this process to the operation of a bellows (*De respiratione* 7, 474a13).

It is thus understandable that *pneuma* was interpreted as the bearer of vital functions and of vitality and as being present in a living creature so long as this living creature is alive ('breath of life').

The Latin words '*animus*' and '*anima*' are related to the Greek word ἄνεμος and also carry the meaning 'breath of life'.[62]

Aristotle mentions in *Anim.* I 5, 410b29 that the doctrine of the so-called Orphic poems stated that 'the soul enters from the cosmos though inhalation, and that this soul is borne in on the winds.'

He also knows that Plato closely connected the presence of life with the respiratory function.

However, in all the writings in which he talks about living creatures, Aristotle is convinced that the bearer of vital processes is present *prior to* the process of respiration. For respiration requires lungs. And before the lungs can function, they must be formed in the embryological process of development (*De generatione animalium* II 6, 742a5).

Moreover, Aristotle became convinced that the vital functions must have a somatic aspect. The transfer of life via semen, but also the phenomenon that a bearer of vital potency does not display any vital activity (the situation of 'germinal rest' in a grain of corn, flower bulbs, and potatoes kept in storage), led him to conclude that life is inseparably bound up with a physical entity. Aristotle chose to use the term *pneuma* for this, even though it was clear that this gave a radically new meaning to the term, and even though he thus created confusion with the word *pneuma* in the sense of 'breath', which he also continued to use.

---

[61] Cf. G.L. Duprat, 'La théorie du πνεῦμα chez Aristote', *Archiv für Gesch. der Philos.* 12 (1898) 305–321, p. 306. Aristotle himself states in *De mundo* 4, 394b8–9, 12–13 that *pneuma* is synonymous with *anemos* as 'a compact mass of air which blows'.

[62] Cf. R.B. Onians, *The Origins of European Thought* (Cambridge 1951) 93 ff. The word ψυχή is also etymologically related to the verb '*psychein*', 'to blow'. Cf. J. Bremmer, *The Early Greek Concept of the Soul* (Princeton 1983) 21.

'*Pneuma*' in the specifically Aristotelian sense:

- the most essential feature of *pneuma* is that it is the bearer of vital heat (*De generatione animalium* II 3, 736b33–737a1);
- as the bearer of vital heat it is the bearer of the *anima nutritiva* or *anima vegetativa*;
- as such it is responsible for the entire embryological process of development which precedes the possibility of respiration in living creatures that (later) possess a respiratory process; and which results in the entire living specimen in lower animals and in plants;
- Aristotle emphatically distinguishes the heat of *pneuma* from the heat of fire. The nature of *pneuma* is equivalent to the element of the sun, stars (*De generatione animalium* II 3, 736b35–737a1);
- on one occasion Aristotle describes *pneuma* as 'hot air' (*De generatione animalium* II 2, 736a1). Again we should probably connect the 'heat' of this air with astral heat;
- but *pneuma* cannot be real 'air'. Aristotle says in *De generatione animalium* III 11, 762a18–21 that *pneuma* is present everywhere in water (and that therefore 'soul' is present everywhere in a certain sense!), but he firmly rejects the idea that water could contain air: all the air introduced into water is forced to the surface by its own natural movement (*De spiritu* 2, 482a22–24);[63]
- *pneuma* is present throughout the living organism because it is present in the blood (or its analogue).

The two entirely different meanings of the Greek word *pneuma* are lucidly contrasted by Aristotle in *De mundo* 4, 394b9–12[64] (and nowhere else).

The debate with the traditional concept of *pneuma* in Plato and his predecessors was conducted by Aristotle in *De spiritu*. We believe that he did develop an 'overall view of the biological role of *pneuma*' in this work.[65]

---

[63] On the confusion about the term '*pneuma*', see also G.E.R. Lloyd, 'Aspects of the relationship between Aristotle's psychology and his zoology', in M.C. Nussbaum, A. Oksenberg Rorty (eds), *Essays on Aristotle's* De anima (Oxford 1992) 147–167, pp. 152–153, 166 (repr. in id., *Aristotelian Explorations* (Cambridge 1996) 38–66, pp. 45–46, 64.

[64] Cf. G. Reale; A.P. Bos, *Il trattato Sul cosmo per Alessandro attribuito ad Aristotele* (Milano 1995) 285–288.

[65] Against J.E. Annas (1992) 20.

Under the direction of the vegetative soul (or the vegetative soul-'part'), *pneuma* first of all forms the heart or its analogue in the central part of the living entity. It itself is always most present in the heart, because the heart is the largest blood vessel; but it is also present in the other parts of the living creature via the interconnected system of blood vessels.

Through its heat *pneuma* causes the chest to expand and in this way causes the movement of the lungs, which via respiration have a moderating effect on the internal vital heat (*De respiratione* 21).

Guided by the soul's perception, *pneuma*, through its expansion and contraction, causes the movements of the instrumental parts (*De motu animalium* 8).[66]

[66] For the best discussion of Aristotle's concept of 'innate *pneuma*', see A.L. Peck, *Aristotle, Generation of animals* (1942) Appendix B, 586–593. The view of G. Freudenthal, *Aristotle's Theory of Material Substance. Heat and Pneuma* (Oxford 1995) is unsatisfactory on a number of points.

TRANSLATION

Chapter 1

[The innate pneuma: *two views on its maintenance]*

1, 481a1. The innate *pneuma*, how does it maintain itself and grow? For we see that it increases and becomes stronger with age and as the physical disposition changes.

Is it the same as with the other parts, because something is added? Now what is added is food for ensouled creatures. (1a5) So we should consider the nature and origin of the food.

Now there are two ways in which food is produced for the innate *pneuma*, namely either (A) by means of respiration or (B) by means of the process of concoction which accompanies the introduction of food, as for the other parts.

Of these two the <former> manner of nutrition[1] seems just as likely to take place by means of nutritive substance. For a body is nourished by a body, (1a10) and *pneuma* is a body.

[Aristotle's position]

So how does this work? Most probably by a kind of drawing of blood from the veins and a process of concoction of this blood. For blood is food in its last phase, which is the same for all living creatures. Just as blood absorbs food for its own vessel, so also for that which is enclosed by it, i.e. the vital heat.

[1] Instead of οὐχ οὕτως in the manuscripts we read ἐκείνως. This word may have been mistakenly replaced by a marginal gloss.

[The content of the version of theory B which is rejected]

Now the air supplies it [food] and is responsible for the activity and, by adding the activity of concoction to itself, causes growth and nutrition.

[The rejected version of theory B critically discussed]

Objection 1
481a15. This in itself is perhaps not so strange. But it is strange that what is primary has been formed from the food. For that which is connected with the soul is purer. Unless somebody were to say that the soul, too, is formed later, when the seeds separate and begin to develop into life forms.

Objection 2
And now if there is a residue of every form of food, (1a20) by what passage is it transported outside? It is not reasonable to assume that this takes place via exhalation. For it is immediately followed by inhalation. So the only possibility left is: through the pores of the *artèria.*

Objection 3
But what is discharged is either thinner or thicker. But both make for an absurdity, if the innate *pneuma* is assumed to be the purest of all. But if it is thicker, it follows (1a25) that some pores must be larger.

Objection 2 (repeated)
But if the living creature therefore takes in food and discharges the residue by the same passages, this is illogical and absurd.

[The criticism of the rejected variant of theory B concluded]

Such are the arguments for the growth and maintenance of the innate *pneuma* on the basis of food.

Chapter 2

[Theory A of 'Aristogenes' critically discussed]

481a28. But the growth and maintenance of the innate *pneuma* as a result of respiration, as Aristogenes holds—for he believes that breath, too, is food, because the air (1a30) is concocted in the <lungs>,[2] and this breath is distributed to the vessels—causes more problems.

[I. Objections to theory A as regards living creatures with respiration]

Objection 1

481b2. For the concoction of the inhaled air, by what is this caused? Most probably by itself [breath], like the concoction of the other nutritive substances. But this in turn is strange, if it does not differ from the outer air. If this is the case, however, the vital heat is probably the cause of concoction.

Objection 2

(1b5) And certainly it is also logical that it is thicker, mixed as it is with the moisture of the vessels, and of the entire mass of the body, so that concoction doubtless makes it more corporeal.

Objection 3

But if the residue becomes thinner, this is implausible.

Objection 4

And the rapidity of the concoction is illogical too. For exhalation immediately follows inhalation. (1b10) What agent would be capable of causing a change and alteration so rapidly? Naturally one might suppose in the first place that it is the vital heat. This is also supported by perception, for the exhaled air is hot.

---

[2] All Greek mss read here πνεύματι. The Latin translation of Daniel Furlanus translates πνεύμονι.

Objection 5

And moreover, if what is concocted is in the lungs and in the *artèria*, the power of the vital heat also resides in these. But they deny this; but they say that the food is heated by the movement of the air[3] (1b15).

Objection 6

But if it [the innate *pneuma*] draws, as it were, food from something else or receives it from something else that causes movement, this is even stranger. In that case, moreover, it is not itself the primary moving cause.

Objection 7

Moreover, respiration extends as far as the lungs, as they themselves say, but the innate *pneuma* is present throughout the living creature. And if it is also distributed from the lungs both to the lower parts and to the others, (1b20) how can the concoction take place so rapidly? This is even stranger and a greater problem. For they [the lungs] do not <immediately> pass on the air, which is not concocted immediately, to the lower parts.[4] And yet this would seem necessary if the concoction takes place in the lungs and if the lower parts, too, are involved in the respiratory process. (1b25). But the consequence of this is an even greater and more unexpected problem: in that case the process of concoction takes place as it were casually and by contact only.

Objection 8

And this, too, is illogical and even less tenable,[5] if the same passage[6] is used for the food and the residue. But if it is transported via another internal part, the same arguments would hold as above. Unless someone were to say (1b30) that a residue is not formed from all food and not for all living creatures, (2a1) anymore than it is in plants, since it cannot be demonstrated for each individual part of the body, unless in the sense that it forms part of the body as a whole.

---

[3] Most mss read πνεύματος here too. Only D^1 reads πνεύμονος. Cf. also 5, 484a6. A. Roselli (1992) 80 opts for 'the movement of the lungs'. But in turn this movement itself must have a principle.

[4] See Objection 4, which was forcibly underlined in Objection 7. In 481b21–22 we read: οὐ γὰρ διαπέμπει ⟨εὐθὺς⟩ οὔτε γ' εὐθὺς πεττόμενον τὸν ἀέρα τοῖς κάτω.

[5] The ms Z has λογοδεστερον here. By letter of August 9, 2005, D. Holwerda has proposed to read: ἀλόγ⟨ου ἐργ⟩ωδέστερον: 'even more difficult (to explain) than something that is illogical'.

[6] The Greek text has λόγος here. W. Jaeger (1913) already proposed to read πόρος.

But the growth of the vessels is just like that of the other parts, and because these [vessels] become broader and distended, (2a5) the air which flows in and out increases. But whether something must be present in them, that is what we are trying to find out. And what this natural air is, and how it increases in a healthy way, that will be obvious on the basis of that.[7]

[II. Objections to theory A and theory B with regard to insects (which do not have respiration)]

And how then does nutrition and growth of the innate *pneuma* take place for living creatures without respiration? For they no longer obtain the food from the air inhaled from outside.

Objection 1

But if they receive their food for that (2a10) from what is inside and from ordinary food, it is reasonable to assume that this also applies to living creatures with respiration. For similar matters come from the same causes and in the same way.

Objection 2

Unless of course it also comes from outside for living creatures without respiration—just as they perceive smells—, but then it is something like respiration after all.

The correctness of this could be disputed by adducing this argument, (2a15) as well as the matter of food intake (for the drawing in of *pneuma* takes place at the same time), and moreover by objecting with regard to refrigeration that they need it just as much. And if this takes place for them via their waist, the intake of air naturally also takes place by that way. So that it is much the same as respiration.

Objection 3

But it is not determined how and by what cause this drawing in takes place, or, (2a20) if there is no drawing in, how the intake takes place. Unless, of course, it occurs spontaneously.

This point requires a separate investigation.

---

[7] In 482a7, following U.C. Bussemaker and W. Jaeger, we read εἴη instead of εἶεν of the manuscripts.

[III. Objections to theory A and theory B with regard to fishes (in the water, where respiration is impossible)]

And what about the nutrition and growth of the innate *pneuma* in aquatic animals? For in the first place they do not draw breath, and we say further that no air is present in the moist substance.

The only remaining possibility is that the innate *pneuma* is nourished and grows by means of ordinary food, so that the method is either not the same for all, (2a25) or the other living creatures with respiration also nourish and increase [their innate *pneuma*] by means of ordinary food. For it must needs be one of these three.

This now is enough as regards the growth and nourishment of *pneuma.*

Chapter 3

[Problems in some theories of respiration]

Objection 1

3, 482a28. But as regards respiration, some do not say what purpose it serves, but only in what way it takes place, for instance Empedocles and Democritus. (2a30)

Objection 2

Others do not even discuss the way it takes place but pretend that it is evident.

Objection 3

And also when respiration serves the purpose of refrigeration, it is necessary to elucidate this point. For if the vital heat resides in the upper parts of the living creature, <the parts>[8] below no longer need refrigeration. But the innate *pneuma* pervades the entire living creature. And it has its starting-point in the lungs, but the result of respiration, it seems in their view, (2a35) is also distributed to all parts of the living creature through the continuity of the system. So they must demonstrate that this is not the case. On the other hand it is strange if these [lower

[8] U.C. Bussemaker proposed to read: ⟨τὰ⟩ κάτω.

parts] do not require a certain motive agent and a form of nutrition. (2b1) But if respiration pervades the entire body, it can no longer be for the purpose of refrigeration.

Objection 4
But this distribution of the breath throughout the body cannot be perceived anyway, no more than its speed.

Objection 5
And the process of counterflow is also surprising, if it takes place from all parts. Unless it takes place in a different way (2b5) from the outer parts, but the primary and central process from the cardiac region. But in that case the activities and powers are divided among a plurality of principles.

Objection 6
Yet it is strange if it is also distributed to the bones: for they say that these also obtain their breath and nutrition from the *artèriai*. Therefore we must, as we said, look at respiration, the purpose for which it takes place and for what parts and how.

Objection 7
(2b10) Moreover, it does not appear for all parts that the supply of food takes place through the *artèriai*, for instance for the vessels themselves and for certain other parts. And plants also live and receive food.

But these matters belong perhaps more to a study on kinds of nutrition.

Chapter 4

[Inquiry into the relation of respiration, pulsation, and nutrition. Continued analysis of the theory of respiration held by Aristotle's opponents]

4, 482b14. There are three movements of the air in the *artèria* [according to their theory], (2b15) viz. respiration, pulsation, and thirdly the movement which supplies and assimilates the food.

It is therefore necessary to say of each of these three where and how and for what purpose it occurs.

[The question: 'Where?']

Of these the movement of pulsation can even be clearly perceived by touching any part of the body. But the movement of respiration is perceptible only to a certain extent and is largely based on logical argumentation. (2b20) And the movement of the supply and assimilation of the food is virtually in its entirety a matter of argumentation, but in the sense that it is concluded on the basis of matters which take place in an empirically observable way.

Now respiration clearly has its origin from within, to be designated a power of the soul or the soul itself, or something else again, for instance a mixture of bodies, which by means of these bodies causes such an attraction.

(2b25) The nutritive movement may seem to have its origin in respiration: for it [respiration] is cyclical and is in fact constant. But whether the whole body does not keep the same pace with regard to the timing of this movement, or whether there is no difference for all its parts, should be investigated.

But the pulsating movement is peculiar and distinct from the two mentioned earlier. (2b30) On the one hand it seems accidental, since, if there is much heat in a fluid, it is necessary that what evaporates causes a pulsation, because it is enclosed [in the fluid].

But it is present in the origin and primarily, since it is present by nature in the very first parts. For it is chiefly and primarily present in the heart, and from there in the other parts. But perhaps, in relation (2b35) to the underlying substance of the living creature, when it starts to function in reality, it is a necessary side effect.

[The question: 'How?']

There is an indication that pulsation has nothing to do with respiration: (3a1) when someone breathes rapidly or evenly, and when he breathes heavily or lightly, the pulsating movement is the same and unchanged, but an irregular and agitated pulse occurs during some bodily ailments and in the case of fears, hopeful expectations, and afflictions of the soul.

(3a5) But we need to consider whether it is true that pulsation also occurs in the *artèriai*, even when its rhythm is constant and regular. At any rate it does not seem to be the case for parts which are far removed.

[The question: 'For what purpose?']

And it does not seem to occur for any purpose at all, as we already said.[9] For respiration and the supply of food, whether they are entirely independent of each other (3a10) or stand in relation to each other, do seem to have a purpose and a reason.

But of these three it would be logical [in their view] for pulsation and respiration to be prior. For nutrition is always nutrition of something that already exists.

Objection 1

Or is this not so? For respiration only begins when separation has taken place from her who has borne the new living creature, and the supply and the food belong both to what is being formed and to what already exists.

Objection 2

(3a15) But pulsation occurs from the very first, while the heart is forming, as can be observed in incubated eggs. In this way it is the first movement, and it resembles an activity and not an enclosure of air, unless this fact therefore contributes to this activity.[10]

Chapter 5

[The relationship of respiration and nutrition in the theory of Aristotle's opponents]

483a18. But the air which is the result of respiration is [they say] transported to the belly, (3a20) not via the oesophagus (for this is impossible); but there is a passage along the loins through which the inhaled air is transported by the respiration from the bronchi to the belly and out again. And this last [in their view] can be established by perception.

[9] Cf. 4, 482b30.

[10] As suggested in 4, 482b34–36.

[A problem relating to the subject of perception]

But there is also a problem with [their view of] perception. For if only the *artèria* perceives, (3a25) is this by the breath which flows through it or by the total mass or by its material substance [viz. the *artèria* alone]?

Or, if air is the first that comes directly below soul, does the *artèria* perceive by that which is more dominant and prior [viz. the soul]?

What then is the soul? They say that it is a power that is the cause of this movement.

Objection

But of course you cannot rightly criticize those who describe the rational and emotional parts as powers. For they, too, describe those parts as powers.

Objection

(3a30) But if the soul is present in this air, the air is ordinary air. Or does it really undergo an effect [from the soul] and thereby change? Obviously the air as ensouled[11] or as soul is brought to what is akin to it, and like increases by like.

Or is this not so? For the whole is not air. But the whole is something that contributes to this power.

Or not this either? (3a35) That which brings about and has brought about this power, that is the origin and foundation.

[Is the vital breath identical with or different from the outer air?]

5, 483b1: But do non-respiring animals have no breath in order that the air in the *artèria* is not mixed with the outer air? Or is this not the reason, but is it mixed in a different way?

Objection

And how does the air in the *artèria* differ from the air outside? For it is plausible and perhaps even necessary that it differs in fineness.

[11] All the manuscripts have εὔψυχον here. U.C. Bussemaker corrected this to ἔμψυχον.

Objection

But there is also the problem (3b5) whether it is hot by itself or by something else. For the air within seems to be just like the outer air. But it receives help through refrigeration.

Which views are right? The air outside is at rest, but when enclosed, it becomes *pneuma*, condensed as it were and somehow introduced into a transport system.

Objection

Or must the air obtain a kind of mixture, because it circulates in a moist and coarse-material environment? But in that case the air (3b10) is not the finest, because it has undergone a mixture. Yet it is logical that the vehicle of the soul in a primary sense is very fine, unless something similar applies to the soul too, and it is not something pure and unmixed.

Only the *artèriai* [they say] can contain breath, but not the sinews. Another difference is that the sinews are elastic, but the *artèriai* burst easily, like veins.

(3b15) The skin [they say] contains veins, sinews, and *artèriai*. Veins, for when the skin is pricked, it emits blood; sinews, for the skin is elastic; *artèriai*, for air is breathed through the skin. For only the *artèria* can contain *pneuma*. But the veins [they say] have pores, in which[12] the vital heat [of the breath in the *artèriai*] (3b20) is present, and in this way heats the blood as in a cauldron.

For blood is not hot by nature, but like metals becomes liquid through heat. That is why it coagulates.[13]

And the *artèria* also has moisture in itself and in the coverings which enclose the cavity. This is shown both by dissections and by the fact that (3b25) both the veins and the *artèriai*, which probably draw in the food, are connected with the intestines and the belly. From the veins the food is distributed to the flesh, not via the sides but via the opening.

For, as if they were irrigation pipes, thin veins alongside[14] the veins extend [in their view] from the large vein (3b30) and the *artèria* past every rib, and the *artèriai* and the veins lie side by side.

---

[12] The mss read αἷς here. This can only refer back to the 'veins'. J.F. Dobson proposed to read οἷς, which may refer back to πόροι.

[13] We read a full stop behind πήγνυσθαι.

[14] J.F. Dobson already proposed to delete φλεβῶν. At the suggestion of D. Holwerda we opt to insert the article τῶν before φλεβῶν.

Moreover, the bones are attached to the sinews and the veins by being joined in the middle and in the connections of the head of the bones, and they [the bones] thus take in food from the veins.[15]

Fishes also breathe [in their opinion]. If they did not breathe, they would immediately die on being taken out of the water.

The veins and the *artèriai* (4a1) are connected with each other, and in their view this can be established by perception too. This would not be the case if the moisture did not require air and the air did not require moisture, on account of the heat in the sinew, in the *artèria*, and in the vein, a heat which is hottest and most fiery[16] (4a5) in the sinew.

Objection 1

Now this vital heat is not suited to the *artèria* as the location of the inhaled air, especially not if respiration exists for the purpose of refrigeration. But if the vital heat is the producing agent[17] and kindles life, as it were, through heat, it would be possible.

Objection 2

Moreover, what about the maintenance of all living creatures that possess this innate vital heat, if there is no opposite, nor anything that cools? For it is clear, (4a10) I think, that all living creatures need refrigeration.

The blood [in their view] retains the vital heat in the veins and shelters it as it were. Hence it [the blood], when it flows out, also lets [the heat] go and the animal dies, because the liver has no *artèria*.

Chapter 6

[Problems relating to the nutrition of bones, sinews, and the flesh of living creatures]

6, 484a14. Does the semen pass through the *artèria* and is it also compressed, (4a15) and does this happen only in emission?[18] So the

---

[15] We read a full stop after δέχεσθαι.

[16] The mss have φλεβωδέστατον here. A. Roselli 107, following D. Furlanus, corrects to φλογωδέστατον.

[17] Τὸ θερμόν is the subject of ποιεῖ. Cf. 9, 485a28: τὸ θερμὸν τὸ ἐργαζόμενον.

[18] A. Roselli assumes a lacuna here in the Greek text. J.F. Dobson assumes a lacuna before this sentence.

<bones>[19] also show the change from blood, because the sinews are nourished from the bones. For they are attached to them.

Objection

Or is this not true either? For there are sinews in the heart too. And sinews are attached to the bones, but not on the other side, because they end in flesh.

4a20. But this means nothing. For the food for the sinews could still come from the bone. But would the food for these bones themselves rather come from the sinews? For this is strange too. For bone is by nature dry and has no passages for liquid. And food is liquid.

But we should first consider, if the sinews receive their nutrition from the bones, what the nutrition of bone is. Do perhaps passages (4a25) carry it there both from the vein and from the *artèria*? In many bones these passages are clearly visible, particularly those leading to the spine. But [in their view] the veins and *artèriai* leading from the bones form a continuous whole with them, for instance along the ribs.

Objection

But in what way do these passages receive their food from the belly, or how does the drawing-in take place? After all, most (bones) are not elastic (cartilaginous), for instance the spine.

But it does not serve (4a30) the purpose of movement either. Is it for connecting?

And we must also know, if the bone is nourished from the sinews, what the nutrition of the sinew is. But *we* say that a sinew is nourished by the sticky fluid which surrounds it. And whence and how this fluid arises is yet to be discussed.

Objection

But to say that flesh consists of veins and *artèria* because blood issues from any point where it is pricked is false, (4a35) in any case with regard to the other living creatures, like birds, snakes, and fishes or oviparous animals in general. But this is a specific feature of full-blooded animals. For when the breast of a small bird is cut, serum issues, not blood.

But Empedocles assumes that nails are formed from sinews, by a process of hardening. (4b1) Is the relation of skin to flesh the same?

---

[19] We could consider reading ἐν ⟨ὀστ⟩οῖς here.

Objection
But how is it possible for shellfish and crustaceans that nutrition takes place from outside by means of respiration? It seems on the contrary that it takes place from inside rather than outside.

Objection
Moreover, how and through what passages does transport from the belly take place? (4b5) And, next, how do they bend back to the flesh, even if this is illogical? For this seems most surprising and totally impossible.

Is this then food for some animals and something else for others, and is the blood not food for all? But the other parts are nourished from it.

Chapter 7

[The various functions of the bones]

7, 484b9. We therefore need to consider whether bones are designed for movement or (4b10) for support and as a protective covering, and moreover whether some of them are a kind of origin, like the celestial axis (in the cosmos). By 'for movement' I mean for instance the bone of a foot or a hand or a leg or an arm, both the movement of bending and locomotion. For the latter is impossible without the movement of bending.

The legs (the 'supporting parts'), we can say, belong to these as well.

(4b15) But bones also serve as a protective covering; the bones of the head have this function for the brain, and those who regard the marrow as the origin, as is well known, assign the same function to the spine. And the ribs are for enclosing.

The primary and stable factor is the spine, to which the ribs are attached for the purpose of enclosing. For there must be something of this kind. For everything that is moved starts from a state of rest.

4b20. But there must always be a goal for the sake of which something exists. Some therefore find the origin here, in the spinal marrow and the brain.

Moreover, bones are for joining and enclosing, like the collar-bone. Perhaps its name (key-bone) derives from this.

Every bone is well-suited to its function. For bending is not possible, either of the whole or of the parts, (4b25) unless there are such

bones, such as the spine, the foot, the arm. For there must be a bending inwards, for the sake of functionality, as much of the foot as of the other limbs.

They all serve some purpose, including the bones which form part of them, like the radius in the forearm for turning[20] the forearm and the hand. For we could not bend the arm forwards and backwards (4b30) without this radius, and would could not raise and bend our legs if there were not two radii functioning in the lower leg.[21]

Just so we should consider for the other bones, for instance the movement of the neck, whether this is one bone. And we should also do this for the bones which serve to fasten and connect, for instance the kneecap over the knee.

But we should also investigate why the others do not have this.

(4b35) All bones with a motor function have sinews, and perhaps in particular those which are suitable for doing something, like those of the arms and the legs, the hands and the feet.

The other bones with a connective function have sinews to the extent that they need them. For some hardly need them or not at all, for instance the spine. But hinge joints do.

(5a1) For what fastens them together is serum and a mucous fluid. The others are moreover connected by sinews, for instance those about the joints.

Chapter 8

[The functionality of all things in nature]

8, 485a4. A better explanation of all things is obtained by an investigation like the present. But we must study as far as adequate the final causes for the sake of which things exist.

In our view, it is not the bones which exist for the sake of movement, but rather the sinews or their analogues, the primary part containing the *pneuma* which causes movement.

For even the belly moves and the heart has sinews. Bones are not present in all living creatures, but in some they are necessarily present.

---

[20] I. Bekker has rightly corrected τροφῆς as found in the mss to ⟨σ⟩τροφῆς.

[21] With ms Z, A. Roselli reads here: ἐν τῇ κνήμῃ. The other mss have: κινήσει.

And such a living creature requires sinews for such a movement (5a10) or for < >.[22]

For an octopus can walk, if only small distances and with difficulty.

For we should assume as a principle that the bones of all animals serve the purpose of movement, or some other purpose, but contributing to their characteristic movement.

For instance the feet for land animals, two for those that stand erect, but more for animals which move entirely on the ground, whose matter (5a15) is earthier and colder (other animals can even move without feet, for they move in their situation with a movement all of their own),[23] and wings for birds, and their form is suited to their nature, but they differ for the faster and heavier flyers.

They have feet for the purpose of getting food and for standing, except in the case of the bat. That is why the bat gets its food (5a20) from the air. And that is why it does not need to rest. For they do not need <to alternate>.[24]

But among aquatic animals shellfish have feet on account of their weight [and not for locomotion]. Thus far on locomotion.

But for everything which serves other purposes the governing principle (for our inquiry) is what is specific to each living creature, even if this is not very clear, for instance why (5a25) many-footed insects are the slowest (whereas quadrupeds are faster than bipeds). Is this because their bodies move entirely on the ground or because they are naturally cold and move with difficulty, or for another reason?

Chapter 9

[Vital heat as the only and multi-functional life-bearing principle]

Our opponents who hold that it is not the vital heat which is the efficient principle in bodies, and who claim (5a30) that fire has only one direction of movement and only a power to cut, are wrong. For even in inanimate things it does not always produce the same effect in all

[22] The text seems to have a lacuna of 5 to 6 letters here.

[23] We propose to read here: ὅλως. ἐγχωρεῖ ⟨ἰδ⟩ίᾳ [sc. κινήσει] γὰρ οὕτω κινεῖσθαι, instead of βίᾳ.

[24] We propose to correct δι' ἄλλων to διαλλ⟨αγ⟩ῶν. Bats do not need to interrupt their flight to search for food on the ground, as birds do. Cf. *I. A.* 18, 714b20–22.

cases,[25] but some things it condenses, others it rarefies, others it dissolves, yet others it hardens. We must therefore assume that the same situation applies to ensouled creatures, when we inquire into what can be called the fire which nature uses, as into the fire which craft uses.

For in the crafts, too, the fire of the goldsmith produces a different result (5a35) from that of the coppersmith and that of the carpenter and the cook. But perhaps it is more correct to say that the crafts accomplish this: for they use fire (5b1) as an instrument to soften or melt or dry things, and also to shape some things.

The natural vital principles (of living creatures) do the same. Hence their products differ.[26]

It is therefore ridiculous to judge by externals only. For whether the action of heat and fire separates or refines or whatever, (5b5) the products will be different for the users of this fire.

But the crafts use fire solely as an instrument; nature, on the other hand, also uses it as matter. And this is not problematical, but rather it is hard to understand that nature herself uses the vital heat, and that, together with the visible qualities, nature also produces the form.

(5b10) For this is no longer a matter of fire or air. It is clearly remarkable that such a power should be combined with these matters. And the case is just as remarkable with the soul. For it is present in them. Therefore it is not incorrect to identify it with them, either as a whole or one of its parts, the part that forms and that causes the movement always to be actually the same.[27] For this also applies to the nature (5b15) to which generation, too, is due.

But how are we then to explain the difference of the vital heat in each individual living creature, the heat taken as instrument or as matter or as both? For fire displays differences of more and less. This is much like mixed or unmixed. For purer fire is more fire. The same rule applies to the other simple bodies.

(5b20) For because the bone and flesh of a horse differ from those of an ox, it is necessary that they consist of different components or differ in the proportion of their mixture.[28] Now if the components are different, what are the differences of each of the simple bodies in itself

---

[25] J.F. Dobson corrects ὅλα to ὅλως with reference to 3, 482a30 and 2, 482a23.

[26] We propose to correct διαφοραί in b3 to διάφορα.

[27] D. Furlanus and W. Jaeger correct ἐνέργειαν to ἐνεργοῦν. A. Roselli 127 proposes: ἐνεργείᾳ.

[28] The mss have χρήσει here. D. Furlanus proposed to read κράσει. Cf. 485b25.

and what <is their power>?[29] For we are searching for these <differences>. But if the components are the same, they will differ owing to the proportions of their mixture.

For it must needs be one of the two, as in the other cases: (5b25) for a mixture of wine and honey differs [from another mixture] on account of the underlying substance, but one quantity of wine differs from another through its constitution.

Hence Empedocles <speaks>[30] too simply about the formation of bone, since [in his view] all bones have the same proportion in their mixture. In that case there ought to be no difference between the bones of a horse and a lion or a man. But in reality they differ in hardness, softness, (5b30) density, and so on.

Moreover, even parts of the same living creature differ in density and rarity, and so on. So they do not have the same proportion of mixture in their components. For the difference between thick and thin and large and small may be due to quantity, but hard and dense and their opposites (5b35) are due to the quality of the mixture.

But those who speak in this way must see (5b35) how the formative principle may differ (6a1) because its own quantity varies or because something by itself or mixed or in something else is heated, like the difference between something that is cooked and that is baked. Perhaps this is true. For the vital heat of nature is mixed with it and produces the bones at the same time. So the argument holds good for the flesh [of a living creature]. (6b1) For the same differences occur there, and most probably also in the vein and the *artèria* (windpipe), and so on.

So one of the two: either the proportion of the components in the mixture is not the same, or we should not try to determine the proportions for hardness and density and their opposites.

[29] W. Jaeger supposes a lacuna in the text here and suggests: ἡ δύναμις; Another possibility is: ἡ σύνθεσις.

[30] Perhaps φύσιν of the manuscripts should be corrected into φησίν, as D. Holwerda suggested by letter of September 19, 2005.

COMMENTARY

CHAPTER ONE

[The innate pneuma: *two views on its maintenance]*

481a1: 'The innate *pneuma*, how does it maintain itself and grow?' (Τίς ἡ τοῦ ἐμφύτου πνεύματος διαμονή, καὶ τίς ἡ αὔξησις;)

The central subject of this treatise is the innate *pneuma* or life-bearing spirit.

The title of the work derives from the first sentence, just as in some recognized works of Aristotle.

Pneuma is present in all living creatures from their conception. According to Aristotle, it is present in living creatures both with and without a respiratory system.

Moreover, living creatures with respiration always undergo a developmental phase in which the respiratory function has not yet been actualized. For *pneuma* is already present in the semen from which every living entity is born. This is because the begetter of such a living entity is himself a bearer of *pneuma* too, and through his vital heat is able to concoct the food he has eaten, so that it becomes a useful nutrient, blood. Through this process of concoction the begetter also produces semen as a residue (*perittôma*) of high purity, which contains *pneuma* and passes on a life-generating movement to the menstrual blood of the female partner.[1]

Like A.L. Peck, it seems best to us to leave *pneuma* untranslated, on account of the misunderstandings which words like 'vital spirit' of 'vital breath' are liable to create. If a translation is nevertheless chosen, 'vital' or 'life-bearing spirit' is preferable to 'vital breath', because it avoids the suggestion of a respiratory process.

---

[1] For a sound treatment of this concept in Aristotle's oeuvre, see *Aristotle, Generation of animals*, with an English translation by A.L. Peck (London 1942) 576–593. See also *Aristoteles, Over voortplanting* vertaald, ingeleid en van aantekeningen voorzien door R. Ferwerda (Groningen 2005).

This concept of the innate *pneuma* as the bearer of soul and all vital functions in all living creatures was a fundamental concept of Aristotle's philosophy. And of no one else.[2] The Stoic theory of *pneuma* is radically different.

But Aristotle had to do with predecessors who also assigned a vital role to *pneuma*, namely all those who saw 'vital breath' as the central force of life and who considered this life inextricably connected with respiration. In his *De respiratione* Aristotle discussed at length the theories of Empedocles, Democritus, Diogenes of Apollonia, Anaxagoras, and Plato's *Timaeus*. But the only question he addresses there is how they understood the process of respiration. The discussion in *De spiritu* focuses on clarifying the concept of 'the innate *pneuma*'. For Aristotle this *pneuma* is something special, the analogue of the astral element in sublunary creatures and the instrumental body of the soul (*sôma organikon*). For his opponents it is 'vital breath', which they identify with the soul, or at least assume to be closely connected with the soul.

J.H. Dobson's translation (1914) 'natural breath' is unfortunate. It has nevertheless been retained in the *Revised Oxford Translation* (1984) vol. 1, 764. W.S. Hett 487 has: 'the breath inherent in us'; P. Gohlke (1947) 19 opts for 'angeborene Lebensluft', 'weil es sich dabei weder um gewöhnliche Luft, noch auch nur um Atemluft handelt'. But this translation remains confusing too. J. Tricot (1951) 177 chooses 'souffle vital'. A. Roselli (1992) 133 has: 'il pneuma congenito'. But this is not yet precise either. For Aristotle it is a fundamental point that *pneuma* is not just present from birth (see 5, 483a13–17!), but *earlier*. We have chosen to translate ἔμφυτον as 'innate', though this can also create misunderstanding if associated with the moment of birth.

'Innate' (ἔμφυτον) occurs only here in *Spir.* The term σύμφυτον, which is synonymous, occurs six times. This difference in frequency is also found in the Corpus Aristotelicum (the collection of all the extant works attributed to Aristotle).

The passage in *M.A.* 10, 703a10: 'How this innate *pneuma* is preserved has been set out elsewhere' (τίς μὲν οὖν ἡ σωτηρία τοῦ συμφύτου πνεύματος, εἴρηται ἐν ἄλλοις) has often been connected with *De spiritu*. Cf. the highly questionable discussion by W. Jaeger (art. 1913; repr. 1960) 76–77. A. Roselli 69 denies the necessity of this connection and states that 'la autenticità di *MA* dunque non è infirmata da un rimando al

[2] For the foundation of this thesis, see A.P. Bos, *The soul and its instrumental body. A reinterpretation of Aristotle's philosophy of living nature* (Leiden 2003).

non autentico *Spir.*' It may be that the passage from *M.A.* 10 refers to *Iuv.* 6, 470a19–b5, which talks about 'the preservation of the natural vital heat' (τὴν τοῦ φυσικοῦ θερμοῦ σωτηρίαν). But this connection is not necessary either. See also our commentary on 481a12.

1, 481a1: does maintain itself' (διαμονή)—here at the beginning and in 481a27 at the conclusion of chap. 1; but it recurs in 5, 484a8. The only place where it occurs in the Corpus Aristotelicum is *De plantis*: I 3, 818a40; 7, 822a1; II 6, 826b19.[3]

A comparable place is 'the continuance of the presence of the nutritive soul in vital heat' (ἡ μονὴ (ἐν τῷ θερμῷ τῆς θρεπτικῆς ψυχῆς)) in *Iuv.* 24 / *Resp.* 18, 479a30.

The verb 'to be maintained' (διαμένειν) is common in Aristotle. E.g. *Resp.* 1, 470b15; b21. See also ὑπομένειν in *Iuv.* 4, 469b14: ὑπομένει τὸ ζῆν.

For the distinction between 'to be maintained' (διαμονή) and 'growth' (αὔξησις), cf. *Anim.* II 4, 416b11 in the discussion of the *anima nutritiva* or *vegetativa*, the vital principle of plants and the most basic soul-part of animals and humans: 'There is a difference between nutritive substance and growth substance. For a living creature as something that possesses a certain bulk, there is growth substance, for something that is a concrete entity, nutritive substance' (ἔστι δ' ἕτερον τροφῇ καὶ αὐξητικῷ εἶναι· ᾗ μὲν γὰρ ποσόν τι τὸ ἔμψυχον, αὐξητικόν, ᾗ δὲ τόδε τι καὶ οὐσία, τροφή). *G.A.* II 6, 744b32–36. Simply to stay alive requires a supply of food. Growth requires an extra supply of food. *G.C.* I 5, 322a19–33.

1, 481a2: 'For we see that it increases and becomes stronger with age and as the physical disposition changes.' (ὁρῶμεν γὰρ ὅτι πλέον καὶ ἰσχυρότερον γίνεται καὶ καθ' ἡλικίας μεταβολὴν καὶ κατὰ διάθεσιν σώματος.)

Cf. *G.A.* V 1, 778a23. We may ask how it can be determined that the innate *pneuma* increases in volume and strength. For this, see esp. *Iuv.* 27 / *Resp.* 21, 480a19: 'when the vital heat, in which the nutritive principle is situated, increases' (πλέον γινόμενον (sc. τὸ θερμὸν ἐν ᾧ ἡ ἀρχὴ ἡ

[3] The Greek text of *De plantis* is a retranslation into Greek of a Latin translation of an Arabic translation of the (lost) Greek work *De plantis* by Nicolaus Damascenus, in which he probably makes extensive use of the lost writings of the same name by Aristotle and Theophrastus. Cf. *[Aristoteles] Nicolaus Damascenus, De plantis. Five translations*, ed. and introd. by H.J. Drossaart Lulofs, E.L.J. Poortman (Amsterdam 1989).

θρεπτική)) quoted below, and *P.A.* III 4, 667a27: 'the *pneuma* increases and becomes stronger' (τὸ πνεῦμα πλεῖον καὶ ἐνισχύει μᾶλλον).

G.A. V 7, 787b6: 'As animals grow older, the part that causes motion becomes stronger' (προιούσης δὲ τῆς ἡλικίας ἰσχύει μᾶλλον τοῦτο τὸ μόριον τὸ κινοῦν ἐν ἑκάστοις) deals with the (human) voice and sounds of animals and differences in their pitch and volume. Cf. 786b27; 787a15; 787a18; 787a31; 787b10; 787b15: 'Bulls are the most muscular, also their hearts, so that the part by which they set the air in motion is tense, like a cord of sinews drawn tight' (μάλιστα δ' οἱ ταῦροι νευρώδεις, καὶ ἡ καρδία· διόπερ σύντονον ἔχουσι τοῦτο τὸ μόριον ᾧ κινοῦσι τὸ πνεῦμα ὥσπερ χορδὴν τεταμένην νευρίνην). Especially the last passage makes it clear that voice results from the inhaled air being set in motion.

See also *Iuv.* 6, 470a29: 'the strength of its vital heat withers' (ἐξαυαίνεται ἡ τοῦ θερμοῦ ἰσχύς—W.D. Ross 1955) and *M.A.* 10, 703a8; *P.A.* III 4, 667a27, which are more specifically concerned with the innate *pneuma.*

1, 481a3: 'Is it the same as with the other parts, because something is added?' (ἢ ὡς τἆλλα μέρη, προσγινομένου τινος;)

Cf. *Cael.* I 3, 270a23: 'Anything which is subject to growth grows... in consequence of substance of the same kind being added to it and dissolving into its matter' (τὸ αὐξανόμενον ἅπαν αὐξάνεται... ὑπὸ συγγενοῦς προσιόντος καὶ ἀναλυομένου εἰς τὴν ὕλην).

1, 481a4: 'Now what is added is food for ensouled creatures' (προσγίνεται δὲ τροφὴ τοῖς ἐμψύχοις).

All living creatures, starting from the level of plants, take in food because they need food. In some cases this food is ready and directly suitable for taking in (e.g. for plants; cf. *P.A.* II 3, 650a22; 10, 655b32; *H.A.* IV 6, 531b10). But animals take in food that is not directly suitable for integration in their own physical constitution. This food must first be 'elaborated' in a 'process of concoction', so that it is made suitable for integration.[4]

Because of the author's starting-point in the first lines of this treatise, the entire remaining discussion will focus on vegetative processes, which

[4] Cf. G.E.R. Lloyd, 'The master cook', in id., *Aristotelian explorations* (Cambridge 1996) 83–103; R. Ferwerda, 'Het inwendig oventje. De rol van warmte in het denken van Aristoteles over spijsvertering en voortplanting en over de positie van de vrouw', *Filosofie* 11 (2001) 3, pp. 17–26.

for Aristotle take place on the level of the *anima nutritiva* and the vital heat connected with it.

Here Aristotle talks about 'food' without further specification. In 1, 481a11 he calls blood 'food in its final phase'. Blood is the substance which can be integrated in the various parts of the visible body. 2, 482a10 also talks about 'ordinary food' (τῆς κοινῆς τροφῆς).

1, 481a5: 'So we should consider the nature and origin of the food' (ὥστε ταύτην σκεπτέον, ποία τε καὶ πόθεν).

In what follows, the question of what is food for the innate *pneuma* takes on broad ramifications and also returns in the question of the nutrition of plants, and of bones, sinews, and flesh. Only the question of the nutrition of plants is assigned in 3, 482b13 to a separate study on kinds of food.

The treatise *De spiritu* could, however, be interpreted as a study 'on the nutrition of the innate *pneuma*' of animals and humans.

'So we should consider' (σκεπτέον).

This term occurs eight times in *Spir.* In addition we find σκέψις once. It always marks the introduction of a new point of interest.

The last chapter of the last treatise of the *Parva naturalia* contains a passage which could be regarded as a reason for writing *Spir.*: *Resp.* 21, 480a17: 'Respiration arises because the vital heat in which the vegetative principle is located increases. For just as the other parts need food, so too the vital heat, and even more than the other parts. For this is also the cause of nutrition for the others. So it is necessary that if this heat increases, the instrument [of respiration and refrigeration] also increases in volume. And we must assume that the constitution of the instrument is comparable with bellows in smithies' (Ἡ δ' ἀναπνοὴ γίνεται αὐξανομένου τοῦ θερμοῦ, ἐν ᾧ ἡ ἀρχὴ ἡ θρεπτική. καθάπερ γὰρ καὶ τἆλλα δεῖται τροφῆς, κἀκεῖνο, καὶ τῶν ἄλλων μᾶλλον· καὶ γὰρ τοῖς ἄλλοις ἐκεῖνο τῆς τροφῆς αἴτιον ἐστιν. ἀνάγκη δὴ πλέον γινόμενον αἴρειν τὸ ὄργανον. δεῖ δ' ὑπολαβεῖν τὴν σύστασιν τοῦ ὀργάνου παραπλησίαν μὲν εἶναι ταῖς φύσαις ταῖς ἐν τοῖς χαλκείοις).

The same problem was touched upon in *Resp.* 6, 473a10–12.

This connection could plausibly suggest that *Spir.* comes directly after *Resp.* But a case can also be made for *Spir.* preceding *Iuv.* and *Resp.*

1, 481a6: 'Now there are two ways in which food is produced for the innate *pneuma*, namely either (A) by means of respiration or (B) by means of the process of concoction which accompanies the introduction of food, as for the other parts' (δύο δὴ τρόποι δι' ὧν γίνεται, ἢ

διὰ τῆς ἀναπνοῆς, ἢ διὰ τῆς κατὰ τὴν τῆς τροφῆς προσφορὰν πέψεως, καθάπερ τοῖς ἄλλοις).

J.F. Dobson: 'nutrition may result in either of two ways...' Likewise W.S. Hett 487; P. Gohlke 158: 'Sie kommt auf zwei Wegen'; J. Tricot 175: 'Il y a deux façons dont la nutrition a lieu.' Likewise A. Roselli 133. None of these translators seems to have any hesitations about the author's opinion in this matter.

For δι' ὧν, cf. *Rhet. ad Alex.* 36, 1442b25: 'could not obtain in any other way' (δι' ἄλλου τρόπου τυχεῖν ἀδύνατον) and 31, 1438b14: 'There are three different methods in which we shall arrange them' (τάξομεν δὲ αὐτὰς διὰ τριῶν τρόπων).

The statement seems simply to mean that there are two ways in which food is taken in. But in that case we would not expect a disjunction but a conjunction of the two different options.

The subject van γίνεται is 'food' (τροφή) from 481a5, i.e. 'food for the *pneuma*'. This means that, as regards the first option, we certainly have a most un-Aristotelian position here. Aristotle regarded respiration not as a process of nutrition but of refrigeration. And in chap. 2 he disputes the position of 'Aristogenes' that respiration is a process of nutrition.

1, 481a6: 'either (A) by means of respiration or (B) by means of the process of concoction which accompanies the introduction of food' (ἢ διὰ τῆς ἀναπνοῆς ἢ διὰ τῆς κατὰ τὴν τῆς τροφῆς προσφορὰν πέψεως).

These two possibilities also seem to suggest that the author wants to talk about how 'nutrition of the innate *pneuma*' comes about. After all, respiration ensures that a living creature is supplied with breath (*pneuma*). And as an alternative the author does not simply mention the introduction of food via the oesophagus and stomach, but 'the process of concoction' which accompanies the introduction of food. This 'cooking' or 'concoction' also results in an 'evaporation' (*anathymiasis* / *pneumatôsis*). In the view of some, this explains the pulsing movement in the veins, or the *artèriai*—cf. 4, 482b30–32.

But both here and in 481a27 and 28 and 2, 482a24–26 there is a clear contrast: (B) is the option of growth by means of food; (A) is the option of growth by means of respiration.

The importance of two forms of nutrition for living creatures, i.e. via respiration and via the process of concoction, is motivated in 5, 484a2–3 (in a representation of the position of Aristotle's opponents) by the remark that veins and *artèriai* are interconnected, because moisture needs *pneuma*, and *pneuma* moisture.

We can observe, further, that the word 'food' in this opening section varies somewhat in meaning. 481a4 talks about 'food' for living creatures. We think this means: everything that is taken in through the mouth (of animals) or the roots (of plants). In 2, 482a10 this seems to be meant by 'ordinary food'. But in 481a6 the focus seems to shift to 'food for the *pneuma*', because *pneuma* is regarded as a 'part' (481a4) of a living creature. But if 'respiration' is mentioned as a possible provider of 'food' here (481a6), we are obviously dealing with 'food' in an analogous sense. For this is not food taken in via the mouth (and oesophagus) or the roots. 481a11 then goes on to talk about 'food' as a result of digestion of the food introduced through the mouth (a digestion which, in Aristotle's view, always produces a residue).

The interest in respiration here is not a duplication of *De respiratione.* Respiration is discussed in *Spir.* because of questions about the relationship with the innate *pneuma. Spir.* shows that the innate *pneuma* is the precondition for respiration.

In *De respiratione* 5 and 6 Aristotle gave two descriptions of theories which he says claim to talk about the maintenance of vital heat: the theory in Plato, *Timaeus* 79a–80d, which describes respiration as a process of simultaneous air displacement (*'periôsis'/'antiperistasis'*), and an anonymous theory which presents air as 'food' for the vital heat.[5] This idea could be inspired by the empirical fact that fire flares up when air is added (as with bellows in a smithy—cf. *Resp.* 7, 474a12–15, in a passage on Empedocles). This theory strongly resembles the theory of 'Aristogenes' in *Spir.* 2 and Plato's discussions in the *Timaeus.*

In *Resp.* 7, 473b1–8 Aristotle reports Empedocles' theory of respiration as a process by which air flows up and down through the body *via the veins* and thus brings about respiration, a process in which air from these veins/air ducts also comes out through their pores and through the skin.

These theories come closest to the questions discussed in *De spiritu.* And, as we saw above, *De spiritu* also seems to link up directly with the problems dealt with in *De respiratione.*

---

[5] Cf. *Resp.* 6, 473a3: 'But we must not entertain the notion that it is for purposes of nutrition that respiration is designed, and believe that the internal fire is fed by *pneuma*; respiration, as it were, adding fuel to the fire, while the feeding of the flame results in expiration' ('Αλλὰ μὴν οὐδὲ τροφῆς γε χάριν ὑποληπτέον γίνεσθαι τὴν ἀναπνοήν, ὡς τρεφομένου τῷ πνεύματι τοῦ ἐντὸς πυρός, καὶ ἀναπνέοντος μὲν ὥσπερ ἐπὶ πῦρ ὑπέκκαυμα ὑποβάλλεσθαι, τραφέντος δὲ τοῦ πυρὸς γίγνεσθαι τὴν ἐκπνοήν).

1, 481a8: 'for the other parts' (τοῖς ἄλλοις).

J.F. Dobson translates: 'the other parts'; W.S. Hett 487: 'the rest of the body'; J. Tricot 175: 'les autres parties du corps'; A. Roselli 133: 'le altre parti del corpo'; cf. p. 71.

This seems plausible if Aristotle means: the innate *pneuma* is 'nourished' by respiration or by the process of concoction which accompanies the supply of ordinary food, just as the other parts of the living creature (apart from *pneuma*) are nourished in this way. In that case τοῖς ἄλλοις is identical to τἆλλα μέρη in 481a4. Cf. *Resp.* 21, 480a17–19.

In view of the discussion which follows, however, it may also be that τοῖς ἄλλοις should be connected with a tacit ἐμψύχοις, 'the other living creatures' (see 481a5), and that this anticipates the statement in 2, 482a7: τοῖς δὲ δὴ μὴ ἀναπνευστικοῖς and 2, 482a21: τοῖς δὲ δὴ ἐνύγροις, that living creatures without a system of respiration seem equally to need 'nourishment' of their *pneuma*. This position seems underlined by 481a12: πᾶσιν—'all living creatures' and by the statement that non-breathing creatures get this nutrition from 'ordinary food' (2, 482a10).

1, 481a8–9: 'Of these two the <former> manner of nutrition seems just as likely to take place by means of nutritive substance' (τούτων ἴσως οὐχ ἧττον ἂν οὐχ οὕτως δόξειεν διὰ τῆς τροφῆς).

What does τούτων refer to? To the δύο τρόποι of a6 or to ἄλλοις in a8? W.S. Hett 487 opts for τρόποι: 'Of the two the method by means of food seems more likely'; likewise J.F. Dobson; J. Tricot 175; also A. Roselli 133. P. Gohlke 158 seems to opt for ἄλλοις: 'Und ebensowenig, wie in andern Fällen, ist bei der Lebensluft die Erneuerung durch Nahrung abzulehnen.' The choice of τρόποι seems right, but Hett's translation is incorrect, because if Aristotle meant what Hett thinks, the chosen alternative would have to be formulated as ὃ διὰ τῆς τροφῆς.

It would in fact be strange if the author first declares that there are two kinds of 'nutrition' (τροφή), and then calls one of them 'the nutrition by means of food'.

Another argument against Hett's translation is that οὐχ οὕτως in a8 is deleted as incomprehensible, though it is impossible to indicate why it entered the text. In the second place it makes lines 481a9–10 completely incomprehensible. For in that case the argument 'body is nourished by body, and breath is a body' is interpreted in the sense:

every body is nourished by bodily nutrition; and *pneuma* is a body; so it is nourished by the result of the concoction of food. But this cannot possibly have been used as an argument for underlining a preference for option (B), since option (A) talks about 'nourishment' of *pneuma* by the inhaled air, and this inhaled air is of course a 'body' too.

More probably the author is aware that the phrase 'nutrition of *pneuma* by respiration' may sound strange to his audience. This may have led him to clarify that this nutrition by respiration also involves a 'nutritive substance', viz. the inhaled air. 2, 481a29 underlines this by stating that, in the view of 'Aristogenes', the inhaled air is 'food'.

Perhaps we should therefore replace the οὐχ οὕτως of the manuscripts with: ἐκείνως, and interpret the sentence as follows: 'of the two ways mentioned the nutrition of *pneuma* <in the former manner> may seem just as likely to take place by means of food'. In that case οὐχ οὕτως makes sense as a marginal gloss clarifying ἐκείνως, which entered the text by mistake. Cf. *G.C.* II 7, 334b15–19: 'not as matter exists potentially, but in the sense explained earlier' (οὐχ οὕτως δὲ ὡς ἡ ὕλη... ἐκείνως δὲ ὕλη τὸ γινόμενον). 334a35: 'But it is not possible in the way they say' (τοῖς δ' ἐκείνως λέγουσι οὐκ ἐνδέχεται). *Metaph.* B 4, 1001a8: 'For some people think they are of the former, others of the latter nature' (οἱ μὲν γὰρ ἐκείνως οἱ δ' οὕτως οἴονται τὴν φύσιν ἔχειν). *E.N.* V 11, 1136a16: 'and is all suffering of injustice of the latter kind or else all of the former' (καὶ ἆρα πᾶν οὕτως ἢ ἐκείνως). *Pol.* II 9, 1270a22; IV 13, 1297a40–41; 15, 1300a27; 29; V 8, 1308b7–9; *Meteor.* III 6, 377b13; IV 9, 387b31. See also the use of ἔκεινα in *Spir.* 2, 482a10, 16 and 25.

In this interpretation, lines 481a8–10 are meant to broaden the concept of 'food'. The author explains that food need not only be understood as the substances which are taken in through the mouth (and the oesophagus) or the roots, but that 'nutritive substance' can be taken more broadly.

This means that we have to place lines a8–10 between brackets as a parenthetical remark. It now becomes clearer that 481a10: 'So how does this work?' (τίς οὖν ὁ τρόπος) follows on from option B in 481a7.

In the further discussion of the two alternative views, viz. 'by means of respiration' (A) or 'by means of (concoction of) food' (B), it is good to bear in mind that Aristotle in *Resp.* 6 (in a critique of a theory which seems identical to that of 'Aristogenes' here) does declare a preference for theory B: 6, 473a10–12: 'Again, what are we to say of this imaginary

generation of heat from the inhaled breath? For we can see that it is rather due to food' (ἔπειτα καὶ τὸ γίγνεσθαι τὸ θερμὸν ἐκ τοῦ πνεύματος τίνα χρὴ τρόπον λέγειν, πλασματῶδες ὄν; μᾶλλον γὰρ ἐκ τῆς τροφῆς τοῦτο γιγνόμενον ὁρῶμεν).

1, 481a9: ('For a body is nourished by a body, and *pneuma* is a body.') (σῶμα γὰρ ὑπὸ σώματος τρέφεται, τὸ δὲ πνεῦμα σῶμα).

On the subject in general, cf. *G.C.* I 5 ff., esp. 321a5: 'It is necessary that (something that grows) grows through something immaterial or through something material' ('Αναγκαῖον δὴ ἢ ἀσωμάτῳ αὐξάνεσθαι ἢ σώματι).

The *pneuma* referred to here is not the innate *pneuma* of 481a1, as J.F. Dobson and P. Gohlke 158 believe, but the *pneuma* supplied from without by respiration. This meaning is clearly intended in 2, 481a29: 'he also holds breath to be food' (τροφὴν οἴεται καὶ τὸ πνεῦμα). Aristotle uses it in the same way in *Resp.* 3, 471a26: 'All animals which breathe in or draw in *pneuma*' (πάντων τῶν ἀναπνεόντων καὶ ἑλκόντων τὸ πνεῦμα). 471b4: 'fishes, which do not possess any *pneuma* from without' ((τῶν ἰχθύων) οὐκ ἐχόντων πνεῦμα θύραθεν οὐθέν). 4, 472a35; 5, 473a2: 'we draw breath frequently' (πολλάκις τὸ πνεῦμα συμβαίνει σπᾶν) and in 6, 473a4: 'as if the internal fire is fed by breath' (ὡς τρεφομένου τῷ πνεύματι τοῦ ἐντὸς πυρός) and 473a10. Cf. also 10, 476a9: '(The lung) its name—*pneumôn*—seems due to its being a receptacle for breath—*pneuma*' (ἔοικε καὶ τὄνομα εἰληφέναι ὁ πνεύμων διὰ τὴν τοῦ πνεύματος ὑποδοχήν). Sometimes Aristotle uses the phrase '*pneuma* drawn in from without' (πνεῦμα θύραθεν ἐπεισακτόν), e.g. *P.A.* II 16, 659b19, in contrast to 'the innate *pneuma*' (τὸ σύμφυτον πνεῦμα), which all living creatures possess by nature. Because he developed a new view of vital phenomena and generation, he is responsible for giving a whole new conceptual meaning to the word *pneuma*. Confusingly, he continued to use '*pneuma*' in the sense of 'inhaled air'. Hence we can find him stating that preservation of the 'innate *pneuma*' requires cooling by means of inhaled *pneuma*.

In the interpretation indicated by our translation, this sentence does not contain an 'argomentazione solo apparentemente dimostrativa', as A. Roselli 71 claims.

But the idea that the innate *pneuma* is fed by inhaled air is totally unacceptable to Aristotle. He holds that respiration has the sole function of cooling the central parts of the body.

[Aristotle's position]

1, 481a10: 'So how does this work?' (Τίς οὖν ὁ τρόπος;)

The question here is not: 'so which (of the two ways mentioned in a6–7) is it'? Greek would not use Τίς but Πότερος for this. The question here is: 'In what way does food for the innate *pneuma* come about?', following on from the previous section.

1, 481a10: 'Most probably by a kind of drawing of blood from the veins and a process of concoction of this blood' (ἢ δῆλον ὡς ἐκ τῆς φλεβὸς ὁλκῇ τινι καὶ πέψει).

This must be an elaboration of 481a7: 'by means of the process of concoction which accompanies the introduction of food' (τῆς κατὰ τὴν τῆς τροφῆς προσφορὰν πέψεως). At first food is bread or fruit. This food enters the stomach via the mouth and oesophagus and is turned into blood by an initial process of concoction. But food in this undigested form is not found in the veins. This passage talks about food deriving from the veins. This must be blood, result of the ordinary process of concoction. The idea here, we might suppose, is that respiration draws blood from the veins and this blood strengthens the innate *pneuma* in a second process of concoction.

1, 481a11: 'For blood is food in its last phase, which is the same for all living creatures' (τὸ γὰρ αἷμα ἡ ἐσχάτη τροφὴ καὶ ἡ αὐτὴ πᾶσιν).

This is a position defended by Plato in *Tim.* 80e7: 'We call this liquid "blood". It is the sustenance of the flesh and of the entire body' (αἷμα, νομὴν σαρκῶν καὶ σύμπαντος τοῦ σώματος).

But it is a central tenet for Aristotle too; cf. *Iuv.* 3, 469a1: 'for blooded animals blood is the ultimate food from which the parts are formed' (...τὸ αἷμα τοῖς ἐναίμοις ἐστὶ τελευταία τροφή, ἐξ οὗ γίνεται τὰ μόρια). Also *Resp.* 8, 474b3: 'the food from which the parts of the animals are formed is blood. And blood and the veins must have the same origin: for the one exists for the sake of the other, as a vessel and receptacle' (ἡ τροφὴ μὲν γὰρ ἐξ ἧς ἤδη γίνεται τὰ μόρια τοῖς ζῴοις ἡ τοῦ αἵματος φύσις ἐστίν. τοῦ δ' αἵματος καὶ τῶν φλεβῶν τὴν αὐτὴν ἀρχὴν ἀναγκαῖον εἶναι· θατέρου γὰρ ἕνεκα θάτερον ἐστιν, ὡς ἀγγεῖον καὶ δεκτικόν). *G.A.* IV 1, 766a33; I 19, 726b2; 20, 728a20; a more accurate formulation is found in II 4, 740a21: 'the animal's ultimate food is blood or its equivalent. The veins are the blood vessels' (τροφὴ

δὲ ζῴου ἡ ἐσχάτη αἷμα καὶ τὸ ἀνάλογον, τούτων δ' ἀγγεῖον αἱ φλέβες). The idea here is that blood is drawn from the veins and concocted and that its evaporation serves to maintain and strengthen the innate *pneuma*. Cf. also 2, 482a10: 'the ordinary food' (τῆς κοινῆς τροφῆς) and 4, 482b31 on τὸ ἐκπνευματούμενον.

This position does raise the question how the various parts of the body, like flesh, bone, sinews, and skin, can all be built up out of the same ultimate food. Chap. 9 answers this question by making it clear that the vital heat of the innate *pneuma* can make its products liquid and solid, compact and rarefied. Aristotle regards semen and menstrual blood as residues of the concoction of the blood by *pneuma* with its vital heat, the important difference being that the residue of a male specimen is the product of greater vital heat.

1, 481a12: 'for all living creatures' (πᾶσιν).

J.F. Dobson translates: 'for the blood is the ultimate and universal nutriment.' This can be interpreted along the lines of W.S. Hett 487: 'for blood is the ultimate food for every part alike.' P. Gohlke 158 does not translate πᾶσιν. But πᾶσιν can be taken as 'all living creatures that possess blood.' Cf. *Somn.* 3, 456a34: 'For all blooded creatures, blood is the ultimate food, and for bloodless animals its equivalent. Blood is located in the veins. The origin of these is the heart. (This is clear from dissections.)... We discussed this in *On nutrition*' (τροφὴ δ' ἐστὶ πᾶσιν ἡ ἐσχάτη τοῖς μὲν ἐναίμοις ἡ τοῦ αἵματος φύσις, τοῖς δ' ἀναίμοις τὸ ἀνάλογον, τόπος δὲ τοῦ αἵματος αἱ φλέβες, τούτων δ' ἀρχὴ ἡ καρδία (φανερὸν δὲ τὸ λεχθὲν ἐκ τῶν ἀνατομῶν).... εἴρηται δὲ περὶ τούτων ἐν τοῖς Περὶ τροφῆς). Cf. *G.A.* II 4, 740a21–24; IV 1, 766a33. See also 2, 482a9–11 and 6, 484b7.

1, 481a12–14: 'Just as blood absorbs food for its own vessel, so also for that which is enclosed by it, i.e. the vital heat' (ὥσπερ οὖν καὶ εἰς τὸ ἀγγεῖον αὐτοῦ καὶ εἰς τὸ περιεχόμενον λαμβάνει *** τροφὴν εἰς τὸ θερμόν).

This sentence is problematical. We should consider that crucial elements in this passage may be beyond our grasp.

In his 1913 text edition W. Jaeger assumed a lacuna after λαμβάνει and suggested: 'just as it receives food from what is supplied, so it receives *pneuma* from blood by a kind of drawing in' (<τροφὴν ἐκ τῶν προσφερομένων, οὕτω καὶ τὸ πνεῦμα ἐκ τοῦ αἵματος ὁλκῇ τινι προσλαμβάνει>). A. Roselli 72 assumed a lacuna after περιεχόμενον. J.F.

Dobson follows W.D. Ross in his correction: περίεχον. His translation: 'So the breath receives food into the hot element as into its vessel and receptacle' does not make sound sense. Likewise W.S. Hett 487 and J. Tricot 175. This means that they distinguish between innate *pneuma* and vital heat. The vital heat is now the 'vessel' (ἀγγεῖον) of the *pneuma.* This seems at odds with *G.A.* II 3, 736b37, where 'the so-called vital heat' (τὸ καλούμενον θερμόν) is identified with '*pneuma* and the nature of *pneuma*' (τὸ πνεῦμα καὶ ἡ ἐν τῷ πνεύματι φύσις).[6]

The essence of the problem is the subject of λαμβάνει. Because the issue is the nutrition of the innate *pneuma* (481a9–10), Dobson and Hett opt for *pneuma* as subject. But P. Gohlke 158 opts in his translation for blood as subject: 'Dieses nimmt die Nahrung auf, gleichsam in sein Gefäss und die darin enthaltene Wärme.' A. Roselli 133 has: 'come dunque sia per il vaso que lo contiene sia per il contenuto <...> prende il nutrimento per il calore.'

H. Bonitz, *Index Aristotelicus* 581a51 notes for τὸ περιεχόμενον: 'forma medii esse videtur.' He is right that a passive form would imply 'that which is enclosed (by the vessel), i.e. blood.' But the meaning may be that the vital heat is present in the blood.

We should take 'the vessel' in 1, 481a12 to refer to the blood vessels. The vessel of the blood is the heart and the veins. Cf. *H.A.* III 19, 520a12. In the embryonic development, according to Aristotle, the heart forms the basis for the entire vascular system. Cf. *G.A.* II 6, 744a5. See also *P.A.* II 1, 647b4: 'But because the heart is the starting-point of the veins, and has in itself the capacity which first forms the blood, it is natural to assume that it consists of the same material as the food which it absorbs' (ἡ καρδία, διὰ τὸ τῶν φλεβῶν ἀρχὴν εἶναι καὶ ἔχειν ἐν αὑτῇ τὴν δύναμιν τὴν δημιουργοῦσαν τὸ αἷμα πρώτην, εὔλογον, ἐξ οἵας δέχεται τροφῆς, ἐκ τοιαύτης συνεστάναι καὶ αὐτήν).

The theory of 'Aristogenes' mentions that the 'vessels' which contain inhaled air also require food for their growth: 2, 482a3 and 4, 482b11.

---

[6] Cf. W. Jaeger, art. 1913; repr. 1960, 77 n. 3. But he considers this 'nur eine Übertreibung' and believes that Aristotle maintains a systematic distinction between innate *pneuma* and vital heat—cf. p. 75. This is also why Jaeger considers chap. 9 to be not Aristotelian but Stoic.

1, 481a12: 'Just as' (ὥσπερ οὖν).

Is this perhaps where the lacuna is? Is this where the name of an earlier author was mentioned, for instance the name of Empedocles, just as Aristotle starts chap. 2 with: 'as Aristogenes holds' (ὥσπερ Ἀριστογένης οἴεται)?[7]

This would support the idea that lines 481a10–12 first contain a clear choice of position by the author of *Spir.*: maintenance and growth of the innate *pneuma* is in fact a matter of drawing in from the veins and concoction. After this position is outlined, it is followed by the mention of an author who holds the same view, *but reduces the process to respiration.* For purposes of orientation we suggest: '<Empedocles' assumption is impossible. For he says that the air, while it flows into the *artèria*>, just as for its own vessel, also takes in food for what is enclosed by it, i.e. for the vital heat' (< ὥσπερ Ἐμπεδοκλῆς οἴεται οὐ δύνατον. λέγει γὰρ τὸν ἀέρα εἰσρέοντα εἰς τὴν ἀρτηρίαν> ὥσπερ οὖν καὶ εἰς τὸ ἀγγεῖον αὐτοῦ καὶ εἰς τὸ περιεχόμενον λαμβάνει<ν> τροφὴν εἰς τὸ θερμόν). This would remove the problem that *Spir.* fails to answer the question which it raises. However, the text offers no specific leads for this.

1, 481a13: 'i.e. the vital heat' (λαμβάνει τροφὴν εἰς τὸ θερμόν).

Cf. *Resp.* 6, 473a10, which talks about 'the generation of the vital heat from the inhaled air' (τὸ γίγνεσθαι τὸ θερμὸν ἐκ τοῦ πνεύματος).

λαμβάνειν may stand for 'to take in' here. In 481a21 ἀντιλαμβάνει stands for 'to inhale'. See also 481a26: 'take in and discharge' (λαμβάνει καὶ ἐκπέμπει). The correction to ἀντιλαμβάνε<τα>ι by A. Roselli 75 in a21 is unconvincing.

The appearance of 'the vital heat' (τὸ θερμόν) is striking. Doubtless it is identical here with the *pneuma* of respiration in the view of Aristotle's opponents. But 9, 485a28 shows it to be Aristotle's own central concept, and essentially different from the view of those opponents.

[7] This could be surmised on the basis of 2, 481a31: 'produces more problems' (πλείους ἔχει τὰς ἀπορίας), which suggests that chap. 1 also discusses views not shared by the author.

[The content of the version of theory B which is rejected]

1, 481a14–16: 'Now the air supplies it [food] and is responsible for the activity and, by adding the activity of concoction to itself, causes growth and nutrition' (ἄγει δ' ὁ ἀὴρ τὴν ἐνέργειαν ποιῶν, τήν τε πεπτικὴν αὐτὸς αὑτῷ προστιθεὶς αὔξει καὶ τρέφει).

This passage marks a shift from Aristotle's own position to a variant which he disputes. 1, 481a10–14 can be interpreted as a postulation of Aristotle's own position. (And in that case there is no problem in seeing *M.A.* 10, 703a10 as a reference to *Spir.*) Aristotle's critical inquiry thus begins here in 481a14 with a discussion of the question whether we should see inhaled air as the principle of the drawing in and concoction of blood.

First we must determine what αὐτός refers back to. The subject of 'causes growth and nutrition' (αὔξει καὶ τρέφει) must be 'the air' (ὁ ἀὴρ). In 4, 482b15 the author talks about a movement in the *artèria* which 'supplies the food' (τὴν τροφὴν ἐπάγουσα).

The second question is: what kind of air is meant in 481a14? J.F. Dobson, who translated σύμφυτον πνεῦμα in 481a1 as 'natural breath', translates ἀήρ here as 'air', but adds in a note: 'ἀήρ is here identified with breath; contrast 481b4 *sqq.*' W.S. Hett 487 follows a similar procedure. It is more natural to assume that the air referred to here should not yet be identified with 'innate *pneuma*', but that it is respiratory air or outer air. This air is now said to supply food for intake. J. Tricot 175 writes 'souffle respiratoire' here instead of 'souffle vital'.

The third question is: how are we to construe 'of concoction' (τὴν τε πεπτικήν)? This phrase cannot be taken with any other word than 'activity' (ἐνέργειαν) in a14. But should this word in fact be connected with this phrase, or is it an object of προστιθείς? J.F. Dobson's translation is clear: 'The air draws in the nutriment and imparts the activity, and applying to itself the digestive power is the cause of its own growth and nutrition'; cf. A. Roselli 133: 'l'aria...applicando a sé stessa la facultà di cuocere, fa crescere e nutre il pneuma'.

It is clear in any case that the activity of concoction is the activity by which food is digested in the veins, as was announced in a11. So the air supplies food and is responsible for the activity of concocting this food. In this way respiration (which Aristotle recognized as belonging to humans and higher animals) is connected with the vegetative activity of concocting food, which Aristotle regards as a function on

the level of plant life. This means that the position represented here is refuted in chap. 9.

A difference compared with theory A discussed in chap. 2 is that the author says there 'that the air is concocted', which immediately raises the question: what agent is responsible for this concoction (481a29 and 32)?

Finally, there is the question: what entity is said to increase in volume and be nourished? Dobson is clear on this point too. W.S. Hett 487 leaves it open: 'causes growth and nourishment'. It is more natural to assume that the result of concoction is presented as being caused by respiratory air and, after concoction, being added by the air to itself. This involves a view which sees the breath of respiration as (closely connected with) the soul of the living creature, which causes vital activity, including digestive activity, and which adds to itself the result of this concoction of food as new, fresh vital breath.

For this interpretation of προστιθείς, cf. *Phys.* VII 2, 245a26: 'For growth is a kind of addition' (πρόσθεσις γάρ τις ἡ αὔξησις). *G.C.* II 6, 333a35: 'But in the view of Empedocles there can be no growth other than as a form of addition. For fire grows by fire' ('Αλλὰ μὴν οὐδ' αὔξησις ἂν εἴη κατ' 'Εμπεδοκλέα, ἀλλ' ἢ κατὰ πρόσθεσιν· πυρὶ γὰρ αὔξει τὸ πῦρ). *Phys.* I 7, 190b5: 'Things which come to be in the proper sense, come to be...some by addition, like everything that grows' (γίγνεται δὲ τὰ γιγνόμενα ἁπλῶς τὰ μέν...τὰ δὲ προσθέσει, οἷον τὰ αὐξανόμενα).

What we have here, then, is a description of a theory which holds the breath of respiration responsible for the vital movements in the living creature (and so not the vital heat, as Aristotle does, and as the author of this work will set out in chap. 9). This means that chap. 1 presents *two non-Aristotelian* theories, *which are thoroughly analyzed and rejected.* The gist of the first theory is that the vital principle of a living creature is maintained by food supplied and concocted thanks to the effect of the inhaled air (B). The other is the theory that respiration directly provides new vital heat by 'concoction' of inhaled air (A).

Inasmuch as both theories assign a central role to respiration for vital activity, both must deny life in a proper sense to large groups of animals and to all plants. Cf. Aristotle against Empedocles in *Anim.* II 4, 415b27–416a9. For Aristotle both theories are 'hot air'.

Strong support for this interpretation of chaps. 1 and 2 can be found in the opening lines of the last chapter. Aristotle calls his opponents there people 'who hold that it is not *the vital heat* which is the efficient

principle' (9, 485a28). The sentence suddenly becomes transparent if we realize that the two theories (A) and (B), which have been the focus of critical attention from chap. 1 through to chap. 8, did not see the ultimate 'efficient cause' in the innate *pneuma*, as Aristotle did, but in respiration.

To recognize this is to see the indissoluble unity between chap. 9 and the eight preceding chapters.

[The rejected version of theory B critically discussed]

Objection 1

1, 481a15: This in itself is perhaps not so strange. But it is strange that what is primary has been formed from the food' (οὐδὲν δ' ἴσως ἄτοπον αὐτό γε τοῦτο, ἀλλὰ γενέσθαι τὸ πρῶτον ἐκ τῆς τροφῆς).

The author brings up a fundamental point here. He accepts a theory on how food for the innate *pneuma* can be formed in a process in which food is concocted. But he objects that the innate *pneuma* is something which precedes all processes of concoction. For as all Aristotle's biological writings show, this *pneuma* is *the principle of all vegetative processes.*

τὸ πρῶτον should be taken here as the subject of γενέσθαι. Not food but the vegetative soul-principle is primary. Hence *pneuma* as instrument of the soul is 'primary'.

In the same way 4, 482b32 says that pulsation must be primary because it is directly connected with the 'first' parts, that is, with the heart as 'first' form of vital dynamics. Cf. 4, 483a17. Hence the first is also 'the first principle of movement'—2, 481b17.

1, 481a17: 'For that which is connected with the soul is purer' (καθαρώτερον γὰρ ὃ τῇ ψυχῇ συμφυές).

A. Roselli 74 notes that, in his authentic writings, Aristotle neglected to give a definition of the innate *pneuma*. But here the innate *pneuma* is described not just as innate but as '"strettamente connesso, della stessa natura" dell'anima'. This leads Roselli to assert that the author of *Spir.* has a material conception of the soul too and that we are therefore dealing with a Stoic conception.

This is entirely wrong. The critique of the view discussed here cites the soundly Aristotelian theory that the innate *pneuma* 'is connected with the soul'. The same thing is said in 9, 485b10–13. *Pneuma* is interpreted

here as '*sôma physikon organikon*' or 'instrumental body' of the soul, with which it forms a unity. *Mund.* 4, 394b9–11 talks about *pneuma* in the same way: 'the ensouled and life-giving substance in plants and animals' (ἥ τε ἐν φυτοῖς καὶ ζῴοις... ἔμψυχός τε καὶ γόνιμος οὐσία).

Against the idea that the innate *pneuma* is nourished by food deriving from the blood, the author argues that the innate *pneuma* must have a higher degree of purity, and so cannot result from the concoction of food.[8]

He admits that the objection is invalid if the unity with the soul is said to be realized not from the outset, but at a later stage.

1, 481a17: 'Unless somebody were to say that the soul, too, is formed later, when the seeds separate and begin to develop into life forms' (εἰ μὴ καὶ τὴν ψυχὴν ὕστερον λέγοι γίνεσθαι, διακρινομένων τῶν σπερμάτων καὶ εἰς φύσιν ἰόντων).

This is a puzzling passage too. J.F. Dobson translates: 'unless we were to say that the soul is a later product than the body, arising when the seeds are sorted out and move towards the development of their nature' and notes: 'i.e. from the μῖγμα. Cf. *de Caelo* iii 305b4, of Empedocles'; likewise J. Tricot 176.

In *Anim.* I 4, 408a18–19 Aristotle had connected such a view with Empedocles. The latter had spoken about the phase in which the four elements separate and about the soul as the ratio (*logos*) of the mixture (*mixis*) of the elements: 'the ratio of the mixture is a harmony and soul' (ὁ δὲ τῆς μίξεως λόγος ἁρμονία καὶ ψυχή). See also *Spir.* 9, 485b28. It is natural to assume that the elements come first and that the ratio of their mixture is secondary. The most comparable place is *G.A.* I 18, 722b6 ff., where Aristotle discusses Empedocles' view that man and woman both contribute semen to the generation of the new individual, completing each other's contribution, such that neither is entirely responsible for the new specimen.

But such a view is entirely unacceptable to Aristotle. Empedocles is known to have explained the process of generation of all things as a result of the 'combination' (*synkrisis*) effected by *Philotès* (Love): *Metaph.* A 4, 985a21; *Phys.* VIII 1, 252a19–27; 9, 265b19–22, with 265b22: 'Anaxagoras claims that the mind as prime mover brings about

[8] But Aristotle himself does regard semen as a (high-quality) residue of concoction and the ultimate product of blood, and holds this semen to contain *pneuma*.

separation' (καὶ τὸν νοῦν δέ φησιν Ἀναξαγόρας διακρίνειν τὸν κινήσαντα πρῶτον). See also *G.C.* I 1, 314b6: 'Hence Empedocles claims that there is no coming-to-be of anything, only mixture and separation of what is mixed' (Διὸ λέγει τοῦτον τὸν τρόπον καὶ Ἐμπεδοκλῆς ὅτι φύσις οὐδενός ἐστιν... ἀλλὰ μόνον μίξις τε διάλλαξίς τε μιγέντων) and II 1, 329a3: 'like Empedocles: because they are combined and separated or changed there is coming-to-be and passing-away of things' (ὥσπερ Ἐμπεδοκλῆς· ἐξ ὧν συγκρινομένων καὶ διακρινομένων ἢ ἀλλοιουμένων συμβαίνειν τὴν γένεσιν καὶ τὴν φθορὰν τοῖς πράγμασιν). It seems arguable that the theory disputed in *Spir.* 1 should be most associated with Empedocles, and the theory in *Spir.* 2 most with Plato's *Timaeus.* (On the other hand the term 'seeds' (σπέρματα) is more reminiscent of Anaxagoras.)

A. Roselli 133 translates here: 'a meno che non si sostenga che anche l'anima si genera in un secondo momento, quando cioè i semi *di essa* si separino e raggiungano la loro condizione naturale'.

In the time before Aristotle it was common to assume that the soul only entered a living creature during delivery, when respiration started. Cf. *Anim.* I 5, 410b27–411a2. According to Pl. *Tim.* 78d–e, too, a living creature lives from his first till his last breath.

Aristotle is convinced that every process of growth and development of a living entity is guided by a soul-principle which is already present in the semen. He rejects the idea that there is first a process of development and only later a soul. Cf. *G.A.* II 1, 734a13–16.

1, 481a19: 'begin to develop into life forms' (εἰς φύσιν ἰόντων).

In *Spir.* φύσις sometimes means the 'life form' of an individual living entity. Cf. 9, 485b2: αἱ φύσεις (and perhaps b8: τὴν φύσιν αὐτὴν νοῆσαι τὴν χρωμένην). See also *Anim.* I 5, 411b23: 'they do not possess the instruments necessary for maintenance of their nature' (ὄργανα γὰρ οὐκ ἔχουσιν ὥστε σώζειν τὴν φύσιν). *Iuv.* 2, 468b5–6; 23, 479a6–7: 'by the inferiority of their natural constitution' (διὰ τὸ μὴ συγκεῖσθαι τὴν φύσιν αὐτῶν εὖ).

Objection 2

1, 481a19: 'And now if there is a residue of every form of food, by what passage is it transported outside? It is not reasonable to assume that this takes place via exhalation' (εἴ τε περίττωμα πάσης τροφῆς ἐστι, ποίᾳ διαπέμπεται τοῦτο; κατὰ μὲν γὰρ τὴν ἐκπνοὴν οὐκ εὔλογον).

Cf. *Resp.* 6, 473a6: 'and after the fire has been fed, exhalation occurs' (τραφέντος δὲ τοῦ πυρὸς γίγνεσθαι τὴν ἐκπνοήν).

A soundly Aristotelian argument is put forward here against the view that food for the innate *pneuma* is supplied from the veins. Aristotle always distinguished sharply between the part of the body that takes in food (the mouth, the roots) and the part where digested food is discharged as a residue. See *Resp.* 6, 473a12: 'the consequence is that the food is taken in by the same passage as that by which the residue is discharged. But we do not see this happen in other cases' (συμβαίνει τε κατὰ ταὐτὸ δέχεσθαι τὴν τροφὴν καὶ τὸ περίττωμα ἀφιέναι· τοῦτο δ' ἐπὶ τῶν ἄλλων οὐχ ὁρῶμεν γινόμενον).

Aristotle believes that the food supplied via the mouth and oesophagus is 'concocted', producing not only 'food in its last phase' (blood) but also residues (*perittômata*), such as faeces and urine. However, he also calls semen a residue of the process of concoction. For each residue he indicates the place where it is stored and discharged. But the theory discussed here claims that the innate *pneuma* results from a higher-level process of concoction, a concoction of the blood. Aristotle then raises the question, reasonable in his theory, whether there must not be a residue of this process of concoction and how it is discharged. Because a kind of evaporation of the blood must be involved, he suggests that this discharge must take place via the airways. But 'exhalation' is not an option, because it is the countermovement of inhalation and must be seen in connection with inhalation.

2, 481b30–31 might briefly give the impression that the rule formulated here does not hold for plants. Not so, though plants do represent a special case of this general rule. Cf. *Sens.* 5, 445a17: 'In the first place we see that food must be composite (for the beings nourished are not simple either; hence residues of the food are formed, either internally, or, as in the case of plants, externally...)' (πρῶτον μὲν γὰρ ὁρῶμεν ὅτι τὴν τροφὴν δεῖ εἶναι συνθετήν (καὶ γὰρ τὰ τρεφόμενα οὐχ ἁπλᾶ ἐστιν, διὸ καὶ περιττώματα γίγνεται τῆς τροφῆς, ἢ ἐν αὐτοῖς ἢ ἔξω, ὥσπερ τοῖς φυτοῖς...)).

1, 481a20: 'by what passage?' (ποίᾳ—sc. ὁδῷ).

1, 481a21: 'For it is immediately followed by inhalation' (ἀντιλαμβάνει γὰρ εὐθύς).

The same argument, also in a polemical sense, in 2, 481b9: 'For exhalation immediately follows inhalation' (εὐθὺς γὰρ μετὰ τὴν εἰσπνοὴν

1, 481a21–22: 'So the only possibility left is: through the pores of the *artèria*' (λοιπὸν δὲ δῆλον ὅτι διὰ τῶν τῆς ἀρτηρίας πόρων).

The idea is that air which the blood supplies as food and concocts for the innate *pneuma* also produces residues of this concoction, and that these cannot be discharged by the same passage via exhalation. The alternative is that they are discharged via the pores of the *artèria*.

Here we are confronted for the first time with a central problem in *De spiritu*. Aristotle always uses the term *artèria* for the 'windpipe' through which air is conducted from the mouth to the lungs to cool the heart. Cf. *H.A.* I 12, 492b7 and I 16, 495b16: 'the *artèria* takes in and lets go only *pneuma*, but nothing else which is dry or liquid, or else it causes problems' (ἡ μὲν οὖν ἀρτηρία... δέχεται μόνον τὸ πνεῦμα καὶ ἀφίησιν, ἀλλὸ δ' οὐδὲν οὔτε ξηρὸν οὔθ' ὑγρόν, ἢ πόνον παρέχει). (In addition the windpipe has a function in the process of speech.) *Spir.* regularly uses *artèria* for a vessel which contains breath (and liquid—cf. 5, 483b22) and *which is present throughout the body*. W. Jaeger (art. 1913; repr. 1960) 89 translates 'Luftkanäle'.

R.B. Onians, *The Origins of European Thought. About the Body, the Mind, the Soul, the World, Time and Fate* (Cambridge 1951) 80 proposes the explanation: 'To the earlier, as to later Greeks it might well seem that the arteries, which after death are found empty and dilated, contained "breath" and perhaps also that the pores were πόροι, "passages" inwards', referring in n. 4 to Empedocles B 100 and *Spir.* 5, 483b15.

We will have to assume that the author is representing the view of opponents here, as in *Resp.* 7, 473b1–5. This passage talks about Empedocles' view that some veins (*phlebes*) contain air as well as blood and that they have pores which form a connection with the outer air: 'he says that inhalation and exhalation take place because there are certain vessels which contain blood but which are not full of blood, but which have openings to the outer air' (γίγνεσθαι δέ φησι τὴν ἀναπνοὴν καὶ ἐκπνοὴν διὰ τὸ φλέβας εἶναί τινας ἐν αἷς ἔνεστι μὲν αἷμα, οὐ μέντοι πλήρεις εἰσὶν αἵματος, ἔχουσι δὲ πόρους εἰς τὸν ἔξω ἀέρα).

This is also the basic assumption in Plato's theories of perception and respiration, *Tim.* 67a7–b5; 70c7–8 (criticized in Arist. *P.A.* III 3, 664b6); 79a5–e10. Cf. the rule formulated in *Tim.* 78a2 ff.: 'everything that consists of smaller particles is impenetrable to larger particles, but that which consists of large particles cannot prevent smaller particles from penetrating it. Fire has the smallest particles of all kinds' (πάντα ὅσα ἐξ ἐλαττόνων συνίσταται στέγει τὰ μείζω, τὰ δὲ ἐκ μειζόνων τὰ σμικρότερα οὐ δύναται, πῦρ δὲ πάντων γενῶν σμικρομερέστατον), cited by A. Roselli 75.

J. Tricot 176 n. 4 rightly points out that the use of the term *artèria* in *Spir.* does not indicate the sharp distinction drawn in modern medicine between the venous and arterial systems of the blood vessels. This distinction is based on the (much later) insight that blood flowing from the heart is oxygen-rich and blood flowing to the heart is oxygen-poor. In *Spir.* we are dealing with two independent systems, that of the blood vessels and that of the *artèriai*. The fact that nowadays 'arteries' also has the meaning 'veins' and in Aristotle's time the meaning 'windpipe' is an added complication.

Objection 3

1, 481a23: 'But both make for an absurdity, if the innate *pneuma* is assumed to be the purest of all. But if it is thicker, it follows that some pores must be larger' (ἀμφοτέρως δ' ἄτοπον· εἰ τοῦτο πάντων ἔσται καθαρώτατον. εἰ δὲ παχύτερον, ἔσονταί τινες πόροι μείζους).

The sentence seems deficient. A. Roselli 76 follows the suggestion of I. Garofalo (1988) to insert <γὰρ λεπτότερον> after the first εἰ, and translates on p. 133: 'se il residuo è più sottile dovrà essere più puro di ogni altro pneuma'.

But the sentence can also be read elliptically as: 'But in both cases this makes for an absurdity. [That is, if the residue is finer, it could be discharged by the pores of the *artèria*, but this is absurd] if that [aforementioned innate *pneuma*] is assumed to be purest of all—as was postulated in 481a1; but if the residue is thicker, it follows that some pores [of the *artèria*] must be larger'—but in that case the innate *pneuma*, which is finer, passes through them as well! Cf. J. Tricot 176 n. 5. Underlying this debate is a fundamental principle which Plato formulated in *Tim.* 78a2 and which we already quoted above. Aristotle attributes the same principle to Empedocles in *Resp.* 7, 473b3: 'but they have passages to the outer air which are too small to allow parts of the body to pass through, but larger than the particles of air' (ἔχουσι δὲ πόρους εἰς τὸν ἔξω ἀέρα, τῶν μὲν τοῦ σώματος μορίων ἐλάττους, τῶν δὲ τοῦ ἀέρος μείζους) (where W.D. Ross, *Aristotle, Parva naturalia*, a revised text with introd. and comm., Oxford 1955, 315 rightly proposes to read 'blood particles' (τοῦ αἵματος μορίων) instead of 'parts of the body'.

Objection 2 (repeated)

1, 481a26: 'But if the living creature therefore takes in food and discharges the residue by the same passages, this is illogical and absurd' (εἰ δ' ἄρα κατὰ τοὺς αὐτοὺς λαμβάνει καὶ ἐκπέμπει, τοῦτ' αὐτὸ παράλογον καὶ ἄτοπον). Cf. *Resp.* 6, 473a12 (cited above).

[The criticism of the rejected variant of theory B concluded]

1, 481a27–28: 'Such are the arguments for the growth and maintenance of the innate *pneuma* on the basis of food' (ἡ μὲν οὖν ἐκ τῆς τροφῆς αὔξησις καὶ διαμονὴ σχεδὸν ταῦτα).

The author's argument is clearly and tightly organized. In 1, 481a6 he presents two alternative theories and goes on to discuss one of these. 481a27–28 concludes the first part. Chap. 2 starts by reiterating the theme and referring to the second theory. In 2, 482a8 the author states the theme once again and then puts forward a number of objections which apply equally to one variant of theory B and to theory A, because the debate in this passage focuses on all animals which do not possess a respiratory system. 2, 482a21 restates the central question. Finally, 2, 482a26 clearly indicates that the discussion of the central theme has now been concluded. (In the same vein 8, 485a22: 'Thus far on the change of place' (καὶ ταῦτα μὲν πρὸς τὴν κατὰ τόπον ἀλλαγήν), to conclude a section on the locomotive function of (some) bones).

CHAPTER TWO

[The theory of 'Aristogenes' critically discussed]

2, 481a28: 'But the growth and maintenance of the innate *pneuma* as a result of respiration' (Ἡ δ' ἐκ τῆς ἀναπνοῆς).

δ' provides a clear link with the final sentence of chap. 1, as in the transition from chap. 2 to chap. 3.

We will have to mentally add the words 'growth and maintenance' (αὔξησις καὶ διαμονή) from 1, 481a27. Theory A referred to in 1, 481a6, which was also to be investigated, comes up for discussion now. This theory therefore sees the increase in the innate *pneuma* not as resulting from concoction of ordinary food and blood (option B), but regards the inhaled air itself as food for the vital heat, after the inhaled air itself has been concocted. Like the theory discussed in chapter 1, this theory is countered with soundly Aristotelian arguments.

2, 481a28: 'as Aristogenes holds—for he believes that breath, too, is food, because the air is concocted in the <lungs>' (ὥσπερ Ἀριστογένης οἴεται (τροφὴν γὰρ οἴεται καὶ τὸ πνεῦμα πεττομένου τοῦ ἀέρος ἐν τῷ πνεύμονι...)).

This person is mentioned only here in the Corpus. A physician called Aristogenes is known only as a contemporary of Antigonus Gonatas, who was a king of Macedonia from 276 to 239.[1] If this is the person referred to, Aristotle cannot be the author of *De spiritu*. A. Roselli 76 notes: 'la menzione di Aristogene fornisce l'unico elemento esplicito per la datazione di *Spir.*'

This is correct, but it would only help us to date *De spiritu* if we could really determine when this Aristogenes lived. There is no compelling reason to assume that the Aristogenes mentioned here should be identified with the only person with this name of whom we have some knowledge, even if he was a physician of a certain status. The argument that *Spir.* cannot be by Aristotle because of the reference to Aristogenes is

[1] M. Wellmann, 'Aristogenes', in *P.W.-R.E.* II 1 (Stuttgart 1895) cols. 932–933 mentions four other people of the same name.

just as strong as the proposition that Aristogenes must have been a contemporary of Aristotle because he is mentioned by Aristotle.

It is more natural to associate the person of Aristogenes with a figure who somehow links up with the theories of Empedocles, Anaximenes, Diogenes of Apollonia, Anaxagoras or Plato on the soul and respiration which are described by Aristotle and which have a clear affinity with the theory criticized here.[2]

Resp. 6, 473a3, in a passage which comes directly after a critique of Plato's *Timaeus*, rejects a position very close to that of 'Aristogenes': 'But nor should we assume that respiration exists for the sake of nutrition, in the sense that the inner fire is fed by breath and that someone who breathes provides fuel for this fire and exhalation takes place after the fire has received its food' (Ἀλλὰ μὴν οὐδὲ τροφῆς γε χάριν ὑποληπτέον γίνεσθαι τὴν ἀναπνοήν, ὡς τρεφομένου τῷ πνεύματι τοῦ ἐντὸς πυρός, καὶ ἀναπνέοντος μὲν ὥσπερ ἐπὶ πῦρ ὑπέκκαυμα ὑποβάλλεσθαι, τραφέντος δὲ τοῦ πυρὸς γίνεσθαι τὴν ἐκπνοήν). J. Tricot 148 n. 5 associated this passage with pupils of Plato. A. Roselli 77–78 wrongly disputes the connection between this text and *Spir.* by remarking that *Resp.* 6 is concerned with the vital heat which 'is fed'. In the view of 'Aristogenes', the *pneuma* (breath) is the vehicle of vital heat.

Precisely in *Parva naturalia* we often find Aristotle casually mentioning matters in one place and elaborating on them in a later context. It is therefore worth considering that Ἀριστογένης may be a playful, literary allusion to ὁ Ἀρίστωνος,[3] and that Aristotle is referring to Plato, *the son of Ariston*. Another argument supporting this view is that Aristotle effortlessly switches to a plural 'they say' (481b14; b18, where he refers to the opinion of Aristogenes in 481a29–31 with the words: 'they say'; 5, 483a27), and also in 2, 482a23 and 6, 484a32 forcefully formulates his own view in the words 'but *we* say'.

Cf. also the surprising remark in *Sens.* 5, 445a16: 'But what some Pythagoreans say is unreasonable. For they say that some animals are nourished by odours' (ὃ δὲ λέγουσί τινες τῶν Πυθαγορείων, οὐκ ἔστιν εὔλογον· τρέφεσθαι γάρ φασιν ἔνια ζῷα ταῖς ὀσμαῖς). In his commen-

---

[2] Cf. *Metaph.* A 3, 984a5 (Anaximenes and Diogenes of Apollonia); *Anim.* I 2, 405a21 (Diogenes); *Resp.* 1, 470b6; b10 (Diogenes); 2, 470b30 (Anaxagoras and Diogenes); 3, 471b15 (Diogenes).

[3] We can compare the sobriquet 'Kadmogenes' for Heracles in Sophocles, *Trachiniae* 116 and 'Dareiogenes' for Xerxes in Aeschylus, *Persae* 6 and 146. See also Introduction, n. 54.

tary W.D. Ross (1955) says nothing about the possible identity of these Pythagoreans.

2, 481a29: 'for he believes that breath, too, is food' (τροφὴν γὰρ οἴεται καὶ τὸ πνεῦμα).

Cf. Pl. *Tim.* 78e4: 'this activity [of respiration] was assigned to our body in order that it could nourish itself and live by means of moistening and cooling' (ἡμῶν τῷ σώματι γέγονεν ἀρδομένῳ καὶ ἀναψυχομένῳ τρέφεσθαι καὶ ζῆν).

So this theory gives a broader interpretation to the word 'food' than most people (and Aristotle himself) commonly do. In 1, 481a8–10, if our interpretation of these lines is correct, Aristotle already created latitude for an interpretation of the inhaled air as 'food'. It is also a substance (*sôma*), and bodies are nourished by nutritive substances.

A. Roselli 77 therefore believes that this theory of Aristogenes does not take respiration to serve the purpose of refrigeration. But this is not stated anywhere and seems at odds with 3, 482a31 ff.

For Aristotle the view of 'Aristogenes' is also implausible because Aristotle holds that food must be 'composite': *Sens.* 5, 445a18: 'food must be composite (since the creatures nourished by it are not simple either)' (τὴν τροφὴν δεῖ εἶναι συνθετήν (καὶ γὰρ τὰ τρεφόμενα οὐχ ἁπλᾶ ἐστιν...)).

2, 481a29: 'because the air in the <lungs> is concocted' (πεττομένου τοῦ ἀέρος ἐν τῷ πνεύμονι).

This is at odds with Aristotle's views. He holds that the (only) process of concoction takes place in the stomach and then in the heart (as regards blood). No concoction takes place in the lungs, but the air which is drawn to there serves to cool the heart, which is adjacent to the lungs.

The Greek mss. read πνεύματι here, but it would be strange for *pneuma* to be concocted in *pneuma* and the Latin translation by Furlanus seems to have rendered 'lungs' (πνεύμονι). The confusion here is wholly understandable on account of τοῦτο which follows in 481a30 and must certainly refer to *pneuma*. The reading πνεύμονι seems to be supported by 2, 481b17–19: 'Moreover, respiration extends as far as the lungs, as they themselves say, but the innate *pneuma* is present throughout the living creature' (ἔτι δ' ἡ μὲν ἀναπνοὴ μέχρι τοῦ πνεύμονος, ὥσπερ λέγουσι αὐτοί, τὸ δὲ πνεῦμα δι' ὅλου τὸ σύμφυτον). This passage seems a

repetition in different words of 2, 481a29–30. Cf. also 3, 482a33–34. P. Gohlke 159 nevertheless has: 'in der Lebensluft'.

2, 481a30: 'and this [breath] is distributed to the vessels' (τοῦτο δ' εἰς τὰ ἀγγεῖα διαδίδοσθαι).

In this view, the air concocted in the lungs is then distributed to the 'vessels'. This terms usually denotes blood vessels (thus perhaps in 1, 481a12). W.S. Hett 489 talks about 'several receptacles', J. Tricot 177 about 'les vaisseaux sanguins'. But because this passage deals with 'concocted air' which is distributed, the 'vessels' are probably the *artèriai*, 'air ducts'. Cf. 5, 483b12 and b18, where only *artèriai* are said to receive *pneuma*. In the views of Empedocles, Plato and 'Aristogenes' rejected by Aristotle, it is impossible to draw a sharp distinction between blood vessels and air ducts.

For 'to distribute' (διαδίδωμι), cf. Pl. *Tim.* 45b1; 49c6; 64b4; c1; e5; and 67b3. Outside of the *Tim.* the verb is found only three times in Plato.

2, 481b1: 'causes more problems' (πλείους ἔχει τὰς ἀπορίας).

Three objections were made to the rejected variant of theory B. Partly the same objections, but also a series of others, are raised against theory A. These objections relate to the successive elements in the brief summary of Aristogenes' theory: (a) concoction (the efficient cause; the speed and place of concoction); (b) the distribution of *pneuma* to the vessels, and (c) the residue problem.

[I. Objections to theory A as regards living creatures with respiration]

Objection 1

2, 481b2: 'For the concoction of the inhaled air, by what is this caused?' (ἥ τε γὰρ πέψις ὑπὸ τίνος;)

If inhaled outer air becomes food for the innate *pneuma* as a result of concoction (a29), it makes sense to ask what is responsible for the concoction. If it is the innate *pneuma* itself, where does this very first *pneuma* come from?

481b2: 'Most probably by itself [breath], like the concoction of the other nutritive substances' (εἰκὸς μὲν γὰρ ὑπ' αὐτοῦ, καθάπερ καὶ τῶν ἄλλων).

The concoction of the inhaled air, like the concoction of the other nutritive substances, is probably caused by itself, that is, respiratory breath.

2, 481b3: 'But this in turn is strange, if it does not differ from the outer air' (αὐτὸ δὲ τοῦτ' ἄτοπον, εἰ μὴ διαφέρει τοῦ ἔξω ἀερός).

The subject of διαφέρει in b4 must be identical with αὐτός in b2. Cf. 5, 483b2–6. According to Aristotle, concoction is a matter of the innate *pneuma* and its vital heat. But he rejects concoction of the inhaled air. On the other hand 'Aristogenes' holds that inhaled air becomes *pneuma* as a result of concoction. But in that case the inhaled air, before it has been concocted, must differ from the vital *pneuma*. For in a homogeneous mass there cannot be anything that undergoes or causes an effect.

Cf. Pl. *Tim.* 57a3–5: 'For any kind that is similar and identical to itself cannot possibly bring about any change... nor undergo any change' (τὸ γὰρ ὅμοιον καὶ ταὐτὸν αὑτῷ γένος ἕκαστον οὔτε τινὰ μεταβολὴν ἐμποιῆσαι δυνατὸν οὔτε τι παθεῖν...)

2, 481b4: 'If this is the case, however, the vital heat is probably the cause of concoction' (οὕτω δ' ἡ θερμότης ἂν πέττοι).

οὕτω here means: 'But if (the vital breath differs from the outer air, because it possesses vital heat as a specific property), in that case...' Cf. 5, 484a6–7. But this implies a vital heat which is more original than the breath of respiration. This is the constant direction of Aristotle's argument.

Objection 2

2, 481b4: 'And certainly it is also logical that it is thicker' (καὶ μὴν καὶ παχύτερον αὐτὸν εὔλογον εἶναι).

αὐτόν cannot refer back to the innate heat (θερμότης) and must relate to the air. The proposition here is that the inhaled air is made thicker by the process of concoction, because it comes into contact with moisture from the blood (vessels) and air (ducts) and the mass of the body as a whole. This seems to formulate an objection, since the author has posited as his own position in 481a17: 'that which is connected with the soul is purer'. Cf. also 1, 481a22–25.

We would actually expect αὐτό as a reference to *pneuma*. ὄν in 481b6, which has been passed down as a variant of ὄντα, would go well with this.

2, 481b5: 'mixed as it is with the moisture from the vessels' (μεθ' ὑγρότητος τῆς ἀπὸ τῶν ἀγγείων).

Cf. 5, 483b22: 'the *artèria* has moisture in itself and in the coverings which enclose the cavity' (τὴν ἀρτηρίαν καὶ ἔχειν ὑγρότητα καὶ ἐν αὐτῇ καὶ ἐν τοῖς χιτῶσι τοῖς περιέχουσι τὸ κοίλωμα).

2, 481b6: 'and of the entire mass of the body' (καὶ τῶν ὅλων ὄγκων).

J.F. Dobson translates: 'and from the solid parts'; W.S. Hett 489: 'and from the solid parts in general'; A. Roselli 134: 'da tutto il corpo'. The meaning does in fact seem to be: 'the entire mass of the visible body'. Cf. 5, 483b8: 'because it circulates in a moist and coarse-material environment' (ἐν ὑγρότητί τε καὶ σωματικοῖς ὄγκοις ἀναστρεφόμενον).

Objection 3

2, 481b7: 'But if the residue becomes thinner, this is implausible' (τὸ δὲ περίττωμα, εἴπερ γίνεται λεπτότερον, οὐ πιθανόν).

Cf. Objection 3 to theory B in 1, 481a22. 'Aristogenes' seems to assume that exhalation takes place via the pores in the veins/air ducts and throughout the body. This obviously presupposes that the concocted air remains inside, whereas the residues are discharged. But in a system of pores this is only possible if the matter remaining inside cannot pass through the pores, and the matter that is discharged can. But a residue is usually thicker than what it is formed from. Cf. 1, 481a22.

Objection 4

2, 481b8: 'And the rapidity of the concoction is illogical too. For exhalation immediately follows inhalation' (ἄλογος δὲ καὶ ἡ ταχυτὴς τῆς πέψεως· εὐθὺς γὰρ μετὰ τὴν εἰσπνοὴν ἡ ἐκπνοή).

Cf. Objection 2 raised against the rejected variant of theory B in 1, 481a19–21. Objection 4 clearly implies that 'Aristogenes' must have presented exhalation as the discharge of residues. But we should consider that the concept of residues is an Aristotelian concept. It is natural to assume that Aristotle here presents the exhalation to which his opponents refer as the discharge of a residue.

2, 481b12–15: cf. 5, 484a5–7!

2, 481b12: 'For the exhaled air is hot' (ὁ γὰρ ἐκπνεόμενος θερμός).

Cf. *Resp.* 5, 472b33 (in the critical discussion of Pl. *Tim.*): 'It is strange, too, that inhalation stands for the entrance of (vital) heat. For the opposite is found to be the case. For the exhaled air is hot' (ἄτοπον δὲ καὶ τοῦ θερμοῦ τὴν ἀναπνοὴν εἴσοδον εἶναι. φαίνεται γὰρ τοὐναντίον· τὸ μὲν γὰρ ἐκπνεόμενον εἶναι θερμόν).

Objection 5

2, 481b14: 'But they deny this' (ὅπερ οὔ φασιν).

J.F. Dobson creates confusion with his translation: 'but the common view is that it is not'; likewise J. Tricot 177. W.S. Hett 491 rightly: 'this they deny'. For 'Aristogenes', apparently, the heat which concocts the inhaled air results from movement, and is not the work of a vital source of heat, which is Aristotle's view. J. Tricot 178 n. 1 remarks that this seems at odds with 2, 481b2. A. Roselli 80 comments here: 'sembra che *Spir.* si riferisca alla dottrina di Erasistrato', which we believe to be incorrect.

The author shifts his target here from the individual 'Aristogenes' to various supporters of the theory under discussion. 'Aristogenes' therefore does not stand for an individual thinker, but is the representative and leader of a group or school. Cf. also 481b18: 'as they themselves say' (ὥσπερ λέγουσιν αὐτοί), which can be regarded as a direct reference to the position of Aristogenes formulated in 2, 481a29–31 and 3, 482b8.

2, 481b14: 'but [they say] that the food is heated by the movement of the air' (ἀλλ' ἐν τῇ κινήσει τῇ τοῦ πνεύματος ἐκθερμαίνεσθαι τὴν τροφήν).

There is one manuscript D^1 that reads τοῦ πνεύμονος ('the lungs'), a reading adopted by A. Roselli 80. But this is not absolutely necessary. In the description of Pl. *Tim.* 77c6–79a5 the inhaled air is heated while the process of inhalation and exhalation goes on continuously. Cf. 79e2: 'The <air> driven round which falls into the fire is heated' (τὸ δὲ περιωσθὲν εἰς τὸ πῦρ ἐμπῖπτον θερμαίνεται).

Objection 6

2, 481b15: 'But if it [the innate *pneuma*] draws, as it were, food from something else or receives it from something else that causes movement' (εἰ δ' ἐξ ἑτέρου τινὸς οἷον ἐπισπᾶται ἢ καὶ κινοῦντος δέχεται).

Aristotle draws consequences from propositions of his opponents which they themselves may not have drawn. But if the vital breath is fed by inhaled air which is concocted in the lungs and the air duct by the movement of this air (or the lungs), this process seems to take place independently of the vital breath itself. This raises the question: what is actually the vital principle and for what is it reponsible, in the view of 'Aristogenes' and his supporters? Aristotle is firmly convinced that the soul with its innate *pneuma* is the first principle of movement (τὸ πρῶτον κινοῦν—b17) and that the soul is the 'unmoved' principle and *pneuma* 'the moved mover'. Cf. *M.A.* 10.

2, 481b18: 'as they themselves say' (ὥσπερ λέγουσιν αὐτοί).

This statement in b17–19 floats in the air, unless we take it as a reference to 2, 481a29–30. If this is right, Aristotle switches smoothly from the opinion of Aristogenes to the view of his school. Cf. also 3, 482a33–34.

2, 481b19: 'And if it is also distributed from there [i.e. from the lungs] both to the lower parts and the others, how can the concoction take place so rapidly?' (εἰ δ' ἀπὸ τούτου διαδίδοται καὶ πρὸς τὰ κάτω καὶ πρὸς τὰ ἄλλα, πῶς ἡ πέψις οὕτω ταχεῖα;).

Cf. 3, 482a34–36; 482b2–5; 5,483a18–22; 483b24–26. This is a correct description of the theory set out in Pl. *Tim.* 77c–80d. Cf. 78c4: 'The funnel being twofold, he let down one of the two through the windpipe into the lungs, the other past the windpipe into the abdomen' (διπλοῦ δὲ ὄντος αὐτοῦ κατὰ μὲν τὰς ἀρτηρίας εἰς τὸν πλεύμονα καθῆκεν θάτερον, τὰ δ' εἰς τὴν κοιλίαν παρὰ τὰς ἀρτηρίας). 78e5: 'Indeed, when the respiration goes in or out, it is followed by the internal fire connected with it. The fire floating up and down penetrates the abdomen and takes in food and drink there. It dissolves these...' (ὁπόταν γὰρ εἴσω καὶ ἔξω τῆς ἀναπνοῆς ἰούσης τὸ πῦρ ἐντὸς συνημμένον ἕπηται, διαιωρούμενον δὲ ἀεὶ διὰ τῆς κοιλίας εἰσελθὸν τὰ σιτία καὶ τὰ ποτὰ λάβῃ, τήκει δή, etc.).

Objection 7

2, 481b21: 'For they [the lungs] do not <immediately> pass on the air, which is not concocted immediately, to the lower parts' (οὐ γὰρ διαπέμπει †τοῦτό γ'† εὐθὺς πεττόμενον τὸν ἀέρα τοῖς κάτω).

Thus A. Roselli 82. The transmitted Greek text clearly raises problems. Objection 7 seems to accentuate Objection 4. The concoction of

the inhaled air cannot reasonably take place in the brief time between inhalation and exhalation. Even more unlikely is the idea that this air is distributed in no time throughout the entire body. Perhaps we should read: οὐ γὰρ διαπέμπει <εὐθὺς> οὔτε γ' εὐθὺς πεττόμενον τὸν ἀέρα τοῖς κάτω.

J.H. Dobson translates: 'For the lungs cannot distribute the air to the lower parts during the actual process of its digestion.' This translation connects the neuter τοῦτο with 'the lungs'. It would be better to read τοῦτόν γ' and connect it with the air.

2, 481b23: 'And yet this would seem necessary if the concoction takes place in the lungs' (καίτοι τὸ μὲν δόξειεν <ἂν> ἀναγκαῖον εἶναι τοῦτο τῆς πέψεως γινομένης ἐν τῷ πνεύμονι).

By letter of August 9, 2005 D. Holwerda has proposed to reconstruct this sentence by reading καίτοι <τοῦ>το and deleting the τοῦτο that comes after εἶναι as a reader's conjecture which has ended up in the wrong place in the text.

2, 481b26: 'as it were casually and by contact only' (οἷον γὰρ διόδῳ καὶ θίξει γίνεται μόνον).

So Aristotle considers it impossible that the process of concoction should take place so 'casually'. But he does believe that the vital heat is cooled by means of a casual 'contact'. Cf. *Resp.* 21, 480b3: 'while the air is cold when it is inhaled, but warm when it is exhaled, owing to its contact with the heat present in this part of the body' (εἰσιόντα μὲν ψυχρὸν ἐξιόντα δὲ θερμὸν διὰ τὴν ἁφὴν τοῦ θερμοῦ τοῦ ἐνόντος ἐν τῷ μορίῳ τούτῳ).

Objection 8

2, 481b27: 'And this, too, is illogical and even less tenable' (ἄλογον δὲ καὶ τουτὶ καὶ †λογοδεστερον†).

This is the Z reading. The other manuscripts read: ἀλογωδέστερον. W. Jaeger already commented that a comparative is unacceptable after an ordinary positive. J.F. Dobson reads: λογοδεέστερον and translates: 'still more untenable'. He is followed by W.S. Hett 491; P. Gohlke 161: 'Das wäre unverständlich, und noch unverständlicher, wenn für...' J. Tricot 178: 'Voici encore une conséquence plus irrationnelle et plus insoutenable encore, puisque...' A. Roselli proposes to read λόγου ἐνδεέστερον or καταδεέστερον, because no word λογοδεής is attested. For a suggestion by D. Holwerda, see the note to the translation.

The closest extant text is Pl. *Tim.* 62a6, where Plato expresses a wish that the effect of fire and its opposite may 'not lack an explanation': μηδὲν ἐπιδεὲς ἔστω λόγου.

2, 481b27: 'the same passage' (ὁ αὐτὸς πόρος).

The Greek text has λόγος, which is retained by J.F. Dobson: 'the same account'. Likewise W.S. Hett 491 and J. Tricot 178. W. Jaeger proposed to read πόρος; cf. 1, 481a25 and 2, 481b28. His proposal is accepted by A. Roselli 82.

2, 481b29: 'the same arguments would hold as above' (οἱ αὐτοὶ λόγοι οἳ καὶ πρότερον).

Again we find that the author has a clear picture in his mind of the theories of his opponents and their weak points. He refers here to Objections 2 and 3 to theory B, discussed in 1, 481a22–27. Cf. *Resp.* 6, 473a6–8.

2, 481b29: 'Unless someone were to say that a residue is not formed from all food and not for all living creatures' (εἰ μὴ τοῦτο λέγοι τις, ὡς οὐ πάσης τῆς τροφῆς οὐδὲ πᾶσι γίνεται περίττωμα).

The theory that a residue is formed from all food, which was put forward in 1, 481a19 and seemed a sound argument, is criticized here. This allows Aristotle's opponents to argue that no residue is formed as a result of concoction of the inhaled air.

2, 482a1: 'anymore than it is in plants' (καθάπερ οὐδὲ τοῖς φυτοῖς).

Aristotle himself believes that plants draw food from the earth which the earth has already processed into directly absorbable food for all vegetative forms of life. Cf. *P.A.* II 3, 650a20: 'For plants take the ready-to-eat food from the earth with their roots: hence they do not secrete residues, for they use the earth and the heat in it as a stomach' (τὰ μὲν γὰρ φυτὰ λαμβάνει τὴν τροφὴν κατειργασμένην ἐκ τῆς γῆς ταῖς ῥίζαις (διὸ καὶ περίττωμα οὐ γίνεται τοῖς φυτοῖς· τῇ γὰρ γῇ καὶ τῇ ἐν αὐτῇ θερμότητι χρῆται ὥσπερ κοιλίᾳ).

Cf. also *Sens.* 5, 445a18. So in a certain sense there is a residue of plants, but it is stored in the earth, which serves as a nutrient medium.

2, 482a2: 'unless in the sense that if forms part of the body as a whole' (εἰ δὲ μή οὕτι γε παντός).

W. Jaeger reads: ὅτι γε παντός.

J.F. Dobson translates: 'at least not in all animals'. Likewise J. Tricot 178. Perhaps we should prefer: 'And if this is not the case, no [residue need be formed] from every kind [of concocted food] either'.

2, 482a3–7: 'But the growth of the vessels is just like that of the other parts, and because these [vessels] become broader and distended, the air which flows in and out increases. But whether something must be present in them, that is what we are trying to find out. And what this natural air is, and how it increases in a healthy way, that will be obvious on the basis of this' (ἀλλ' ἄρα γε ἡ μὲν ἀγγείων αὔξησις ἡ αὐτὴ καὶ τῶν ἄλλων μορίων, εὐρυνομένων δὲ καὶ διισταμένων τούτων πλείων ὁ ἀὴρ ὁ εἰσρέων καὶ ἐκρέων. εἰ δέ τι ἀναγκαῖον ἐνυπάρχει, τοῦτο αὐτὸ ζητεῖται τίς ὁ φυσικὸς. καὶ πῶς οὗτος πλείων ὑγιῶς, ἐκ τούτου φανερὸν ἂν εἴη).

Cf. *Anim.* II 9, 422a3: 'because the veins and the passages become broader' (διευρυνομένων τῶν φλεβῶν καὶ τῶν πόρων). Διισταμένων can also refer to the distension of bones and the like, *H.A.* III 11, 518b9; *G.A.* II 6, 742a9. This passage should be seen in connection with 3, 482b10, which emphatically denies that the supply of food for the 'vessels' (i.e. *artèriai*) is the same as for other parts, since *pneuma* and food can only be supplied through the *artèriai* when the *artèriai* have developed. But this process does not involve respiration. Cf. 4, 483a12–15.

J.F. Dobson translates this passage as follows: 'But according to this view the vessels grow just like the other parts, and as they become broadened and distended, the volume of air which flows in and out is increased: and if there must inevitably be some air contained in them, the actual question which we are now asking, "What is the air which naturally exists in them and how does this increase under healthy conditions?" will be obvious from the preceding statement.' He adds a note: 'Reading τοῦτο αὐτὸ <ὃ> ζητεῖται· τίς ὁ φυσικὸς καὶ...(W.D.R.).' W.S. Hett 491–493 broadly follows Dobson. Other translators do not offer clear improvements.

The author first says that the inhaled air increases because the vessels increase in circumference (and the inhaled air can therefore increase in volume). He immediately goes on to talk about living creatures which lack a respiratory function (and whose vessels therefore cannot contain air from respiration).

The question raised here may therefore be whether in fact the vessels of the body always necessarily contain inhaled air.

We might therefore consider making a small correction to the Greek: τοῦτο αὐτὸ ζητεῖ <κ>αὶ τί[ς] ὁ φυσικός. καὶ πῶς... Now ὁ φυσικός is not an adjective connected with 'the air', but denotes 'the man of science', 'the natural scientist'. The construction is comparable with 9, 485b21–23: 'If the components are different, what are the differences of each of the simple bodies in itself and what <is their capacity>? For it is these differences which we are seeking' (εἰ μὲν οὖν ἕτερα, τίνες αἱ διαφοραὶ ἑκάστου τῶν ἁπλῶν καὶ τίς <...> ταύτας γὰρ ζητοῦμεν). See also 9, 485a33: ζητοῦντα. Read in this way, the passage becomes more relevant precisely in the transition to the discussion of non-breathing animals. Moreover, it suggests that Aristotle here is touching on the question whether the development of the 'vessels' both in the embryonic phase (when there is no respiration yet) and in living creatures without respiration is not necessarily the product of something other than inhaled air. In chap. 9 he will then explain at length 'what this is'.

[II. Objections to theory A and theory B with regard to insects (which do not have respiration)]

It seems to make sense to see the previous eight Objections as specifically targeted at 'Aristogenes'. The arguments adduced from 482a7 onwards are aimed against theory A and theory B together.

2, 482a7: 'And how... for living creatures without respiration' (τοῖς δὲ δὴ μὴ ἀναπνευστικοῖς).

See also 5, 483b1 and in 8, 485a11 and a21 'octopuses' and 'multipedes' and shellfish and crustaceans. Aristotle is chiefly thinking of insects when he talks about non-respiring creatures. Cf. *Resp.* 2, 471a19 and 9, 474b31–475a20; a29: 'insects are creatures which do not breathe' (οὐκ ἀναπνεῖ τὰ ἔντομα τῶν ζῴων). Among insects the specimens which are longer-lived do have a cooling system, but not via the lungs. Insects are divided into two, as it were, and in the middle have a membrane which is set in motion by their innate *pneuma* and makes a buzzing noise. The movement of the membrane cools the insects; cf. 474b31: 'The insects which are longer-lived... are split behind their middle part, so that they can be cooled by the membrane, which is very thin' (ὅσα δὲ μακροβιώτερα τῶν ἐντόμων... τούτοις ὑπὸ τὸ διάζωμα διέσχισται, ὅπως διὰ λεπτοτέρου ὄντος τοῦ ὑμένος ψύχηται).

On the basis of *G.A.* II 4–6 W. Jaeger (art. 1913; repr. 1960) 73 concluded: 'Aristoteles schliesst auf das angeborene Pneuma der höheren Tiergattungen aus der Notwendigkeit, es für die niedrigeren, zumal die Nichtatmer, zu statuieren.' Exactly the same train of thought is followed in *Spir.*

ἀναπνευστικά—in the Aristotelian Corpus, besides here and in 4, 483a12, only in *Sens.* 5, 445a27: 'to the place of respiration' (εἰς τὸν ἀναπνευστικὸν... τόπον) (in a passage disputing a theory of the Pythagoreans, who held that some living creatures could be nourished by odours).

Objection 1

2, 482a9: 'But if they receive their food for that from what is inside and from ordinary food, it is reasonable to assume that this also applies to living creatures with respiration' (εἰ δ' ἀπὸ τῶν ἔντος καὶ τῆς κοινῆς τροφῆς, εὔλογον κἀκείνοις).

J.F. Dobson turns matters upside down in his translation: 'If in the former case it was from forces within, and from the common nutriment of the body, it is reasonable to say that the same is true in their case also.' Likewise the Revised Oxford Translation (1984) I 766 and J. Tricot 179. But κἀκείνοις must refer to what is further away in the text, i.e. 'living creatures *with* respiration', which is the subject from the beginning of chap. 2. So the idea is that if insects do not receive their food for the innate *pneuma* through respiration, this argues for the case that respiring land animals do not receive it in this way either.

In 2, 482a16 κἀκείνων also refers to 'the aforementioned' [living creatures with respiration]. But again the sentence should be understood elliptically: 'and moreover by objecting with regard to refrigeration that they [insects] need it just as much', like living creatures with respiration, and therefore need respiration just as much.

2, 482a10: 'ordinary food' (τῆς κοινῆς τροφῆς).

Not inhaled air but ordinary food, common to all living creatures, which is taken in via the mouth (or a plant's roots) and is concocted into blood in the stomach. It should therefore be distinguished here from what is meant in 1, 481a11: 'For blood is food in its last phase, which is the same for all living creatures' (τὸ γὰρ αἷμα ἡ ἐσχάτη τροφὴ καὶ ἡ αὐτὴ πᾶσιν).

2, 482a10–11: 'For similar matters come from the same causes and in the same way' (ἀπὸ γὰρ τῶν αὐτῶν τὰ ὅμοια καὶ ὡσαύτως).

This principle of universality is found repeatedly in *Spir.*; cf. 2, 482a24–26; 6, 484b7–8; 8, 485a11–12.

Objection 2

2, 482a11: 'Unless of course it also comes from outside for living creatures without respiration' (εἰ μὴ ἄρα καὶ τούτοις ἀπὸ τοῦ ἐκτός).

481a9 established that insects do not have a respiratory system like dogs and human beings. It seems natural to conclude that the maintenance of their innate *pneuma* must be due to food. But the author here considers whether there may be another possibility.

2, 482a12: 'just as they perceive smells' (ὥσπερ καὶ τῶν ὀσμῶν αἰσθάνονται).

Cf. *Anim.* II 7, 419a35: 'Animals that live in water also seem to perceive smells. But human beings and animals that breathe cannot smell without breathing. The reason for this will be discussed later' (φαίνεται γὰρ καὶ τὰ ἔνυδρα τῶν ζῴων ἔχειν αἴσθησιν ὀσμῆς. Ἀλλ' ὁ μὲν ἄνθρωπος καὶ τῶν πεζῶν ὅσα ἀναπνεῖ, ἀδυνατεῖ ὀσμᾶσθαι μὴ ἀναπνέοντα. ἡ δ' αἰτία καὶ περὶ τούτων ὕστερον λεχθήσεται) (viz. in 9, 421b13–422a6); *Anim.* II 9, 421b25: 'Bloodless animals must possess smell, but without breathing' (Ὀσφραίνεσθαι μὲν οὖν ἀναγκαῖον, ἀλλ' οὐκ ἀναπνέοντα (sc. τὰ ἄναιμα)); b32: 'Similarly in certain species of animals the organ of smell is like the eye (of hard-eyed animals), uncurtained, while in others which take in air it has a curtain over it, which is drawn back in inhalation, owing to the dilating of the veins or pores' (transl. J.A. Smith) (οὕτως οὖν καὶ τὸ ὀσφραντικὸν αἰσθητήριον τοῖς μὲν ἀκάλυφες εἶναι, ὥσπερ τὸ ὄμμα, τοῖς δὲ τὸν ἀέρα δεχομένοις ἔχειν ἐπικάλυμμα, ὃ ἀναπνεόντων ἀποκαλύπτεσθαι, διευρυνομένων τῶν φλεβῶν καὶ τῶν πόρων.) See also *Sens.* 5, 443a3–6: 'This is clear in the case of fishes and shellfish. For these possess the faculty of smell although there is no air in water (for air rises when it enters water) and they do not breathe' (δῆλον δ' ἐπὶ τῶν ἰχθύων καὶ τῶν ὀστρακοδέρμων· φαίνονται γὰρ ὀσφραινόμενα οὔτε ἀέρος ὄντος ἐν τῷ ὕδατι (ἐπιπολάζει γὰρ ὁ ἀὴρ, ὅταν ἐγγένηται) οὔτ' αὐτὰ ἀναπνέοντα). W.D. Ross (1955) 213 notes: 'It was not until the time of Boyle (1670) that it was known that water contains air, and not until the time of Bernouilli (1690) that it was known that fish cannot live in water from which the air has been

expelled by boiling.' See also *Sens.* 5, 444b7–20 and *P.A.* II 16, 659b15: 'Some perceive odours with their gills, others through their blow-hole, and insects via their waist. They are all, so to speak, moved by the innate *pneuma* in their body: they all possess this *pneuma* by nature; it has not been introduced from outside' (τὰ μὲν διὰ τῶν βραγχίων, τὰ δὲ διὰ τοῦ αὐλοῦ, τὰ δ' ἔντομα διὰ τοῦ ὑποζώματος αἰσθάνονται τῶν ὀσμῶν, καὶ πάντα τῷ συμφύτῳ πνεύματι τοῦ σώματος ὥσπερ κινεῖται· τοῦτο δ' ὑπάρχει φύσει πᾶσι καὶ οὐ θύραθεν ἐπείσακτόν ἐστιν).

Aristotle is convinced that insects and fishes perceive odours, but do not possess respiration. Cf. 2, 482a23.

2, 482a13: 'but then it is something like respiration after all' (ἀλλ' οὕτως γ' οἷον ἀναπνοὴ γίνεται).

Ms. Z and A. Roselli 82 read οὕτως γ' here. W. Jaeger opted for οὔτοιγ'. Another variant is οὔτι γε. J.F. Dobson opts for the Z reading: 'but then they must have some process similar to respiration.' Likewise W.S. Hett 493; J. Tricot 179; A. Roselli 135. P. Gohlke: 'ohne dass geradezu ein Einatmen zu beobachten wäre' (?). D. Holwerda (October 3, 2005) proposes to accept Jaeger's reading.

Naturally we must take a18 into account here: 'so that it is roughly the same as respiration' (ὥσθ' ὅμοιόν τι τῇ ἀναπνοῇ). It seems as if 482a11–19 is a discussion by the author against his own firm opinion, expressed in a9, that insects do *not* have respiration. His opponents could say: insects need to be cooled; this must be effected by the inhaled air. Aristotle does not give his answer here, but we know from *Resp.* that he concedes that some insects have refrigeration, but not a process of respiration.

2, 482a13: 'The correctness of this could be disputed' (περὶ οὗ κἂν ἀπορήσειέ τις).

It seems as if Aristotle lists arguments here which his opponents could marshal against him:

a) insects take in food and take in air at the same time;
b) insects also require refrigeration (a proposition which Aristotle endorses); therefore they also need a system of respiration, like land animals (which Aristotle denies);
c) if refrigeration of insects takes place via their waist—ὑπόζωμα—(as Aristotle believes), air can also be supplied via the waist (which Aristotle denies).

2, 482a15: 'the matter of food intake (for the drawing in of *pneuma* takes place at the same time)' (τὴν ἐπίσπασιν τῆς τροφῆς—ὁλκὴ γὰρ ἅμα πνεύματος—).

J.F. Dobson: 'the way in which they draw nutriment; for we should say that they must draw in some breath at the same time.' Likewise W.S. Hett 493; J. Tricot 179; P. Gohlke 161–162.

For 'to draw (in)' (ἐπίσπασιν), see 481b15: 'draws' (ἐπισπᾶται). Aristotle's opponents can also argue: insects take in food; with the food they take in air. ὁλκή here is the drawing in of air (see a18). 1, 481a11 talked about the 'drawing' of blood from the veins, 6, 484a28 talks about the 'drawing' of food from the abdomen. According to Aristotle's opponents, however, this is always a consequence of the respiratory process. When Aristotle remarks in a19 that his opponents do not specifiy this 'drawing in', he seems to mean: the 'drawing in' of air is clear for creatures with lungs; for creatures without lungs it is impossible to be clear how this 'drawing in' takes place.

2, 482a17: 'And if this takes place for them via their waist' (εἰ δὲ διὰ τοῦ ὑποζώματος αὐτοῖς γίνεται).

J.F. Dobson: 'But if in their case the refrigeration takes place through their diaphragm.' Likewise W.S. Hett 493; P. Gohlke 162: 'Erfolgt diese aber durch die Kerbstelle hindurch...'; J. Tricot 179: 'Mais si, chez eux, le refroidissement s'opère par la région du corps située sous le corselet', with a reference to *Resp.* 9, 475a3.

But the word used there is τὸ διάζωμα (475a2). In *P.A.* II 16, 659b16 we find the word ὑπόζωμα in the statement that 'insects perceive odours via their middle part' (τὰ δ' ἔντομα διὰ τοῦ ὑποζώματος αἰσθάνονται τῶν ὀσμῶν) and H. Bonitz, *Index* 796a59 notes that ὑπόζωμα and διάζωμα alternate in Aristotle. Thus e.g. in *H.A.* III 1, 509b17 and 25. But A. Preus[4] has cast doubt on the passage in *P.A.* II 16, partly on account of the use of the term ὑπόζωμα. Cf. A. Roselli 84. This doubt has no firm foundation. Preus is familiar with the passage in *Spir.* 2 (p. 272), but regards it as inauthentic and at odds with (other) statements by Aristotle. He disregards the fact that the passage in *Spir.* follows from a consideration of the opponents' position. Both passages show that Aristotle denies respiration to insects but attributes smell to

[4] A. Preus, 'Aristotle's *Parts of animals* II 16, 659b13–19: is it authentic?', *Classical Quarterly* 18 (1968) 270–278.

them, even though he does not know how this takes place. Cf. *Sens.* 5, 444b7–28 with 444b13: 'many other similar animals have an acute perception of their food by its odour. It is not equally certain what the organ is whereby they so perceive' (transl. J.I. Beare) (καὶ πολλὰ τῶν ἄλλων τῶν τοιούτων ζῴων ὀξέως αἰσθάνεται τῆς τροφῆς διὰ τὴν ὀσμήν. ὅτῳ δὲ αἰσθάνεται, οὐχ ὁμοίως φανερόν).

Objection 3

2, 482a19: 'But it is not determined how and by what cause this drawing in takes place' (πλὴν οὐχ ἀφορίζεται τίς ὁλκὴ καὶ ὑπὸ τίνος).

J.F. Dobson translates: 'But it cannot be determined...' A better translation is W.S. Hett 493: 'But this does not define what this drawing in is...'

The possibility suggested in 1, 481a14: 'But the air supplies the food' (ἄγει δ' ὁ ἀήρ) does not apply to animals without respiration. Aristotle here blames his opponents for failing to indicate clearly how insects draw in air and by what instrument. In respiring animals the lungs are the instrument which, spurred on by the heart, effectuates respiration. Lungs are lacking in insects and fishes. The underlying motive here is that, for Aristotle, the innate *pneuma* is the efficient cause, but it requires a different interpretation from that of his opponents.

Cf. Pl. *Tim.* 79a5–80d1: Plato here explains the 'drawing in' of air and food from the fact that empty spaces cannot exist, so that wherever a certain substance is pushed away another substance is 'drawn in' which fills the gap. In 80c he adduces the 'attraction' (ἕλξις) of magnets and explains it (away) by remarking that it does not really involve a form of 'drawing' (ὁλκή) but of simultaneous displacement, owing to the impossibility of a void.

[III. Objections to theory A and theory B with regard to fishes (in the water, where respiration is impossible)]

2, 482a21: 'And what about the nutrition and growth of the innate *pneuma* in aquatic animals?' (Τοῖς δὲ δὴ ἐνύγροις).

The systematic organization which Aristotle used in *Resp.* is in evidence here too. After land animals with respiration he discussed land animals without respiration. Now he turns to aquatic animals without

respiration. Cf. 8, 485a21: τῶν ἐνύδρων—the word Aristotle uses more frequently for water animals.

A relevant passage in this connection is Pl. *Tim.* 92a7: 'But the fourth kind, which lives in the water, ... They... thought these creatures unworthy even to inhale pure air:... condemned them to inhale the muddy water of the depths' (τὸ δὲ τέταρτον γένος ἔνυδρον... οὐδ' ἀναπνοῆς καθαρᾶς ἔτι ἠξίωσαν... ἀλλ'... εἰς ὕδατος θολερὰν καὶ βαθεῖαν ἔωσαν ἀνάπνευσιν). See also 5, 483b34, which attributes to Aristotle's opponents the view that fishes also breathe.

2, 482a23: 'and we say further that no air is present in the moist substance' (οὐδ' ἐνυπάρχειν ὅλως ἐν τῷ ὑγρῷ φαμεν ἀέρα).

A. Roselli 86 refers here to *Resp.* 2, 470b28 ff. She adds: 'ma la confutazione di Aristotele è molto decisa e dettagliata.' But if Aristotle is also the author of *Spir.*, he can obviously confine himself in *Spir.* to a brief statement of his position.

The author uses the plural here, thus clearly indicating that he is a supporter of the Peripatetic line, over against the camp of his opponents. Cf. 6, 484a32. See also *Sens.* 5, 443a3–6 (cited in our comm. on *Spir.* 2, 482a12).

In various manuscripts ἀέρα is followed by the words: 'because *pneuma* is formed from (ordinary) food' (ὅτι διὰ τῆς τροφῆς ἡ τοῦ πνεύματος γένεσις). D. Furlanus deletes these words as a marginal comment which found its way into the text.

2, 482a24: 'The only remaining possibility is that the innate *pneuma* is nourished and grows by means of ordinary food' (λοιπὸν ἄρα διὰ τῆς τροφῆς).

J. Tricot 179: 'Reste donc que c'est seulement par le moyen de la nourriture que ces animaux absorbent l'air.'

This translation may cause misunderstandings. In his critique of theory A held by 'Aristogenes' Aristotle states here that this theory does not apply to fishes, and that therefore the innate *pneuma* of fishes cannot be nourished by inhaled air, but, if at all, by ordinary food (as theory B argued).

2, 482a24: 'so that the method is either not the same for all, or the other living creatures with respiration also nourish and increase [their innate *pneuma*] by means of ordinary food. For it must needs be one of these

three' (ὡς οὐχ ὁμοίως πᾶσιν ἢ κἀκεῖνα διὰ τῆς τροφῆς [τὰ ἔνυγρα]· τριῶν γὰρ τούτων ἀναγκαῖον ἕν).

Cf. 9, 486b2: 'So one of the two' (ὥστε δυεῖν θάτερον). Aristotle's opponents had argued that, for all living creatures, the maintenance and growth of their innate *pneuma* was due to food or respiration; the third possibility is: some in this way, others in that. But a final decision has not yet been made. A. Roselli 86 reads a question mark after τροφῆς. A raised dot is better.

τὰ ἔνυγρα in the transmitted text is probably based on a misunderstanding, since κἀκεῖνα refers back to 'the aforementioned creatures with respiration'. Therefore Jaeger's suggestion to read τὰ <μὴ> ἔνυγρα is no more plausible than deletion of the words τὰ ἔνυγρα, as U.C. Bussemaker proposed (followed by A. Roselli 86).

For οὐχ ὁμοίως πᾶσιν, cf. the Aristotelian proposition already formulated in 2, 482a10–11: 'For similar matters come from the same causes and in the same way' (ἀπὸ γὰρ τῶν αὐτῶν τὰ ὅμοια καὶ ὡσαύτως). Likewise 6, 484b7–8 and 8, 485a11–12 (with commentary).

2, 482a26: 'This now is enough as regards the growth and nourishment of *pneuma*' (Καὶ ταῦτα μὲν ὡς περὶ τὴν αὔξησιν καὶ τροφὴν τοῦ πνεύματος).

Cf. 8, 485a22: 'Thus far on the change of place'.

The addition of ὡς is meant restrictively here: 'as regards'. See Liddell, H.G., Scott, R., Jones, H.S., *A Greek English Lexicon* (Oxford, 9th ed. 1940; repr. 1961) *s.v.* AbII2, who refer to Xenophon, *Anabasis* IV 3, 31. See also Arist. *Cael.* I 3, 269b21: νῦν μὲν ἱκανῶς ὡς πρὸς τὴν παροῦσαν χρείαν, ἀκριβέστερον δὲ πάλιν, ὅταν ἐπισκοπῶμεν περὶ τῆς οὐσίας αὐτῶν.

Chap. 2 is clearly connected with chap. 3 by the word pair μὲν... δέ (a26–27), as is chap. 1 with chap. 2.

(We thank Prof. D. Holwerda for suggestions in his letter of October 3, 2005.)

CHAPTER THREE

[Problems in some theories of respiration]

Chap. 3 is entirely dedicated to an enumeration of seven objections to the theories on respiration of Aristogenes and all others who regard it as the most fundamental vital process.

Objection 1

3, 482a28: 'But as regards respiration, some do not say...' (Περὶ δὲ ἀναπνοῆς οἱ μὲν οὐ λέγουσιν...).

In his critical apparatus W. Jaeger refers to *Resp.* 1, 470b6 ff., and notes: 'this derives from there' (*unde haec petita*), thus underlining his view that *Spir.* is by an anonymous author from the time after Aristotle.

In fact: why does the author in this work now address the theme of respiration, after *De respiratione* had done so at length? This could indicate that it was written by someone other than Aristotle, unless there is a clear connection with the preceding chapters 1 and 2 of *Spir.*

This connection certainly exists, since chap. 2 is purely concerned with a theory which holds respiration *directly* responsible for the maintenance and growth of the innate *pneuma*; and chap. 1 critically discussed a theory which holds respiration *indirectly* responsible for this process. This connection is reinforced by the relationship with 2, 481b17 ff.: 'Moreover, respiration extends as far as the lungs, as they themselves say, but the innate *pneuma* is present thoughout the living creature. And if it is also distributed from there [viz.: from the lungs] to the lower parts' (ἔτι δ' ἡ μὲν ἀναπνοὴ μέχρι τοῦ πνεύμονος, ὥσπερ λέγουσιν αὐτοί, τὸ δὲ πνεῦμα δι' ὅλου τὸ σύμφυτον. εἰ δ' ἀπὸ τούτου διαδίδοται καὶ πρὸς τὰ κάτω...). In what follows Aristotle will make it clear that the vital principle must already be present before respiration and that the innate *pneuma* has no connection with the inhaled air! The entire work deals with the question: what is the innate *pneuma*? Is it the breath which is taken in via respiration, or is it something of a different order, which is already operative on an even more fundamental level? In actual fact there is no overlap with *Resp.*

It is striking that Aristogenes is not mentioned here in Objection 1. We should probably conclude that, according to Aristotle, he did explain what purpose respiration serves, viz. (a) for the nourishment of the innate *pneuma* and (b) for the refrigeration of the living creature.

3, 482a29: 'for instance Empedocles and Democritus' (καθάπερ Ἐμπεδοκλῆς καὶ Δημόκριτος).

A full discussion of respiration will have to talk about the efficient cause and the final cause. Empedocles and Democritus address only the purpose of respiration. This is also stated in *Resp.* 4, 471b30–472a3 and 7, 473a15–16. Others are deficient on both counts. In *Spir.* Democritus is mentioned only here. We will come across Empedocles again in 6, 484a38 and 9, 485b26. Again, therefore, the setting of *Spir.* is closely similar to that of the (other) *Parva naturalia.*

Interpreters of this work who propose to date it half a century or more after Aristotle should at least indicate why Praxagoras and Erasistratus and such thinkers are not mentioned explicitly anywhere, if their influence is as clearly noticeable in *Spir.* as they say.

Objection 3

3, 482a31: 'And also when respiration serves the purpose of refrigeration, it is necessary to elucidate this point' (δεῖ δὲ καὶ εἰ καταψύξεως χάριν, αὐτὸ τοῦτο διασαφῆσαι).

As appears from 2, 482a16, the disputed theory of 'Aristogenes' and his supporters also attributed a refrigerative function to respiration.

The discussion on this matter plays an important part in *Spir.*: 3, 482a13; 482b1; 4, 483b6; 5, 484a6; 484a10. Aristotle considers refrigeration of the cardiac region to be the primary function of respiration, which is confined to the windpipe and the lungs. His opponents are also aware of the necessity of refrigeration, but cannot provide a consistent theory because they hold that the respiratory flow of air extends throughout the body.

Pl. *Tim.* 70d1 also attributes a refrigerative function to the lungs: 'in order to cool the heart and give it rest and relief in its burning' (ἵνα... ψυχοῦσα, ἀναπνοὴν καὶ ῥᾳστώνην ἐν τῷ καύματι παρέχοι). So there is no need to find an objection by Aristotle against himself here. In 482b1 Aristotle emphatically objects against his opponents that their theory, if they claim that the inhaled air is distributed throughout the living creature, makes it impossible to attribute a refrigerative function

to respiration, since on the argument of 2, 481b12–15 heat should be mainly located in the lungs and the *artèriai*.

3, 482a32: 'For if the vital heat resides in the upper parts of the living creature, <the parts> below no longer need refrigeration' (εἰ γὰρ ἐν τοῖς ἄνω τὸ θερμὸν, οὐκ ἄν ἔτι δέοιτο κάτω (sc. τῆς καταψύξεως)).

Though Aristotle situates the vital heat (and the soul) in a living creature's centre, this is not the mathematical centre: the heart is clearly located in the upper half.[1] The upper half is therefore more the bearer of vital heat than the lower half. This is crucial to an interpretation of the problematic phrase 'the fire above' (τὸ πῦρ ἄνω) in *Long.* 3, 465b2.[2]

Aristotle draws attention to a real problem here: if the vital *pneuma* is distributed throughout the visible body of the living creature, and if it is the bearer of the vital heat, why is refrigeration necessary in the cardiac region in particular? Is the heat of the one vital *pneuma* different in different places in the visible body? On the necessity of refrigeration, cf. *Resp.* 1, 470b24: 'All animals possessing lungs with blood have greater need of respiration on account of their high degree of heat' (τὰ δ' ἔναιμον ἔχοντα πνεύμονα πάντα μᾶλλον δεῖται τῆς ἀναπνοῆς διὰ τὸ πλῆθος τῆς θερμότητος)—in contrast to frogs and tortoises.

U.C. Bussemaker proposed to read here οὐκ ἄν ἔτι δέοιτο <τὰ> κάτω. Cf. 2, 481b20. This proposal is accepted by J.F. Dobson, W.S. Hett 494 and J. Tricot 180.

3, 482a34: 'And it has its starting-point in the lungs' (καὶ ἀρχὴ ἀπὸ τοῦ πνεύμονος).

It is un-Aristotelian to claim that the innate *pneuma* has its starting-point in the lungs. For Aristotle the heart is the starting-point of the innate *pneuma*. Aristotle regards the lungs as the starting-point of respiration, which serves to cool the heart. The author seems to be thinking here of 2, 481b17, where he imputed to Aristogenes and his supporters the view that respiration extends as far as the lungs.

---

[1] Cf. *PA.* III 4, 665b18: 'it (the heart) is in the middle, more in its upper than in its lower half' (περὶ μέσον γὰρ, μᾶλλον δ' ἐν τῷ ἄνω ἢ κάτω).

[2] On this subject, see A.P. Bos, '"Fire above": the relation of soul to its instrumental body in Aristotle's *De longitudine et brevitate vitae* 2–3', *Ancient philosophy* 22 (2002) 303–317.

3, 482a34: 'but the result of respiration, it seems in their view, is also distributed to all parts of the living creature through the continuity of the system' (δοκεῖ δὲ καὶ τὸ τῆς ἀναπνοῆς εἰς πάντα διαδίδοσθαι κατὰ συνεχείαν).

This idea was already presented and criticized in 2, 481b19. We can conclude from what follows that the disputed theory holds the inhaled air to be conveyed by the *artèriai* into the abdomen, and from there to the bones and from there to the sinews and the flesh. In *H.A.* II 17, 507a34 Aristotle clearly contrasts the windpipe with the oesophagus. The former issues into the lungs; the oesophagus extends as far as the stomach via the midriff.

Without any foundation A. Roselli 88 claims of κατὰ συνεχείαν: 'non è espressione aristotelica'. Aristotle regularly uses the term συνεχής to indicate the continuity and connectedness of systems. Cf. *H.A.* III 5, 515a32–b6; 7, 516a8–10; *P.A.* III 5, 668b25. The term συνέχεια is also found in *H.A.* III 5, 515b6.

Perhaps this συνέχεια is also involved in Objection 4 of 3, 482b4–7 and in 6, 484a27. Plato describes a similar process of distribution with a kind of relay character for perception in *Tim.* 64b4: 'this impression is passed on by the various parts' (διαδίδωσιν κύκλῳ μόρια ἕτερα ἑτέροις ταὐτὸν ἀπεργαζόμενα). Cf. also 45d1: 'It therefore passes on... those movements to the entire body as far as the soul' (τούτων τὰς κινήσεις διαδιδὸν εἰς ἅπαν τὸ σῶμα μεχρὶ τῆς ψυχῆς αἴσθησιν παρέσχετο).

3, 482a35: 'So they must demonstrate that this is not the case' (ὥστε τοῦτο δεικτέον ὡς οὐκ ἔστιν).

Aristotle, too, opposes the view that the inhaled air is distributed as a vitalizing principle thoughout the body. He argues this in 6, 484a27 and 484b4. But here he is still concerned with an internal contradiction in the system of Aristogenes and his supporters. If they hold refrigeration to be an important aspect of respiration, they must demonstrate that the air does not circulate through the entire body.

Objection 4

3, 482a36: 'On the other hand it is strange if these [lower parts] do not require a certain motive agent and a form of nutrition' (ἄτοπον δὲ εἰ μὴ δεῖταί τινος κινήσεως καὶ οἷον τροφῆς).

J.F. Dobson: 'It is strange if the lower parts do not require some motive force and, as it were, some nutriment'; likewise W.S. Hett 495 and J. Tricot 180. A. Roselli 135 also takes 'le parte inferiori' as the subject of δεῖται; P. Gohlke 163: 'die Lebensluft'.

Aristotle himself reduces *all* vital functions to the activity of the innate *pneuma*. See *Resp.* 3, 471a26: 'In all animals that breathe and draw breath we see that a movement occurs of the part which draws in the air' (πάντων τῶν ἀναπνεόντων καὶ ἑλκόντων τὸ πνεῦμα ὁρῶμεν γινομένην τινὰ κίνησιν τοῦ μορίου τοῦ ἕλκοντος).

In *Resp.* 21, 480a16–b12 Aristotle describes the process of respiration as being caused by an increase in vital heat in the centre of the living creature. Because this heat increases, the adjacent lungs and the surrounding thorax also expand.

See also *P.A.* III 6, 669a13: 'The lung is the instrument for respiration. It has the origin of its movement in the heart' (τοῦ δ' ἀναπνεῖν ὁ πλεύμων ὄργανον ἐστί, τὴν μὲν ἀρχὴν τῆς κινήσεως ἔχων ἀπὸ τῆς καρδίας).

3, 482b1: 'But if respiration pervades the entire body, it can no longer be for the purpose of refrigeration' (εἰ δὲ διαπνεῖ πρὸς πᾶν οὐκ ἔτι καταψύξεως εἵη χάριν).

W. Jaeger proposed to add <ἄν> here before ἔτι.

J.F. Dobson, who considers this unnecessary, translates: 'And it is strange that it should no longer be for the sake of refrigeration, if it does pervade the whole.' Likewise J. Tricot 180. W.S. Hett 495 comes closer with: 'while if the breath is all-pervasive its purpose cannot be refrigeration'; likewise P. Gohlke 163 and A. Roselli 135. Jaeger's addition does not in fact seem strictly necessary. And the subject of διαπνεῖ is perhaps not *pneuma*, but 'respiration'. Pl. *Tim.* 70c–d also states that refrigeration is above all necessary for the location of the central fire. Refrigeration is in fact the function of the lungs. Aristotle objects that the theory of respiration which pervades the body with its effects is at odds with this. Cf. Pl. *Tim.* 78b and F.M. Cornford, *Plato's Cosmology* 308 ff. On p. 314 Cornford notes that Galen referred to Plato's system as διαπνοή—a kind of 'trans-spiration', because as well as respiration it also assumed a passage of air and fiery particles through and out of the body (and back again).

Objection 5

3, 482b3: 'And the process of counterflow is also surprising, if it takes place from all parts' (καὶ πάλιν τὸ τῆς παλιρροίας, εἴπερ ἀπὸ πάντων, θαυμαστόν).

We can compare Empedocles D.K. 31 fr. B 100, line 23: 'whenever it shrinks away into the far recesses' (ὁππότε μὲν παλίνορσον ἀπαίξειε μυχόνδε), in the extensive quotation that Aristotle gives in *Resp.* 7, 474a4 ff.

Aristoteles uses the term παλίρροια for a part of his own conception in *Somn.* 3, 461a6: 'the counterflow of the vital heat' (τὴν τοῦ θερμοῦ παλίρροιαν) and *PA.* III 7, 670b9. Plato does not use the term, but he does employ the metaphor of ebb and flow for the respiratory and nutritive systems: *Tim.* 43b5: 'For no matter how important the overflowing and flowing off of the tide of nutrition was' (τοῦ κατακλύζοντος καὶ ἀπορρέοντος κύματος ὃ τὴν τροφὴν παρείχεν). Cf. 43a4–6: ἀπόρρυτον.

3, 482b4: 'Unless it takes place in a different way from the outer parts, but the primary and central process from the cardiac region' (πλὴν εἰ ἄλλον τρόπον ἀπὸ τῶν ἐσχάτων, τὸ δὲ πρώτως...ἀπὸ τῶν περὶ τὴν καρδίαν).

Cf. 4, 483a7: 'in parts far removed [from the heart]' (τοῖς μακρὰν ἀπηρτημένοις).

3, 482b6: 'But in that case the activities and powers are divided among a plurality of principles' (ἐν πολλοῖς δ' οὕτω τὸ τῶν ἐνεργειῶν καὶ τῶν δυνάμεων).

J.F. Dobson translates this difficult sentence as follows: 'In many instances such a want of symmetry in functions and faculties may be observed.' W.S. Hett 495: 'Such discrepancy of functions and faculties is common'; likewise J. Tricot 181. P. Gohlke 163: 'so wie vielfach Wirksamkeit und Kräfte verteilt sind.' A. Roselli 136 translates: 'In molti casi (?) *** delle attività e delle facoltà' and notes on p. 89: 'il testo è corrotto e probabilmente lacunoso; forse si introduceva qui un'aporia sulle facoltà delle singoli parti in relazione alla presenza in esse del pneuma.'

It is a mystery what observations Dobson is thinking of. Aristotle is probably making a critical comment here, to which he returns in 4, 482b26–28. If the process of counterflow to the heart region is not the

same as in the rest of the body, the one activity of respiration seems to break up into a plurality of activities. In that case the process differs from a 'distribution through the continuity of the parts' (διαδίδοσθαι κατὰ συνέχειαν), which is mentioned in 3, 482a35. For a similar critique, see *PA.* III 4, 665b28: 'Firstly, these people assume that there are a number of different origins lying scattered here and there' (πολλὰς ἀρχὰς καὶ διεσπαρμένας ποιοῦσιν) and *Metaph.* Λ 10, 1075b37–1076a4.

Objection 6

3, 482b7: 'Yet it is strange if it is also distributed to the bones' (ἄτοπον οὖν ὅμως εἰ καὶ εἰς τὸ ὀστοῦν διαδίδοται).

The disputed theory holds that respiration has an effect on the entire body; cf 482a3; and 482b1: εἰς πάντα διαδίδοσθαι and 482b1: διαπνεῖ πρὸς πᾶν. Including the skeleton therefore. This takes place via the *artèria*. The question of how bones are nourished by *pneuma* is picked up in 6, 484a16 and following. We should consider here that Pl. *Tim.* 74e calls some bones ἐμψυχότατα and others ἀψυχότατα. Bones containing 'much soul' are in Plato the bones which protect the brain and spinal fluid and are chiefly involved in the irrigation system described in *Tim.* 77c6 and following.

J.F. Dobson corrects οὖν to γοῦν: 'However, it is at any rate strange...' He is followed by W.S. Hett 495 and J. Tricot 181. A. Roselli 89 prefers δ' οὖν.

3, 482b8: 'for they say that these also obtain their breath and nutrition from the *artèriai*' (καὶ γὰρ δὴ τοῦτό φασιν ἐξ ἀρτηριῶν).

P. Gohlke 163 has the strange translation here: 'auch diese haben ja ersichtlich Luftröhren'. According to his explanatory note on p. 196, he holds this to be Aristotle's own opinion. Strong arguments against this view are φασιν in 482b8 and 6, 484a22–23. It may well be that Aristotle makes this statement as being implied in his rendering of Aristogenes' view in 2, 481a30.

So the issue here is not just the supply of blood or the like to the bones.

It is entirely legitimate to see the description of the living organism's irrigation system, as given in Pl. *Tim.* 77c6 ff., as the textual basis for this claim about Aristotle's opponents. This irrigation system is an interconnected system for the supply of blood and air.

3, 482b8: 'as we said' (καθάπερ εἴρηται).

This may refer back to 3, 482a28–32. Aristotle's own view of the matter is that the purpose of respiration is to cool the vital heat in the heart's blood. This respiration is caused by the innate *pneuma* when heat becomes excessive. Cf. *Resp.* 3, 471b26–29.

3, 482b9: 'Therefore we must...look at respiration, the purpose for which it takes place and for what parts and how' (σκεπτέον περὶ ἀναπνοῆς, καὶ τίνος ἕνεκα καὶ ποίοις μέρεσι καὶ πῶς).

It is remarkable in *Spir.* how, starting from one opening question, Aristotle constantly weaves new themes into his inquiry. In 1, 481a5 he had said: 'So we should consider the nature and origin of the food' (ταύτην (τὴν τροφὴν) σκεπτέον, ποία τε καὶ πόθεν). Here it is respiration which is to be thoroughly analyzed. In 4, 482b16 it is the three movements of *pneuma* in the *artèria* which need to be discussed and in 7, 484b9 the nature and purpose of bones require investigation. But this is not an indiscriminate copying of other people's notes; it follows from the fundamental discussion which the author wishes to conduct.

3, 482b9: 'and for what parts' (καὶ ποίοις μέρεσι).

J.F. Dobson: 'the parts which it affects'; likewise the other translators. The dative can in fact be interpreted as a *dativus commodi*: 'for what parts'. In that case the question is what parts of the living body benefit from respiration. It will need to be discussed whether the entire body benefits, or only the upper part (482b32–33); and whether the bones also receive *pneuma* from the *artèria* (482a7–8).

But another possibility is a causal dative: 'by what parts'. The primary reference here would be to the lungs. But the opponents talk about a continuous process in which the inhaled air is distributed thoughout the body. And about the opposite process. This involves more parts than the lungs alone (482b3–7).

Objection 7

3, 482b10: 'Moreover, it does not appear for all parts that the supply of food takes place through the *artèriai*, for instance for the vessels themselves and for certain other parts' (ἔτι δὲ οὐδ' ἐπιφορὰ τῆς τροφῆς φαίνεται πᾶσι δι' ἀρτηριῶν, οἷον αὐτοῖς τε τοῖς ἀγγείοις καὶ ἄλλοις τισι τῶν μερῶν).

The Z reading φαίνεται seems preferable here to the reading φέρεται of the other manuscripts and W. Jaeger.

Cf. 2, 482a3–4, where it is said that the growth of vessels takes place in the same way as the growth of other parts.

Why is it that the vessels do not receive their nutrition from the *artèriai*? The answer must be: first there need to be *artèriai* and they must be built up from food that the nascent living creature has taken in—as Aristotle had indicated already in 2, 482a3—, before food can be carried through the *artèriai*. Aristotle thus infers the necessity of an even more fundamental vegetative process which precedes supply through the *artèriai*. See also 4, 483a14, which says explicitly that the supply of food must be effective before respiration. The 'other parts' could plausibly refer to 'the lungs' and 'the mouth'. Cf. *De audibilibus* 800a17–20.

In the process of arguing Aristotle is also engaged in discussing the question raised in 1, 481a5 regarding the food for living creatures, 'the nature and origin of the food'.

But there is a problem here. Aristotle's opponents distinguish *artèriai* and veins. As 5, 484a2–3 shows, they also hold that *pneuma* requires liquid, and liquids *pneuma*. (Blood, for instance, needs the heat of *pneuma* to remain liquid—5, 483b19–21.) *Pneuma* is found only in the *artèriai* (and so not in the veins)—5, 483b18. The question is whether the *artèriai* contain anything besides *pneuma*, or whether the movements of air in the *artèriai* have the side-effect that the blood, too, moves in the veins and provides its nutrition to all parts of the body. This justifies Aristotle's question how this 'drawing in' (*holkè*) takes place—2, 482a19–20.

3, 482b11: 'all parts' (πᾶσι).

This must refer to 'parts' (μέρεσι). Cf. 482b10: 'for what parts' (ποίοις μέρεσι).

In support it is argued that plants also live and receive food. This argument is based on the observation that plants do not have respiration (as Empedocles says too). So in any case there is a process of nutrition that does not depend on respiratory processes. Aristotle is the first to have focused sharply on the vegetative level in all that lives (see 2, 482a1).

3, 482b12: 'And plants also live and receive food' (ζῇ δὲ τὰ φυτὰ καὶ τρέφεται).

W. Jaeger inserted <ὥσπερ> here after δὲ. This was already rejected by J.F. Dobson. Aristotle puts forward a typically Aristotelian argument here. Life and nutrition take place at a level where respiration does not yet exist. But he may also intend a reference to Pl. *Tim.* 77a6–c5, which talks about plants and trees as providing food for man. Plato says of these in 77b2: 'Yet the kind of which we are now speaking shares only the third kind of soul...' (μετέχει...τοῦ τρίτου ψυχῆς εἴδους).

3, 482b13: 'But these matters belong perhaps more to a study on kinds of nutrition' (ταῦτα μὲν οἰκείοτερά πως τοῖς περὶ τὰς τροφάς).

References to a study 'On nutrition' ('On growth and nutrition') are found in *Somn.* 3, 456b6 (as already written); announced in *Anim.* II 4, 416b31; *G.A.* V 4, 784b2. See also *P.A.* II 3, 650b10; 7, 653b14; III 14, 674a20; IV 4, 678a19; *Meteor.* IV 3, 381b13.

But we should note that in *P.A.* II 3, 650b5–11 Aristotle speaks in much the same way as our passsage: 'The manner in which the parts derive their growth from blood, and the subject of food in general, can be more suitably discussed in *Generation* and other books' (ὃν δὲ τρόπον λαμβάνει ἐξ αὐτοῦ τὰ μόρια τὴν αὔξησιν, ἔτι δὲ περὶ τροφῆς ὅλως, ἐν τοῖς περὶ γενέσεως καὶ ἐν ἑτέροις οἰκειότερον ἐστι διελθεῖν). See also *P.A.* IV 4, 678a16–20.

CHAPTER FOUR

[Inquiry into the relation of respiration, pulsation and nutrition. Continued analysis of the theory on respiration held by Aristotle's opponents]

4, 482b14: 'There are three movements of the air in the *artèria* [according to their theory]' (τρεῖς αἱ κινήσεις τοῦ ἐν τῇ ἀρτηρίᾳ πνεύματος).

This passage is crucial to an understanding of *Spir.* as a whole. In 3, 482b9 Aristotle announced that it was to be investigated 'for what purpose', 'for what parts', and 'how' respiration takes place. But the subject proper is the innate *pneuma*. In chap. 4 he therefore broadens the question to include 'the movements of *pneuma*', of which respiration is one (according to his opponents). He will now ask 'for what purpose', 'how' and 'where' they occur.

J.F. Dobson, W.S. Hett 495, P. Gohlke 163, J. Tricot 181 and A. Roselli 136 completely fail to appreciate that this passage represents the theory of Aristotle's opponents. Cf. also A. Roselli 90: 'L'individuazione dei tre movimenti costituisce per *Spir.* un dato di fatto acceptato e non soggetto a discussione.' She rightly points to the contrast with *Resp.* 20, 479b17–19. But she regards *Spir.* 4 as a direct attack on the position of Aristotle!

However, the fundamental discussion on the theory of 'Aristogenes' and his supporters with its very special view of the distribution of the inhaled air via the *artèria* throughout the body, which started in chap. 3, is continued here by Aristotle. 'Aristogenes' represents a theory which is completely at odds with the Aristotelian conception.

In any case it is useful in connection with this passage to consider Pl. *Tim.* 43b5–6, where the tide to which Plato compares the respiratory system is said to supply food to the living creature: 'For no matter how important the overflowing and flowing off of the tide of nutrition was' (πολλοῦ γὰρ ὄντος τοῦ κατακλύζοντος καὶ ἀπορρέοντος κύματος ὅ τὴν τροφὴν παρεῖχεν). But we will also have to ask how this relates to what Plato writes in *Tim.* 78c5: 'Because the funnel consisting of two parts was involved, he let down one of the two through the windpipe into the lungs, and the other past the windpipe into the belly' (διπλοῦ δὲ ὄντος αὐτοῦ, κατὰ μὲν τὰς ἀρτηρίας εἰς τὸν πλεύμονα καθῆκεν θάτερον, τὸ δ'

εἰς τὴν κοιλίαν παρὰ τὰς ἀρτηρίας). A striking feature there is the use of the plural *artèriai*. The only other place where Plato uses the term is *Tim.* 70d3 (there in the singular and in the sense of 'windpipe' to the lungs).

Aristotle seems to be saying that, according to the theory of his opponents, the three movements (respiration, pulsation, and food supply) are connected with the *pneuma* in the *artèriai*. Here we can leave room for a distinction between movements of *pneuma* and movements *caused by pneuma*. At 5, 483a24 he also says that the *artèria* perceives. We can assume that this, too, is a matter of the vital breath in the *artèriai*.

We should note, however, that Plato does not talk anywhere about 'pulsation' of blood or of vital breath. He uses the related verb only in *Phaedr.* 251d4, in his description of the soul which has a perception of beauty: 'throbbing like a fevered pulse' (πηδῶσα οἷον τὰ σφύζοντα). And πήδησις is for him a matter of the heart (*Tim.* 70c1 and d4). Perhaps pulsation was considered an effect of the heat in the body and in the blood and this heat was taken to be caused by *pneuma*.

4, 482b15: 'pulsation' (σφυγμός).

The notion of 'pulsation' is encountered here for the first time. In the preceding passage there was no reason to suspect that this subject would also be discussed.

In *Spir.* this term is used eight times. In the Corpus the term alternates with σφύξις. Cf. *Resp.* 20, 479b27; 480a14.

4, 482b15: 'and thirdly the movement which supplies and assimilates the food' (τρίτη δ' ἡ τροφὴν ἐπάγουσα καὶ κατεργαζομένη).

We are dealing here with the theory of Aristotle's opponents, which sees respiration as the centre of all vital activity. Cf. 4, 483a8: 'For respiration and the supply of food' (τὸ γὰρ αὖ τῆς ἀναπνοῆς καὶ τῆς ἐπαγωγῆς). See also 1, 481a14: 'But the air supplies it [food] and is responsible for the activity and, by adding the activity of concoction to itself, causes growth and nutrition' (ἄγει δ' ὁ ἀὴρ... αὔξει καὶ τρέφει) and 3, 482b10: 'Moreover, it does not appear for all parts that the supply of food takes place through the *artèriai*' (οὐδ' ἐπιφορὰ τῆς τροφῆς φαίνεται πᾶσι δι' ἀρτηρίων). This formulation is a correct representation of Pl. *Tim.* 78e–79a5. According to Aristotle's opponents, the inhaled air and the internal fire connected with it is the principle which assimilates the food. He himself will postulate in 9, 485a28 that they are mistaken and that the vital heat present in the blood is the 'efficient principle' (τὸ ἐργαζόμενον).

4, 482b16: 'where and how and for what purpose' (καὶ ποῦ καὶ πῶς καὶ τίνος χάριν).

The question 'where' the three movements occur is dealt with in 4, 482b17–36. The question 'how' in 4, 482b36–483a7. The question 'for what purpose' is discussed in 483a7 ff.

[The question: 'Where?']

4, 482b18: 'But the movement of respiration is perceptible only to a certain extent, and is largely based on logical argumentation' (ἡ δὲ τῆς ἀναπνοῆς μέχρι μέν του φανερά, τὸ δὲ πλέον κατὰ λόγον).

See also 5, 483a21–23 and commentary there. For the contrast between what can be empirically established and what can be concluded on the basis of argumentation, cf. *G.A.* III 10, 760b27–33 and *Iuv.* 2, 468a20–23 (the programme elaborated there is carried out in 468a23–4, 469a28 and 4, 469a28 ff.).

4, 482b20–21: 'And the movement of the supply and assimilation of the food is virtually in its entirety a matter of argumentation, but in the sense that it is concluded on the basis of matters which take place in an empirically observable way' (ἡ δὲ τῆς τροφῆς ἅπασα κατὰ λόγον ὡς εἰπεῖν, ὡς ἐκ τῶν συμβαινόντων δὲ κατὰ τὴν αἴσθησιν).

J.F. Dobson has here: 'That of nutrition is in practically all parts determinable by reasoning, but by sense in so far as it can be observed from its results.' Cf. W.S. Hett 497.

However, Aristotle draws a contrast here between what can be empirically observed and what not. The process of digestion is hidden from our view. But on the basis of empirical data (regarding the effects of nutrition) certain facets of it can be reasoned out.

In *H.A.* III 2, 511b13–23 Aristotle argues that the venous system is difficult to describe, because all the veins are contained within the living creature and they are less clearly visible in someone who has died, when the blood has emptied from the veins.

4, 482b22: 'to be designated a power of the soul or the soul itself' (εἴτε ψυχῆς δύναμιν εἴτε ψυχὴν δεῖ λέγειν ταύτην).

Cf. *Iuv.* 1, 467b16: 'the other parts of the soul or its powers, whatever we are to call them' (τὰ μὲν οὖν ἄλλα τῆς ψυχῆς ἢ μόρια ἢ δυνάμεις ὁποτέρως ποτὲ δεῖ καλεῖν).

This question is raised again in 5, 483a27: 'What then is the soul? They say that it is a power which is the cause of this movement' (τί οὖν ἡ ψυχή; δύναμιν φασι τὴν αἰτίαν τῆς κινήσεως τῆς τοιαύτης).

4, 482b23: 'or something else again, for instance a mixture of bodies, which by means of these bodies causes such an attraction' (εἴτε καὶ ἄλλην τινα σωμάτων μῖξιν, ἢ δι' αὐτῶν ποιεῖ τὴν τοιαύτην ὁλκήν).

J.F. Dobson's translation: 'or some other combination of bodies' is incomprehensible. We should translate: 'or something else, e.g. a *mixture* of bodies'.

Once again this shows that chap. 4 critically discusses a theory not held by the author of *Spir.* For a theory which comes close to it, cf. *Anim.* I 4, 408a13–28 (six times 'mixture' (μῖξις) in twelve lines, and in relation to Empedocles). See also *Cael.* III 7, 305b4—the relationship with spermata. Empedocles sometimes called the soul a 'mixture' of elements. Cf. *Anim.* I 4, 408a13: 'that the soul is a ratio of mixture' (τὸ τὸν λόγον τῆς μίξεως εἶναι τὴν ψυχήν). This position is akin to the view that the soul is the *harmonia* of the body.

It may well be that Aristotle has Pl. *Tim.* 79a5–e9 in mind here, where the combination of fire and air in the living creature and heating and refrigeration provide the explanation for the respiratory system.

4, 482b25: 'The nutritive movement may seem to have its origin in respiration' (ἡ δὲ θρεπτικὴ δόξειεν ἂν ἀπὸ τῆς ἀναπνοῆς).

We must mentally add here: τὴν ἀρχὴν ἔχειν (see b22). But further on the hypothesis proposed here proves wrong and is rejected, because the author goes on to show that respiration does not start until after birth, whereas nutrition already takes place in the embryonic phase (483a11–15).

4, 482b25: 'for it [respiration] is cyclical' (αὕτη γὰρ ἀνταποδίδοται).

Αὕτη should be taken to refer to respiration. The author seems to draw attention to a feature of respiration that shows a similarity to the process of digestion. Respiration is characterized by a pendulum movement, with two different directions of inhalation and exhalation. The nutritive process thus seems to correspond to some degree in the movement of food intake and discharge of residues.

For this, cf. Pl. *Tim.* 79e8: 'By constantly undergoing the same action and in reaction causing the same effect, <this air> brings about a circular swinging movement, up and down. This double process

gives rise to inhalation and exhalation' (τὸ δὲ τὰ αὐτὰ πάσχον καὶ τὰ αὐτὰ ἀνταποδιδὸν ἀεί, κύκλον οὕτω σαλευόμενον ἔνθα καὶ ἔνθα ἀπειργασμένον ὑπ' ἀμφοτέρων τὴν ἀναπνοὴν καὶ ἐκπνοὴν γίγνεσθαι παρέχεται).

For Aristotle it is totally unacceptable to assume that both processes take place throughout the body and that both are interlinked.

4, 482b26: 'and is in fact constant' (καὶ ὁμοία τῷ ἀληθεῖ).

For this meaning of ὅμοιος, cf. 9, 485b13: τὴν κίνησιν ὁμοίαν.

Pl. *Tim.* 43b5 and 80d1 ff. presents the movement of inhalation and exhalation as the cause of the supply and discharge of food.

4, 482b26: 'But whether the whole body does not keep the same pace with regard to the timing of this movement, or whether there is no difference for all its parts, should be investigated.' (εἰ δὲ μὴ πᾶν ὁμαλίζει τοῖς χρόνοις τὸ σῶμα κατὰ τὴν τοιαύτην κίνησιν, ἢ εἰ μηδὲν διαφέρει τὸ ἅμα πάντα τὰ μέρη, σκεπτέον). So A. Roselli 92. W. Jaeger reads a comma after μή and a period after κίνησιν.

The various proposed translations are not very helpful: J.F. Dobson: 'And to discover whether the whole body is not equable[1] with regard to the time taken by such motion, or whether there is no difference as to its simultaneity, we must consider all the parts'; W.S. Hett 497: 'As to whether the time taken by this movement is not uniform throughout the body, or whether its simultaneity makes no difference, all the parts must be examined'; P. Gohlke 164: 'Und wenn dies auch nicht der Fall ist, so macht doch der ganze Körper diese Bewegung in gleichem Takt, jedenfalls muss man alle Teile daraufhin untersuchen, ob auch kein Unterschied in dieser Gleichzeitigkeit sich zeigt'; J. Tricot 182: 'Et pour savoir si la totalité du corps entier ne correspond pas également au temps exigé par un tel mouvement, ou si on ne décèle aucune différence dans la simultanéité des mouvements, nous devons pour cela considérer toutes les parties.' A. Roselli 136 seems an improvement: 'E si deve indagare se tutto il corpo si comporta in modo non omogeneo per quanto riguarda i tempi di questo movimento, o se invece non vi è differenza per il fatto che tutte le parti ne sono affette contemporaneamente'.

[1] The *Revised Oxford Translation* I 767 has 'uniform' here.

We should see this passage in relation to 3, 482b3–7. Aristotle suggests there that no direct causal relation exists between respiration and the flow of *pneuma* throughout the body in the theory of Aristogenes and his supporters. In the opening in the theory of his opponents, an opening which he himself has created, Aristotle sticks a crowbar, as it were, allowing him to arrive at the argumentation for his own view in 4, 483a11–18. He demonstrates there that respiration does not begin until after birth, while the process of growth has been going on for some time.

At issue is the relation of respiration to the supply of food. Respiration is a process in which what is taken in is expelled again, i.e. it is an oscillating movement. The nutritive activity is a matter of food intake and discharge of residues, i.e. it strives for a balance between two opposite movements. But does this mean that the nutritive movement follows the movement of respiration? Certainly this is the thrust of the theory held by Empedocles and Plato. They see the passage of food throughout the body as an effect of respiration. Cf. Pl. *Tim.* 80d6: 'Thus it is that in all living creatures the stream of food continues to flow thoughout their body' (καθ' ὅλον τὸ σῶμα πᾶσιν τοῖς ζῴοις τὰ τῆς τροφῆς νάματα οὕτως ἐπίρρυτα γέγονεν).

Now there is always a simultaneity of respiration and digestion in living creatures with respiration. But not a parallelism. The discharge of food does not keep pace with the exhalation of inhaled air. Exhalation immediately follows inhalation (cf. *Spir.* 1, 481a21; 2, 481b9). The discharge of residues takes place long after the intake of food.

4, 482b29: 'On the one hand it seems accidental' (τῇ μὲν ἂν δοκῶν εἶναι κατὰ συμβεβηκός).

Cf. *Resp.* 20, 479b26: 'The beating of the heart, which, as can be seen, goes on continually, is similar to the throbbing of an abscess' (transl. G.R.T. Ross) (ἡ δὲ συμβαίνουσα σφύξις τῆς καρδίας, ἣν ἀεὶ φαίνεται ποιουμένη συνεχῶς, ὁμοία φύμασίν ἐστιν...) with 480a2: 'In the heart the beating is produced by the heat expanding the fluid, of which the food furnishes a constant supply' (transl. G.R.T. Ross) (ἐν δὲ τῇ καρδίᾳ ἡ τοῦ ἀεὶ προσιόντος ἐκ τῆς τροφῆς ὑγροῦ διὰ τῆς θερμότητος ὄγκωσις ποιεῖ σφυγμόν...). Aristotle clarifies the phenomenon of pulsation with reference to the bubbling of water that is brought to the boil. This bubbling is 'accidental' to water, for water does not always boil. But something that is truly accidental cannot *always* occur. Hence Aristotle

believes that pulsation seems 'accidental' but is not 'accidental': 4, 483a17.

4, 482b31: 'since... it is necessary that what evaporates causes a pulsation, because it is enclosed [in the fluid]' (ἀνάγκη τὸ ἐκπνευματούμενον διὰ τὴν ἐναπόληψιν ποιεῖν σφυγμόν).

This comparison could suggest that pulsation takes place in the blood (in the veins), for blood is a fluid. But blood is heated by the *pneuma* in the *artèriai* (5, 483b18–21). For Aristotle's position, cf. *Resp.* 20, 479b31: 'for boiling is due to the evaporation of fluid by heat' (ἡ γὰρ ζέσις γίνεται πνευματουμένου τοῦ ὑγροῦ ὑπὸ τοῦ θερμοῦ) (479b26: 'the beating of the heart' (ἡ δὲ συμβαίνουσα σφύξις τῆς καρδίας)). A crucial difference is that in Aristotle it is a movement of the heart. Cf. A. Roselli 94.

4, 482b32: 'because it is enclosed [in the fluid]' (διὰ τὴν ἐναπόληψιν).

The term returns in 4, 483a7: ἐμπεριληφθείς. Its only other occurrence is in *Meteor.* II 9, 370a1. The matching verb is more common and, together with cognate words (ἐμπεριλαμβάνεσθαι, περιλαμβάνεσθαι), plays a striking role in Aristotle's discussion of 'spontaneous generation', which is possible because *pneuma* is trapped in a kind of 'bubble'. Cf. *G.A.* III 11, 762a18–b21 and see also *Mund.* 4, 395a11–14, where the sound of thunder is described as: 'air which violently moves through water' (ὥσπερ ἐν ὕδατι πνεῦμα σφοδρῶς ἐλαυνόμενον).

4, 482b32: 'But it is present in the origin and primarily' (ἐν ἀρχῇ δὲ καὶ πρῶτον).

J.F. Dobson disregards the sharp contrast here with δοκῶν εἶναι κατὰ συμβεβηκός in 482b29: 'and pulsation must arise in the originating part and in the earliest stage.' J. Tricot 182 is comparable. W.S. Hett 497 understands the idea: 'but it is also original and primary.' P. Gohlke 164 wrongly translates: 'vor allem am Ursprungsort.' See 483a15!

The meaning here is: 'the pulsation seems accidental..., but [it cannot be accidental for] it is already present by nature at the earliest stage.' Thus A. Roselli 136.

482b33: 'present by nature' (σύμφυτον).

As with the σύμφυτον πνεῦμα, it is not entirely correct to say of the pulsating movement that it is 'innate', since it is important for Aristotle that it functions before birth (4, 483a15).

4, 482b33–34: 'For it is chiefly and primarily present in the heart, and from there in the other parts' (ἐν γὰρ τῇ καρδίᾳ μάλιστα καὶ πρῶτον, ἀφ' ἧς καὶ τοῖς ἄλλοις).

Cf. *G.A.* V 2, 781a24–25. There is no reason to follow W. Jaeger in deleting this sentence. W.S. Hett 497: 'for it is found chiefly and primarily in the heart, from which it is communicated to the other organs.'

A passage crucial to interpretation is 4, 483a15–18: 'In this way it is the first movement, and it resembles an activity' (ὥστε αὕτη πρώτη καὶ ἔοικεν ἐνεργείᾳ τινί...). This also shows clearly that, in Aristotle's view, pulsation does not occur in the *artèriai* but in the heart and subsequently in the other parts of the body.

482b34: 'But perhaps, in relation to the underlying substance of the living creature, when it starts to function in reality, it is a necessary side-effect' (τάχα δὲ πρὸς τὴν ὑποκειμένην οὐσίαν τοῦ ζῴου τὴν ἐκ τῆς ἐνεργείας ἀνάγκη τοῦτο παρακολουθεῖν).

W.S. Hett 497: 'Perhaps this is a necessary consequence of the animal's underlying essence, which is realized in activity'; J.F. Dobson had: 'essential nature'. J. Tricot 182: 'Et peut-être est-ce là une suite nécessaire de la substance fondamentale de l'animal, et résultant de son activité même'.

These translations fail to make clear what 'the underlying essence' is (and whether in fact Aristotle can call an essence 'underlying' at all).

In our interpretation Aristotle is saying the same as in 9, 485b12–15: the substance which forms the living creature in indissoluble unity with the nutritive soul, and which is also active in the living creature to which this soul owes its existence.

Aristotle regards the pulsating movement in the heart and the other blood vessels as a necessary consequence of the activation of the nutritive soul's instrumental body: as soon as a fertilized egg cell starts to absorb food, however weakly in the beginning, this food is concocted and so 'boiled', with 'evaporation' of the moisture in it. This leads to the pulsation.

[The question: 'How?']

4, 482b36: 'There is an indication that pulsation has nothing to do with respiration' (ὅτι δ' οὐδὲν πρὸς τὴν ἀναπνοὴν ὁ σφυγμός, σημεῖον).

This is a devastating blow to Aristotle's opponents, whose position entailed that the pulsating movement was an effect of the innate *pneuma* as vital *breath*. J. Tricot 182 n. 5 seems to have no idea of the conflict when he notes: 'Tout en étant une fonction du πνεῦμα.'

In *Anim.* I 1, 403a30 Aristotle describes 'anger' as 'a surging of the blood and heat round the heart' (ζέσιν τοῦ περὶ καρδίαν αἵματος καὶ θερμοῦ). This shows that it is a matter of the soul which has effects in the blood (and not in respiration).

4, 483a1: 'when someone breathes rapidly or evenly, and when he breathes heavily or lightly' (ἐάν τε γὰρ πυκνὸν ἐάν τε ὁμαλὸν ἐάν τε σφοδρὸν ἢ ἀραιὸν ἀναπνέῃ τις).

Cf. *Rhet.* I 2, 1357b18 on a patient with fever.

4, 483a2: 'the pulsating movement is the same and unchanged' (ὅ γε σφυγμὸς ὅμοιος καὶ ὁ αὐτός).

Cf. *Probl.* XXVII 3, 947b29: 'For the throbbing of the heart is different' (Ἐπεὶ καὶ ἡ τῆς καρδίας πήδησις οὐχ ὁμοία...).

4, 483a4: 'in the case of fears, hopeful expectations, and afflictions of the soul' (ἐν τοῖς τῆς ψυχῆς φόβοις ἐλπίσιν ἀγωνίαις).

Cf. *P.A.* III 6, 669a18: 'This jumping of the heart is almost exclusively found in man, because only he has hope and expectations for the future' (τὸ τῆς πηδήσεως διὰ τὸ μόνον ἐν ἐλπίδι γίνεσθαι καὶ προσδοκίᾳ τοῦ μέλλοντος). H. Bonitz, *Index* 592a14 refers to Pl. *Tim.* 70c: 'And for the heart, that starts to pound when we anticipate danger and when passion is aroused' (τῇ δὲ δὴ πηδήσει τῆς καρδίας ἐν τῇ τῶν δεινῶν προσδοκίᾳ καὶ τῇ τοῦ θυμοῦ ἐγέρσει).

In *Anim.* I 1, 403a–b1 Aristotle said of these emotions that they do not take place 'without body'. But in II 1 this 'body' is said to be the 'instrumental body *of the soul*'. Hence this talk about 'fears of the soul' is far from un-Aristotelian. In *Resp.* 20, 479b26 Aristotle talks about 'fear and morbid afflictions' (διὰ φόβον καὶ διὰ πάθος νοσηματικόν) in his explanation of palpitations, the heart's pounding, which can even lead to death (by cardiac arrest, we would say).

4, 483a5: 'But we need to consider whether it is true that pulsation also occurs in the *artèriai*, even when its rhythm is constant and regular' (εἰ δὲ καὶ ἐν ταῖς ἀρτηρίαις ὁ σφυγμός, κἂν ὁ αὐτὸς ὢν ἐν ῥυθμῷ καὶ ὁμαλὸς ᾖ, σκεπτέον).

The definitive answer to this question is given in 4, 483a15: pulsation occurs as soon as the heart develops, and lungs and *artèriai* do not yet exist. But a denial already followed from 482b36: pulsation has nothing to do with respiration.

4, 483a6: 'even when its rhythm is constant and regular' (κἂν ὁ αὐτὸς ὢν ἐν ῥυθμῷ καὶ ὁμαλὸς ᾖ).

This refers back to 4, 483a2: 'the pulsating movement is the same and unchanged' (ὅ γε σφυγμὸς ὅμοιος καὶ ὁ αὐτός). W. Jaeger corrected καὶ to κἂν. A. Roselli adds <ἂν> before ᾖ. But Jaeger's proposal is to be preferred.

4, 483a6: 'At any rate it does not seem to be the case for parts which are far removed [from the heart]' (οὐκ ἔοικε δέ γε τοῖς μακρὰν ἀπηρτημένοις).

For μακρὰν, cf. *Probl.* X 23, 893a39: 'far removed from the source' (μακρὰν τῆς ἀρχῆς ἀπαρτώμεναι) and *Rhet.* III 5, 1407a24: 'but they must correspond in a period which can be remembered and not be too far removed from each other' (δεῖ δὲ ἕως μέμνηται ἀνταποδιδόναι ἀλλήλοις, καὶ μήτε μακρὰν ἀπαρτᾶν).

J.F. Dobson has here: 'This does not appear to be so in the case of parts widely separated.'

But this remark seems at variance with 4, 482b17–18 and with *Resp.* 20, 480a10: 'and all the veins pulse and do so simultaneously with each other, because they are connected with the heart' (καὶ σφύζουσι αἱ φλέβες πᾶσαι, καὶ ἅμα ἀλλήλαις, διὰ τὸ ἠρτῆσθαι ἐκ τῆς καρδίας). We could therefore also consider the translation: 'for matters which are so different'. Cf. L.S.J. and Philo, *Agricultura* 3: οὐ μόνον οὐκ ὄντα τὰ αὐτά, ἀλλὰ καὶ λίαν ἀπηρτημένα. Plutarch, *Tiberius* 3.

[The question: 'For what purpose?']

4, 483a7: 'And it does not seem to occur for any purpose at all, as we already said' (ἥκιστα δ' ἕνεκά του φαίνεται γίνεσθαι καθάπερ εἴρηται).

All the emphasis is on 'it does not seem'. Perhaps this line refers to 4, 482b30.

4, 483a11–17—the question announced in 482b26–29 is decided here: pulsation is the first movement, then the supply of food, and only then, as third, respiration. This passage shows once again how radically new Aristotle's approach is in taking the vegetative level as the most fundamental level. Every theory that identifies respiration as the fundamental function of life is thus sufficiently refuted. It has now also been proved that the bearer of vital functions cannot be the inhaled air but something that is also present in plants and aquatic animals and land animals without a respiratory system, viz. the innate *pneuma* or vital heat. An additional consequence for Aristotle was that he came to see respiration as a system of refrigeration for the (higher) living creatures who possess such a respiratory system.

4, 483a11–12: 'But of these three it would be logical [in their view] for pulsation and respiration to be prior' (τριῶν δ' οὐσῶν πρότερον εὔλογον εἶναι τήν τε σφυγμώδη καὶ τὴν ἀναπνευστικήν).

There is a good reason to see these lines as representing the position of Aristotle's opponents, given the use of the infinitive εὔλογον εἶναι. This is ignored in the translation of J.F. Dobson: 'And of the three, we may reasonably say that...'. Likewise W.S. Hett 499. A. Roselli 137 does not use quotation marks here.

4, 483a12: 'For nutrition is always nutrition of something that already exists' (ἡ γὰρ τροφὴ προυπάρχοντος).

J.F. Dobson wrongly translates: 'for nutrition assumes their pre-existence', viz. of the 'pulsatory and respiratory motions'. Likewise J. Tricot 183; P. Gohlke 165: 'Denn die Nahrung setzt ja beides voraus'. W.S. Hett 499 correctly has: 'for nutrition implies something pre-existent'. Cf. A. Roselli 137: 'la nutrizione compare quando l'essere già esiste'.

4, 483a13: 'For respiration only begins when separation has taken place from her who has borne the new living creature' (τὸ μὲν γὰρ ἀναπνεῖν, ὅταν ἀπολυθῇ τῆς κυούσης).

Aristotle makes this explicit in *G.A.* II 6, 742a5: 'animals with respiration which are differentiated in the womb do not breathe before the lungs are fully grown. And these and the preceding parts are formed before they breathe' (τὰ δ' ἀναπνέοντα καὶ ἐν τῇ μήτρᾳ λαμβάνοντα τὴν διάρθρωσιν οὐκ ἀναπνεῖ πρὶν ἢ ὁ πνεύμων λάβῃ τέλος· διαρθροῦται δὲ καὶ οὗτος καὶ τὰ ἔμπροσθεν μόρια πρὶν ἀναπνεῖν). Respiration requires

lungs. The embryonic development produces these lungs in a process which does not involve respiration.

4, 483a15: 'But pulsation occurs from the very first, while the heart is forming' (ὁ δὲ σφυγμὸς εὐθὺς ἐν τῇ ἀρχῇ ξυνισταμένης τῆς καρδίας).

See earlier 4, 482b32–34 and *G.A.* II 4, 740a3: ἀποκρίνεται πρῶτον ἡ καρδία ἐνεργείᾳ and a17.

4, 483a16: 'as can be observed in incubated eggs' (καθάπερ ἐν τοῖς ᾠοῖς γίνεται φανερόν).

Cf. *P.A.* III 4, 665a33: 'In blooded animals the heart and the liver are immediately visible as soon as they are formed and while they are still very small. Sometimes they can already be distinguished in eggs which have only been incubated for three days, as small as a point' (φαίνεται γὰρ ἐν τοῖς ᾠοῖς ἐνίοτε τριταίοις). See also *G.A.* II 1, 734a23–25: 'for the lung is of greater size than the heart, and yet appears later than the heart in the original development' (μείζων γὰρ τὸ μέγεθος ὢν ὁ πνεύμων τῆς καρδίας ὕστερον φαίνεται τῆς καρδίας ἐν τῇ ἐξ ἀρχῆς γενέσει). This is a typical remark for Aristotle, with his great knowledge of how birds and fishes are formed from eggs. It presupposes observation of the process of hatching by the daily removal of one egg from the clutch of a brooding chicken in order to determine the stage of development.

4, 483a17: 'and it seems an activity and not an enclosure of air' (καὶ ἔοικεν ἐνεργείᾳ τινὶ καὶ οὐκ ἐναπολήψει πνεύματος).

This puts paid to the option of 4, 482b29–32.

4, 483a18: 'unless this fact therefore contributes to this activity' (εἰ μὴ ἄρα τοῦτο πρὸς τὴν ἐνέργειαν).

The word 'therefore' (ἄρα) refers emphatically to 4, 482b34–36. Aristotle keeps open the possibility that pulsation is not itself an activity of the soul but a phenomenon that necessarily occurs in conjunction with the nutritive activity.

CHAPTER FIVE

[The relationship of respiration and nutrition in the theory of Aristotle's opponents]

5, 483a18: 'But the air which is the result of respiration is [they say] transported to the belly' (τὸ δὲ πνεῦμα τὸ ἐκ τῆς ἀναπνοῆς φέρεσθαι μὲν εἰς τὴν κοιλίαν).

The infinitive φέρεσθαι suggests once again that an aspect of the theory of Aristotle's opponents is represented here. A. Roselli 137 indicates this by using quotation marks. The proposition may well render the view of Pl. *Tim.* 77c6–79a4. According to Plato, a living creature possesses life 'amidst fire and air' (ἐν πυρὶ καὶ πνεύματι) (77a1). This combination of fire and air is interwoven with the entire body like a fish-trap.

Aristotle is firmly convinced that the inhaled air goes to the lungs via the windpipe and no further. After that the same air is exhaled via the same route. Aristotle's opponents hold that the air is distributed throughout the body: 3, 482a35: 'distributed to all parts' (εἰς πάντα διαδίδοσθαι); 482b1: 'And if respiration pervades the entire living creature' (διαπνεῖ πρὸς πᾶν); b3: 'and the process of counterflow is also surprising if it takes place from all parts' (τὸ τῆς παλιρροίας, εἴπερ ἀπὸ πάντων); b7: 'if it is also distributed to the bones' (καὶ εἰς τὸ ὀστοῦν διαδίδοται).

In *P.A.* III 3, 664b6 Aristotle mentions people who believe that fluid is taken in via the windpipe, and he finds this ridiculous. P. Louis (1956) 73 and R. Ferwerda (2000) 86 relate this to Pl. *Tim.* 70c6–7. See also 91a4–6. In *P.A.* III 3, 664b10 Aristotle puts forward the counter-argument: 'For there is no opening from the lungs to the stomach, comparable with how we see the oesophagus leading there from the mouth' (πόρος γὰρ οὐδείς ἐστιν εἰς τὴν κοιλίαν ἀπὸ τοῦ πλεύμονος, ὥσπερ ἐκ τοῦ στόματος ὁρῶμεν τὸν οἰσοφάγον).

5, 483a19: 'the belly' (τὴν κοιλίαν).

Cf. *P.A.* IV 10, 688b34: 'After the chest comes the region of the belly' (μετὰ δὲ τὸ στῆθος ὁ περὶ τὴν κοιλίαν ἐστὶ τόπος).

This clearly states that, according to Aristotle's opponents, the air which has been inhaled owing to respiration (and concocted into innate *pneuma*) is conveyed to the belly. This conception serves to explain why the entire living creature displays vital heat and vitality and perceptive activity in all its parts. (Aristotle held the contrary view that the innate *pneuma* is present throughout the living creature *in the blood*). Aristotle's opponents therefore assumed a passage along the loins, starting with the bronchi, to the stomach. In 3, 482a34–36 Aristotle already said that his opponents must demonstrate that the *pneuma* of respiration is not distributed to all parts of the body, if they hold that respiration mainly serves the purpose of refrigeration.

This 'passage' (*poros*) along the loins is therefore an independent 'vessel' (and therefore distinct from the pores in the *artèriai* mentioned in 1, 481a22). Cf. Pl. *Tim.* 78c6. This chimes with the observation in 5, 483b25 that the vessels and the *artèriai* are connected with the intestines and the belly. These vessels and *artèriai* are held responsible for the drawing in of food. In 6, 484a27 Aristotle seems to exclude the possibility of passages leading from the belly and the drawing in of food via this route. Likewise in 6, 484b4: 'how and through what passages does transport from the belly take place?' When at 8, 485a8 he says that the belly has its own movement (and implies that this movement is due to sinews which possess *pneuma*—and therefore not to bones), this also seems an argument against the central role which the opponents assign to the respiratory process.

In *Tim.* 73a3 Plato talks about 'the so-called abdomen'... 'It serves to contain surplus food and drink' (πώματος ἐδέσματός τε..., τὴν ὀνομαζομένην κάτω κοιλίαν ὑποδοχήν) and also calls it 'manger' (φάτνη), 70e.

5, 483a20: 'not via the oesophagus' (οὐ διὰ τοῦ στομάχου).

στόμαχος is the throat or oesophagus. Cf. *H.A.* I 16, 495b19: 'The oesophagus communicates at the top with the mouth; it adjoins the windpipe, and is attached to the spine and the windpipe by membranous ligaments; it ends via the midriff in the belly; it is fleshy and elastic' (Ὁ δὲ στόμαχος ἥρτηται μὲν ἄνωθεν ἀπὸ τοῦ στόματος, ἐχόμενος τῆς ἀρτηρίας, συνεχὴς ὢν πρός τε τὴν ῥάχιν καὶ τὴν ἀρτηρίαν ὑμενώδεσι δεσμοῖς, τελευτᾷ δὲ διὰ τοῦ διαζώματος εἰς τὴν κοιλίαν, σαρκοειδὴς ὢν τὴν φύσιν, καὶ τάσιν ἔχων). *P.A.* IV 5, 678b25. But see also *Resp.* 11, 476a31: 'The windpipe is situated before the oesophagus, through which food passes into what is called the stomach' (προτέρα γὰρ κεῖται

ἡ ἀρτηρία τοῦ οἰσοφάγου, δι' οὗ ἡ τροφὴ πορεύεται εἰς τὴν καλουμένην κοιλίαν).

The inhaled air cannot pass via the oesophagus into the belly, like food, because the inhaled air has first gone to the lungs to be concocted (2, 481a30). So an open connection must be assumed from the lungs to the other parts of the body, and in the first place to the stomach.

5, 483a20: 'there is a passage along the loins' (πόρον εἶναι παρὰ τὴν ὀσφύν).

Aristotle uses the neutral term 'passage' here. But of course he must be talking about an *artèria* in the sense of his opponents, for in their view only the *artèria* contains the vital breath (5, 483b12 and b18). It cannot mean 'pores' here, as in 1, 481a22 and 25 and in 5, 483b19. Perhaps Aristotle deliberately chooses not to use this term now, because *artèria* for him stands for 'the windpipe' in the sense of the connection from mouth to lungs.

In his account of the venous system according to the otherwise unknown Syennesis of Cyprus, Aristotle reports that, in this system, the thick veins run from the navel along the loins: *H.A.* III 2, 511b25: ἐκ τοῦ ὀμφαλοῦ παρὰ τὴν ὀσφύν. The Greek talks in singular about 'passage' and 'loin'. What is meant, obviously, are two parallel 'passages' along both 'loins'. We can compare Pl. *Tim.* 78a6 ff.; 78c4–8; 78e3–79e4.

5, 483a22: 'from the bronchi' (ἐκ τοῦ βρογχίου).

This term is read by ms Z. The others have βραγχίου, which in Aristotle usually means 'gill' (of fish). βρόγχιον does not occur elsewhere in the Aristotelian Corpus. *Bronchion* in 5, 483a22 is something to do with the βρόγχος, 'windpipe' or 'throat'. We might think of a branch of the windpipe. Cf. Pl. *Tim.* 78c3.

5, 483a22: 'and out again' (καὶ πάλιν ἔξω).

Aristotle means inhalation via the mouth, windpipe, lungs, the passage along the loins to the stomach, and then the same way out again. But we should consider that, in some views, air can also enter *via the pores in the flesh and the skin* and go out again. Cf. *Resp.* 5, 472b15 (refutation of the theory of simultaneous air displacement—*periôsis/antiperistasis*—in Plato's *Tim.*). And cf. Pl. *Tim.* 78d4–6: 'The network sinks away into the body—for the body is rarefied in its composition—and then moves out again' (τὸ δὲ πλέγμα, ὡς ὄντος τοῦ σώματος μανοῦ, δύεσθαι εἴσω δι'

αὐτοῦ καὶ πάλιν ἔξω) (in a description of the process of inhalation and exhalation). 78e4 describes the effect of this inhalation and exhalation: 'and this entire activity and passivity has been bestowed on our body so that it could nourish itself and live by means of moisturization and cooling' (τοῦθ' ἡμῶν τῷ σώματι γέγονε ἀρδομένῳ καὶ ἀναψυχομένῳ τρέφεσθαι καὶ ζῆν).

5, 483a23: 'And this last [in their view] can be established by perception' (τοῦτο δὲ τῇ αἰσθήσει φανερόν).

J.F. Dobson: 'and this can be perceived by the sense'; likewise W.S. Hett 499 and P. Gohlke 165. This calls to mind 4, 482b18: 'But the movement of respiration is perceptible only to a certain extent, and is largely based on logical argumentation' (ἡ δὲ τῆς ἀναπνοῆς μέχρι μέν του φανερά, τὸ δὲ πλέον κατὰ λόγον). J. Tricot 184 has here: 'Et ce mécanisme est perçu par la sensation', with a remarkable note: 'C'est-à-dire que la thrachée... a la sensation du souffle qui la traverse.'

The respiratory system is perceptible in the rising and falling of the chest. But it is impossible to see how anybody can perceive the inhaled air being transported via a passage along the loins to the stomach, as the translations of Dobson and others suggest. We should connect τοῦτο here with the preceding phrase καὶ πάλιν ἔξω. That the inhaled air finally leaves the body is in any case an empirical fact. This could be alluded to by 'obvious to a certain extent' (μέχρι μέν του φανερά) in 4, 482b19.

If this is right, we have another clear connection between chap. 4 and chap. 5.

[A problem relating to the subject of perception]

5, 483a23: 'But there is also a problem with [their view of] perception' (ἔχει δ' ἀπορίαν καὶ τὰ περὶ τὴν αἴσθησιν).

J.F. Dobson: 'the question of this perception raises a difficulty'; W.S. Hett 499: 'But the circumstances of this perception present difficulties'; P. Gohlke 165: '(Dies lässt sich unmittelbar wahrnehmen,) doch hat diese Wahrnehmung ihre Schwierigkeit.' Likewise J. Tricot 184.

But there does not seem to be a material connection between the problem raised now and the preceding passage. The expression 'to establish by perception' raises a *general question* regarding the theory

of perception held by Aristotle's opponents. Thus A. Roselli 99 and 137: 'Fa difficoltà anche la sensazione.' This does more justice to the words '[their view of] perception' (τὰ περὶ τὴν αἴσθησιν). Cf. *G.A.* II 6, 743b32: 'There is a difficulty about what happens with the eyes of animals' (ἔχει δ' ἀπορίαν τὸ περὶ τοὺς ὀφθαλμοὺς συμβαῖνον).

The aporia relating to perception goes from 483a23 to 483a35. In 483b1 Aristotle links his argument back to 483a22 with the words 'the outer air' (τῷ ἔξω).

5, 483a24: 'For if only the *artèria* perceives' (εἰ γὰρ ἡ ἀρτηρία μόνον αἰσθάνεται).

This has not yet been mentioned in what goes before. Aristotle's opponents hold that the perceptive faculty is a function of the vital breath, which they situate in the *artèriai*, which are present throughout the body. (The skin also has *artèriai* everywhere according to 5, 483b16.)

A. Roselli 99 notes: 'il redattore di *Spir.* fa riferimento ad una teoria che presuppone appartenga all'arteria, e solo ad essa, la facoltà di percepire. Le fonti non permettono di identificare chi la abbia sostenuta.' But this last statement is disputable. The author of *Spir.* may be thinking here of Pl. *Tim.* 77e5–8. And *Tim.* 43b5–c describes perceptions as 'movements which are conveyed throughout the body to the soul' (αἱ κινήσεις ἐπὶ τὴν ψυχὴν φερόμεναι (διὰ τοῦ σώματος). A connection is made here with the pendulum movement of the nutritive process. Cf. 45d1: 'It therefore passes on... these movements through the entire body as far as the soul. In this way it brings about perception' (τούτων τὰς κινήσεις διαδιδὸν εἰς ἅπαν τὸ σῶμα μεχρὶ τῆς ψυχῆς αἴσθησιν παρέσχετο). Cf. Pl. *Tim.* 64b3 ff. on the origin of perceptions. Things like bone and hair do not have powers of perception; perception is mainly connected with 'fire and air' (64c6). See also *Tim.* 67b2 on speaking and hearing by means of the air.

Aristotle himself postulates that the *anima sensitiva*, in the centre of the living creature, is the subject of perception in indissoluble unity with its 'instrumental body', *pneuma* (which in that case can be called 'perceiving body' (σῶμα αἰσθητικόν)—*Anim.* II 1, 412b24–25).[1] In Aristotle's view, therefore, *pneuma* itself is not the subject. The subject is the immaterial soul as entelechy. In *P.A.* III 4, 667b19 Aristotle explains the unity of

[1] Cf. A.P. Bos, *The soul and its instrumental body* 103–109.

the system of blood vessels, which starts and ends in the heart, with reference to the unity of the *anima sensitiva*, which is situated in the heart, and according to the principle of vital heat.

From this position he asks critical questions about the view of his opponents.

5, 483a25: 'is this by the breath which flows through it or by the total mass or by its material substance [viz. the *artèria* alone]?' (πότερα τῷ πνεύματι τῷ δι' αὐτῆς, ἢ τῷ ὄγκῳ ἢ τῷ σώματι;)

J.F. Dobson: 'does it perceive by means of the wind which passes through it, or by its bulk or by its bodily constitution?'

A question here is whether the author is referring to the mass or physical condition of the *artèria* or of *pneuma*. Probably the first.

Aristotle seems to be presenting a double dilemma here: according to Aristotle's opponents, perception is connected with the *artèria*

/ by the total mass
or
/ \ by the *artèria* alone
\
or by the soul which dominates the *pneuma*.

The first, fundamental dilemma is: the subject of perception is (a) the *artèria* or (b) the soul which dominates the vital heat. As *Sens.* 1, 436b6–7 shows, the dilemma is false for Aristotle, since 'perception reaches the soul via a body' (ἡ αἴσθησις διὰ σώματος γίγνεται τῇ ψυχῇ).

For option (a) of this first dilemma the author then indicates two sub-options: if the *artèria* itself is the subject proper of perception, does this perception depend on *artèria* plus breath or on the nature of the *artèria* alone? (A. Roselli 100 deletes the words ἢ τῷ σώματι in 483a23, which she regards as a marginal gloss explaining τῷ ὄγκῳ. But the proposal is less than compelling.)

The alternative ἔμψυχον ἢ ψυχή in 5, 483a31 seems to take up the alternative indicated in 483a24–26: the vital breath of Aristotle's opponents is either 'soul' itself or ('first instrument of the soul' and therefore) 'ensouled'.

5, 483a25: 'Or, if air is the first that comes directly below soul, does the *artèria* perceive by that which is more dominant and prior [viz. the

soul]?' (ἢ εἴπερ ὁ ἀὴρ πρῶτον ὑπὸ τὴν ψυχήν, τῷ κυριωτέρῳ τε καὶ προτέρῳ;)

J.F. Dobson's translation is incomprehensible and erroneous: 'Or if the air comes first below soul, may it perceive by means of this air which is superior and prior in origin?' J. Tricot 184: 'Ou bien, si l'air vient d'abord au-dessous de l'âme, est-ce par le moyen de cet air qui est supérieur et antérieur?' W.S. Hett 499 seems closer to the mark: 'Or if air is first after the soul, does it perceive by this, as superior and prior?' P. Gohlke 165 probably grasps the right meaning: 'Gewiss geschieht es, da Luft der Seele zunächst untersteht, mit diesem beherrschenderen und ranghöheren Mittel.'

M. Pohlenz, *Die Stoa* (1959) I 73 quotes this passage: 'Auch Aristoteles, für den das immaterielle Eidos des Lebewesens die Seele war, sah in diesem Pneuma wenigstens "das erste unter der Seele", den körperlichen Stoff, dessen sich die Seele bedient, um den Körper zu erhalten und zu lenken.' This is criticized by F. Solmsen, 'Cleanthes or Posidonius? The basis of Stoic physics', in *Meded. der Kon. Nederl. Akademie van Wetenschappen*, afd. Letterkunde, Nieuwe Reeks vol. XXIV (1961) 265–289; repr. in id. *Kleine Schriften*, vol. I (Hildesheim 1968) 436–460, p. 451 n. 59.

Clearly 'that which is more dominant and prior' (τῷ κυριωτέρῳ τε καὶ προτέρῳ) refers to the soul: if the vital breath comes first directly below the soul, the soul is therefore 'prior and more dominant'. So the author here considers an option as proposed in 1, 481a17, i.e. a unity of the vital breath and a soul as regulating and governing principle (comparable with Aristotle's own view of the soul as the entelechy of an instrumental body).

Cf. Pl. *Tim.* 46c7–e2 on the soul as 'cause' and the elements as 'auxiliary causes', esp. 46d5: 'For of all beings there is only one to which belongs the possession of insight, and we must call this soul. And this being is invisible, whereas fire and water and earth and air were all formed as visible bodies' (...ψυχήν—τοῦτο δὲ ἀόρατον, πῦρ δὲ καὶ ὕδωρ καὶ γῆ καὶ ἀὴρ σώματα πάντα ὁρατὰ γέγονεν).

5, 483a27: 'What then is the soul?' (τί οὖν ἡ ψυχή;)

This question relates to the psychology held by the people whose theory Aristotle is critically analyzing. Aristotle's own answer is restated in chap. 9: it is the vital principle that uses the innate *pneuma* as its instrument.

5, 483a27: 'They say that it is a power that is the cause of this movement' (δύναμίν φασι τὴν αἰτίαν τῆς κινήσεως τῆς τοιαύτης).

The movement here must be the movement of the vital breath throughout the living creature; cf. 5, 483a19; a22. At 4, 482b21–23 he suggested that respiration has its origin in a 'power of the soul or in the soul'. So the soul is interpreted by the opponents as the power which causes the movement of respiration. Aristotle's opponents apparently characterize the soul as the *principle of (vital) movement.* This calls to mind Pl. *Phaedr.* 245c9 and the texts in *Tim.* 69d ff. on the divine and the two mortal soul-parts. Cf. also *Tim.* 78d7: 'And as long as the mortal creature can hold its structure together, this process continues ceaselessly' (καὶ τοῦτο, ἔωσπερ ἂν τὸ θνητὸν συνεστήκῃ ζῷον μὴ διαπαύεσθαι)—i.e. as long as the fluctuating movement of respiration goes on—, and Aristotle's refutation of Plato's doctrine of soul (as being characterized by a movement of its own) in *Anim.* I 3, 405b31–406b25 and 407a35–407b11.

5, 483a27–29—cf. Aristotle's criticism of the theory how the 'parts' of the soul are spatially distributed in *Anim.* III 9, 432a15 ff.; 10, 433b1: 'But those who distinguish parts of the soul, if they distinguish and divide the soul according to its powers, find themselves with a large number: vegetative, perceptive, intellective, deliberative, and also appetitive' (τοῖς δὲ διαιροῦσι τὰ μέρη τῆς ψυχῆς, ἐὰν κατὰ τὰς δυνάμεις διαιρῶσι καὶ χωρίζουσι, πάμπολλα γίνεται, θρεπτικόν, αἰσθητικόν, νοητικόν, βουλευτικόν, ἔτι ὀρεκτικόν).

5, 483a28: 'But of course you cannot rightly criticize those who describe the rational and the emotional parts as powers. For they, too, describe those parts as powers' (ἢ δῆλον ὡς οὐκ ὀρθῶς ἐπιτιμήσεις τοῖς τὸ λογιστικὸν καὶ θυμικόν· καὶ γὰρ οὗτοι ὡς δυνάμεις λέγουσι).

This answer immediately recalls Plato's talk about a 'rational' and an 'appetitive' power of the soul. For the *Timaeus*, cf. 69c5 ff. on the immortal and the two mortal soul-parts and 70a2: 'the part that possesses manliness and passion' (τὸ μετέχον τῆς ψυχῆς ἀνδρείας καὶ θυμοῦ).

Aristotle himself also talks about δυνάμεις, but as different powers of one soul. Cf. *Resp.* 8, 474b10: 'Now the other faculties of the soul cannot exist apart from the power of nutrition...and this not apart from the natural fire' (τὰς μὲν οὖν ἄλλας δυνάμεις τῆς ψυχῆς ἀδύνατον

ὑπάρχειν ἄνευ τῆς θρεπτικῆς...ταύτην δ' ἄνευ τοῦ φυσικοῦ πυρός). J.F. Dobson starts this sentence with: 'Or is it clear that you will not be right in...'. P. Gohlke 197 finds it hard to decide whether ἐπιτιμήσεις is a verbal form or a noun. W.S. Hett 501 translates correctly here: 'Surely it is clear that one is not right to censure...'

But the problem here lies in the words καὶ γὰρ οὗτοι. Does this mean: 'For they too', in the sense that these persons who talk about τὸ λογιστικὸν καὶ θυμικόν are different from the people who call the soul the 'principle of movement'? Thus J.F. Dobson, W.S. Hett, 501 and P. Gohlke 166.

D. Holwerda (August 18, 2005) has proposed to reconstruct the sentence and read: ἢ δῆλον ὡς οὐκ ὀρθῶς ἐπιτιμήσεις τοῖς τὸ λογιστικὸν καὶ θυμικόν—καὶ γὰρ οὗτοι—ὡς δυνάμεις λέγουσι, in which λέγουσι is a participle depending on τοῖς. Cf. 9, 485b35: 'those who say this' (τοῖς οὕτω λέγουσιν).

5, 483a30: 'But if the soul is present in this air, the air is ordinary air. Or does it really undergo an effect [from the soul] and thereby change? Obviously the air as ensouled or as soul is brought to what is akin to it, and like increases by like' (ἀλλ' εἰ δὴ ἡ ψυχὴ ἐν τῷ ἀέρι τούτῳ, οὗτός γε κοινός, ἢ πάσχων γέ τι καὶ ἀλλοιούμενος; εὐλόγως ἂν ἔμψυχον ἢ ψυχὴ πρὸς τὸ συγγενὲς φέρεται καὶ τῷ ὁμοίῳ τὸ ὅμοιον αὔξεται).

After κοινός W. Jaeger had a full stop; after ἀλλοιούμενος not a punctuation mark, but a comma after εὐλόγως and ψυχή. He also read δὴ. A. Roselli 101 puts ἔμψυχον ἢ ψυχή between *cruces interpretum.* Probably by mistake, she writes δὲ. In her commentary on p. 100 she also has δὴ.

J.F. Dobson follows a strange course here: 'But if the soul resides in this air, the air is at any rate a neutral substance. Surely, if it becomes animate or becomes soul, it suffers some change and alteration, and so naturally moves towards what is akin to it, and like grows by the addition of like.' Likewise in the *Revised Oxford Translation* (1984). W.S. Hett 501 has minor changes.

P. Gohlke 166 includes the surprising translation: 'dann versteht man, wieso die Seele gut kühlt', as if the text reads εὔψυκτος! J. Tricot 184 has: 'une substance commune'.

κοινός can be taken here as the ordinary air familiar to everyone, like '"ordinary" food' in 2, 482a10. Aristoteles then asks whether this air of the vital breath remains ordinary 'air', or whether this air undergoes

an effect from the soul, of which it is the vehicle. Aristotle himself is firmly convinced that the 'natural body' which becomes the *organon* of the soul can no longer be solely judged according to the laws of natural bodies. He raised this question in *Long.* 2, 465a26 ff.

ἔμψυχον ἢ ψυχή—all manuscripts here read εὔψυχον (which can mean 'brave' in Aristotle), which poses insurmountable difficulties to all interpreters. The entire sentence is problematical. The vital breath in the theory of Aristotle's opponents, as in 5, 483a24–27, is either identical with the soul or ensouled.

5, 483a31: ἀλλοιούμενος—viz. the ἀήρ. Cf. 2, 481b9–10: 'What agent would be capable of bringing about a change and alteration so rapidly?' (τί οὖν τὸ οὕτω ταχὺ μεταβάλλον καὶ ἀλλοιοῦν;). The subject there is the 'change' of inhaled air to *pneuma* owing to the effect of vital heat.

5, 483a32: 'brought to what is akin to it, and like increases by like' (πρὸς τὸ συγγενὲς φέρεται καὶ τῷ ὁμοίῳ τὸ ὅμοιον αὔξεται).

Cf. Pl. *Tim.* 79d6: 'We must admit that heat by its nature goes to its own place, that is, outwards, to what is akin to it' (τὸ θερμὸν δὴ κατὰ φύσιν εἰς τὴν αὐτοῦ χώραν ἔξω πρὸς τὸ συγγενὲς ὁμολογητέον ἰέναι).

This is followed in 79e2 by: 'The... air which falls into the fire is heated, whereas the air which passes out is cooled' (τὸ δὲ... εἰς τὸ πῦρ ἐμπῖπτον θερμαίνεται, τὸ δ' ἐξιὸν ψύχεται). And see 57a3–b7, with b5: 'before they either, entirely repelled and dissolved, find refuge with their own kind, or, defeated, become one from many in a unity which resembles the victorious kind, and continue to live with it' (πρὶν... ἐκφύγῃ πρὸς τὸ συγγενές, ἢ νικηθέντα, ἓν ἐκ πολλῶν ὅμοιον τῷ κρατήσαντι γενόμενον, αὐτοῦ σύνοικον μείνῃ). These passages seem to warrant the proposition that Aristotle has the *Timaeus* in mind here. It might therefore be suggested that our text should be corrected from 483a30 to: ἀλλ' εἰ δὴ ἡ ψυχὴ ἐν τῷ ἀέρι τούτῳ, οὗτός γε κοινός; ἢ πάσχων γέ τι καὶ ἀλλοιούμενος; εὐλόγως ἂν [ἔμψυχον ἢ] ψύχη<ται> πρὸς τὸ συγγενὲς φέρεται καὶ τῷ ὁμοίῳ τὸ ὅμοιον αὔξεται;) In that case the translation should read: 'But if then the soul is present in this air, is the air ordinary air? Or does it really undergo an effect [from the soul] and thereby change? Is it reasonable that it [the vital breath], <when it is cooled>, goes to what it is akin to it, and does like increase by like?'

Plato had previously said in 77a1: 'But this being necessarily had to lead its life amidst fire and air' (τὴν δὲ ζωὴν ἐν πυρὶ καὶ πνεύματι

συνέβαινεν ἐξ ἀνάγκης ἔχειν αὐτῷ). For a critique of the principle 'like is attracted to like', cf. *G.A.* II 4, 740b12.

5, 483a33: 'Or is this not so? For the whole is not air' (ἢ οὔ; τὸ γὰρ ὅλον οὐκ ἀήρ).

J.F. Dobson: 'for it may be contended that the air is not the whole of soul'; W.S. Hett 501 virtually identical. P. Gohlke 166: 'Das ganze ist ja nicht Luft.' J. Tricot 184 differently: 'Car, enfin, la totalité de l'âme n'est pas de l'air...'. Likewise A. Roselli 137.

Starting from his own point of view, Aristotle puts forward here: 'the whole is not identical with the air of the vital breath', but the whole is the unity of 'soul plus *pneuma*'. This means that the 'natural body' which is the instrument of the soul no longer functions purely according to the laws of this natural body.

5, 483a34: 'Or not this either? That which brings about and has brought about this power, that is the origin and foundation' (ἢ οὔ; τὸ ταύτην ποιοῦν καὶ τὸ ποιῆσαν τοῦτ' ἀρχὴ καὶ ὑπόθεσις).

W. Jaeger adds <ἀλλά> after οὔ. A. Roselli indicates a lacuna there. Neither suggestion is strictly necessary. In the previous sentence Aristotle seemed to underline the subordinate position of the vital breath by stating that the natural body 'makes a contribution' to the vital functions. Now, it seems, he emphasizes even more strongly that 'the whole' (a33) brings about the functions and that 'the soul *and* its instrumental body', as an indissoluble unity, are the founding principle.

In this explanation Aristotle reviews three options:

(a) Air is the vehicle of the soul, but otherwise behaves like ordinary air.
(b) Air is ensouled and is a real factor in the combination of soul and breath.
(c) The soul is the founding principle, which uses the air as its instrument.

Perhaps we should read a question-mark after ὑπόθεσις too (as Jaeger did) and translate: 'Is that which brings about and has brought about this power the origin and foundation?'

[Is the vital breath identical with or different from the outer air?]

5, 483b1: 'But do non-respiring animals have no breath in order that the air in the *artèria* is not mixed with the outer air?' (τοῖς δὲ μὴ ἀναπνέουσι, ἵνα ἀνεπίμικτος τῷ ἔξω;)

Cf. the reproach directed at Plato's *Timaeus* in *Resp.* 5, 472b9: 'For if respiration occurs only in land animals, we should be told the reason for this' (εἰ μὲν γὰρ μόνοις τὸ τῆς ἀναπνοῆς ὑπάρχει τοῖς πεζοῖς, λεκτέον τὴν αἰτίαν τοῦ μόνοις).

J.F. Dobson translates here: 'In the case of non-respiring creatures, where the internal air is not mixed with the external...', and explains in n. 1 that he opts for 'the relative use of ἵνα'. W.S. Hett 501 follows in his footsteps. Likewise J. Tricot 184. A. Roselli 137: 'in cui l'aria interna non si mescola a quella esterna.' Differently P. Gohlke 166: 'Bei den nicht atmenden Geschöpfen soll sich die Lebensluft mit der äusseren Luft nicht vermisschen.'

As in chap. 2, 482a7–8: 'the living creatures which do not have respiration' (τοῖς δὲ μὴ ἀναπνευστικοῖς), Aristotle again raises the issue here that life does not just occur in animals that breathe. And he immediately asks what the reason for this could be. Ἵνα probably expresses an intention here and the sentence should be read as an ellipsis: τοῖς δὲ μὴ ἀναπνέουσιν (οὐκ ἔστιν ἀναπνοὴ) ἵνα ἀνεπίμικτος (ὁ ἔσω ἀὴρ) τῷ ἔξω (ἀέρι ᾖ); ἢ οὔ,... It seems most likely that 483b1–2 is an independent objection. The theory of 'Aristogenes' ignores a large number of living creatures. Why is it that they do not need 'air from outside' if the passage and assimilation of their food does depend on the movement of air in the *artèria*? But again, as in 2, 482a7–19, he leaves room here for the objection that insects perhaps possess something like respiration. In 5, 483b33–34 he mentions that, in the view of his opponents, fish possess respiration. But in 6, 484b1–4 he draws attention to crustaceans and shellfish. It is almost certain that they do not have respiration.

Section 483b1–12 contains a striking number of passages which talk about a form of 'mixture': b1; b8; b10; b12. This may recall Empedocles, who conceived of the soul as the *logos* of a certain 'mixture' (Arist. *Anim.* I 4, 408a13).

ἀνεπίμικτος—only here in the Aristotelian Corpus according to H. Bonitz, *Index*.

5, 483b1: 'Or is this not the reason, but is it mixed in a different way?' (ἢ οὔ, ἀλλὰ κατ' ἄλλον τρόπον μειγνύμενος;)

Cf. 2, 482a7–19, where something 'like respiration' was ascribed to (non-respiring) insects.

Objection

5, 483b2: 'And how does the air in the *artèria* differ from the air outside?' (τίς οὖν ἡ διαφορὰ τοῦ ἐν τῇ ἀρτηρίᾳ πρὸς τὸν ἔξω;)

This critical remark does not refer to living creatures that do not breathe. The *artèria* as discussed in chaps. 1–8 is a concept inextricably linked with the activity of respiration (and next with the nutrition of the innate *pneuma* and the other parts).

5, 483b3: 'For it is plausible and perhaps even necessary that it differs in fineness' (διαφέρειν γὰρ εὔλογον, τάχα δὲ καὶ ἀναγκαῖον, λεπτότητι).

Cf. 1, 481a22–25 and 2, 481b3–8 on the fineness and thickness of *pneuma*. The discussion here does not refer to the system of Empedocles, which Aristotle describes in *Resp.* 7, 473b1–5; the discussion there concerns the fineness of air compared with the thickness of blood particles.

5, 483b4: 'But there is also the problem whether it is hot by itself or by something else' (ἀλλ' ἔτι δὲ καθ' αὑτὸν θερμὸς ἢ ὑφ' ἑτέρου;)

Cf. 2, 481b12–15. This passage stated explicitly that, according to 'Aristogenes' and his supporters, though the inhaled air resides in the lungs and the *artèria*, this does not mean that they are also the seat of the vital heat as an independent principle. The air is heated as a result of the movement of the air.

According to Aristotle, *pneuma* itself is the vehicle of vital heat—*G.A.* II 3, 736b33–737a1. Aristotle also calls *pneuma* 'hot air' (*G.A.* II 2, 736a1). But we should consider that, in his view, *pneuma* is not identical with the inhaled air and that this 'heat' is not identical with fire, but has an astral origin.

5, 483b6: 'But it receives help through refrigeration' (βοηθεῖται δὲ τῇ καταψύξει).

W.S. Hett 501: 'but it is assisted by refrigeration'; likewise J. Tricot 185. A. Roselli 138: 'ma riceve il soccorso del raffreddamento.' P. Gohlke has completely lost his way here. βοηθεῖται should be taken passively. 'The vital breath is assisted by the process of refrigeration' and so must be warmer than the outer air. Cf. *Resp.* 8, 474b22–24: 'What is fiery does not go out through cooling but through exhaustion. Hence it needs to

be cooled if it is to go on. This helps against that form of extinction' (φθείρεται τὸ πυρούμενον, οὐ ψυχόμενον ἀλλὰ μαραινόμενον. ὥστ' ἀνάγκη γίγνεσθαι κατάψυξιν, εἰ μέλλει τεύξεσθαι σωτηρίας· τοῦτο γὰρ βοηθεῖ πρὸς ταύτην τὴν φθοράν), and 9, 474b28; 29; 10, 475b16. And cf. Pl. *Tim.* 70c–d: 'the gods devised a plan of relief.... Hence they grafted on the lungs as a remedy' (ἐπικουρίαν μηχανώμενοι τὴν τοῦ πλεύμονος ἰδέαν ἐνεφύτευσαν).

5, 483b6: 'Which views are right?' (πότερα δέ;)

J.F. Dobson: 'But which is really the case'? Likewise W.S. Hett 501 and A. Roselli 138. J. Tricot 185 is closer to the mark: 'Mais à laquelle des deux explications se rallier'?

The question relates to a plural: 'which answers should we give to these two questions?' Aristotle here discusses the question: is there a difference between the air outside and the air inside a living creature? (b2–3). He divides this into two sub-questions:
(1) is there a difference in density?
(2) is there a difference in heat?

5, 483b6: 'The air outside is at rest, but when enclosed, it becomes *pneuma*' (ἔξω μὲν γὰρ πραΰς, ἐμπεριληφθεὶς δὲ πνεῦμα).

J.F. Dobson: 'for when outside it is soft, but when enclosed the air becomes breath'; W.S. Hett 501: 'Outside the air is mild, but when enclosed it is breath'. P. Gohlke 21 proposes to replace πραΰς with παχύς and translates most strangely on p. 166: 'Und ist es mit der Dichte so, dass die aüssere Luft dick ist und nur Lebensluft in sich schliesst, gleichsam eingedickt und irgendwie untermengt?'

For ἐμπεριληφθείς, cf. 4, 482b31: 'because it is enclosed' (διὰ τὴν ἐναπόληψιν). Comparison of the two translations may suggest that πραΰς contrasts here with the 'pulsation' of the *pneuma* in the *artèria*. If so, it is clear that P. Gohlke's proposal to replace πραΰς should be rejected.

But we should also consider that Aristotle in 4, 482b32 has already dismissed the idea of a relation between the inhaled air and pulsation (which he connects with blood and the heart).

Objection

5, 483b8: 'obtain a kind of mixture' (μῖξιν τινὰ λαμβάνειν).

It is relevant here that Empedocles described the soul as 'the ratio of a mixture' (*Anim.* I 4, 408a13: 'And it is also strange that the soul is the ratio of the mixture. For the mixture of the elements resulting in flesh does not have the same ratio as that resulting in bone' (ὁμοίως δὲ ἄτοπον καὶ τὸ τὸν λόγον τῆς μίξεως εἶναι τὴν ψυχήν· οὐ γὰρ τὸν αὐτὸν ἔχει λόγον ἡ μίξις τῶν στοιχείων καθ' ἣν σὰρξ καὶ καθ' ἣν ὀστοῦν); a18: 'This question can also be posed to Empedocles' (ἀπαιτήσειε δ' ἄν τις τοῦτό γε καὶ παρ' Ἐμπεδοκλέους...). *Spir.* 9, 485b26 mentions Empedocles explicitly in connection with his theory of 'mixture'. Aristotle may be suggesting here that his opponents hold the outer air to be inanimate and the inhaled air to be animate because it is air which has undergone a certain 'mixture'. Cf. 4, 482b24.

5, 483b8: 'because it circulates in a moist and coarse-material environment' (ἐν ὑγρότητί τε καὶ σωματικοῖς ὄγκοις ἀναστρεφόμενον).

Cf. 2, 481b4: 'And certainly it is also logical that it is thicker, mixed as it is with the fluid of the vessels, and of the entire mass of the body' (καὶ μὴν καὶ παχύτερον αὐτὸν εὔλογον εἶναι μεθ' ὑγρότητος τῆς ἀπὸ τῶν ἀγγείων ὄντα καὶ τῶν ὅλων ὄγκων). Moreover, fishes and other aquatic animals without respiration are also entirely surrounded by water and coarse-material masses. Cf. *G.A.* III 11, 762a27: 'the sea contains much that is earthy' (ἐν δὲ τῇ θαλάττῃ πολὺ τὸ γεῶδες ἔνεστιν) and 761a33: 'what is moist is by nature more plastic than earth and not much less material, and this is especially true of everything in the sea' (τό τε γὰρ ὑγρὸν εὐπλαστοτέραν ἔχει τὴν φύσιν τῆς γῆς καὶ σωματικὴν οὐ πολλῷ ἧττον, καὶ μάλιστα τὰ ἐν τῇ θαλάττῃ τοιαῦτα).

5, 483b9: 'But in that case the air is not the finest, because it has undergone a mixture. Yet it is logical that the vehicle of the soul in a primary sense is very fine' (οὐκ ἄρα λεπτότατος, εἴπερ μέμικται. καὶ μὴν εὔλογόν γε τὸ πρῶτον δεκτικὸν ψυχῆς).

Again the idea expressed here is very close to that of 1, 481a16–19. Aristotle firmly believes that *pneuma* in its pure state is of a different order from the coarse-material elements. Cf. *Anim.* I 3, 407b20: 'However, they only try to explain the nature of soul, but fail to pay any attention to the body which receives the soul' (οἱ δὲ μόνον ἐπιχειροῦσι λέγειν ποιόν τι ἡ ψυχή, περὶ δὲ τοῦ δεξομένου σώματος οὐθὲν ἔτι προσδιορίζουσιν)

(against the Platonists); cf. II 2, 414a10: '(the body) which receives the soul' (τοῦ δεκτικοῦ).

5, 483b11: 'unless something similar applies to the soul too, and it is not something pure and unmixed' (εἰ μὴ ἄρα καὶ ἡ ψυχὴ τοιοῦτον, καὶ οὐ καθαρόν τι καὶ ἀμιγές).

Significantly in this connection, Plato, *Tim.* 92b describes aquatic animals as creatures which, because they do not possess a pure soul (τὴν ψυχὴν... ἀκαθάρτως ἐχόντων), do not have pure respiration either: ὕδατος θολερὰν... ἀνάπνευσιν.

5, 483b12: 'Only the *artèriai* [they say] can contain breath (*pneuma*), but not the sinews' (τὴν ἀρτηρίαν μόνον εἶναι δεκτικὴν πνεύματος, τὸ δὲ νεῦρον οὔ).

Cf. b18. This seems another important difference between Aristotle and his opponents. In *M.A.* 7, 701b7–10 Aristotle describes how, through expansion or contraction of the innate *pneuma*, the sinews of a living creature are tensed or relaxed, thus setting the bones in motion; cf. 8, 702a7–21 and 10, 703a4–28. If the innate *pneuma* is not present in sinews, motion becomes impossible in Aristotle's view. But why do the opponents say so emphatically that sinews cannot absorb *pneuma*? Is it because they do not have air-holes? 3, 482b7 does say that, according to the opponents, distribution takes place from the *artèriai* to the bones.

J.F. Dobson, W.S. Hett 501, and J. Tricot 185 wrongly connect this sentence with the previous one: 'We may, however, reasonably expect that... and that the air-duct should be capable of receiving the breath, while the sinew is not.' P. Gohlke 167 has: 'Man muss auch wissen, dass nur die Luftader Lebensluft aufnimmt, nicht dagegen die Sehne', but he seems to take this as the view of the author of *De spiritu.*

However, the infinitives here again indicate that the view of the opponents is being represented. A. Roselli 138 conveniently marks this by using inverted commas.

5, 483b14: 'that the sinews are elastic' (τὸ μὲν νεῦρον ἔχει τάσιν).

Cf. *H.A.* III 5, 515a31: 'They are just as elastic as the sinews' (τάσιν ἔχει τοιαύτην οἵαν περ τὰ νεῦρα). Aristotle also describes the sinews as ἑλκτός. Cf. *G.A.* II 6, 743b5: 'the sinews solid and elastic, the bones solid and brittle' (τὸ δὲ νεῦρον ξηρὸν καὶ ἑλκτόν, τὸ δ' ὀστοῦν ξηρὸν καὶ θραυστόν). See also *Meteor.* IV 9, 386b14.

5, 483b14: 'but the *artèriai* burst easily, like veins' (ἡ δ' ἀρτηρία ταχὺ διαρρήγνυται καθάπερ καὶ ἡ φλέψ).

Is this because the *artèriai* also contain pores? In 5, 483b19 the veins are said to contain pores. The same is said of the *artèria* in 1, 481a22.

5, 483b15: 'The skin [they say] contains veins, sinews, and *artèriai*' (τὸ δὲ δέρμα ἐκ φλεβὸς καὶ νεύρου καὶ ἀρτηρίας).

This means that, wherever there is skin, there are *artèriai*. Significantly, Plato in *Tim.* 79a5–e10 describes the respiratory process as taking place in the lungs, but also 'through the porous flesh' (διὰ μανῶν τῶν σαρκῶν—79c4).

5, 483b16: 'when the skin is pricked, it emits blood' (κεντηθὲν αἷμα ἀναδίδωσιν).

Cf. 6, 484a34 and *H.A.* III 19, 521a15: 'During sleep the blood decreases in the external parts, so that it flows less when the creature is pricked' (τοῖς δὲ καθεύδουσιν ἐν τοῖς ἐκτὸς μέρεσιν ἔλαττον γίνεται τὸ αἷμα, ὥστε καὶ κεντουμένων μὴ ῥεῖν ὁμοίως).

In Pl. *Tim.* 76b1–3 we find: 'By means of fire the deity pricked holes all around the surface of the skin. The moisture issued through these holes; and all the moisture and heat that was pure disappeared' (τοῦτο δὴ πᾶν τὸ δέρμα κύκλῳ κατεκέντει πυρὶ τὸ θεῖον, τρηθέντος δὲ καὶ τῆς ἰκμάδος ἔξω δι' αὐτοῦ φερομένης τὸ μὲν ὑγρὸν καὶ θερμὸν ὅσον εἰλικρινὲς ἀπῄειν...).

5, 483b17: 'sinews, for the skin is elastic' (ἐκ νεύρου δὲ ὅτι τάσιν ἔχει).

Cf. Pl. *Tim.* 74d2: 'the nature of sinews... firmer' (τὴν δὲ τῶν νεύρων φύσιν... συντονωτέραν).

5, 483b17: '*artèriai*, for air is breathed through the skin' (ἐξ ἀρτηρίας δὲ ὅτι διαπνοὴν ἔχει).

Cf. 3, 482a34: 'but the result of respiration, it seems in their view, is also distributed to all parts of the living creature' (δοκεῖ δὲ καὶ τὸ τῆς ἀναπνοῆς εἰς πάντα διαδίδοσθαι) and 482b1: 'But if respiration pervades the entire body' (εἰ δὲ διαπνεῖ πρὸς πᾶν...).

5, 483b19: 'But the veins [they say] have pores, in which the vital heat [of the breath in the *artèriai*] is present, and in this way heats the blood as in a cauldron' (τὰς δὲ φλέβας ἔχειν πόρους, ἐν οἷς τὸ θερμὸν ὅν ὥσπερ ἐν χαλκείῳ θερμαίνειν τὸ αἷμα).

J.F. Dobson is right to correct αἷς to οἷς. We should consider, however, that Aristotle in *Resp.* 7, 474a12 and 474a15; 21, 480a21 and 480a29 uses the word φύσας four times in relation to the word for 'cauldron' or 'oven'.

This passage seems to imply that there is a constant connection between veins and *artèriai* [see 483b31: 'and the *artèriai* and the veins always lie side by side' (καὶ ἀρτηρίαν καὶ φλέβα παρακεῖσθαι)] and that the heat of the breath in the *artèriai* is responsible for the heat in the blood and also for the bloodflow. Aristotle had said of this heat in 2, 481b12–15 that, according to his opponents, it is not an independent principle, but a result of the movement in the air.

In *Tim.* 78a Plato had used the principle that smaller particles can penetrate where larger cannot, to explain the action of the inner fire in the blood of the veins. Another relevant text in this connection is 79d1: 'In every living creature the internal parts close to the blood and the veins are the hottest: just as if they contain a source of heat' (πᾶν ζῷον αὐτοῦ τἀντὸς περὶ τὸ αἷμα καὶ τὰς φλέβας θερμότατα ἔχει, οἷον ἐν ἑαυτῷ πηγήν τινα ἐνοῦσαν πυρός).

In 1, 481a22 Aristotle had also said that the *artèriai* have pores.

P. Gohlke 167 has here: 'Sodann ist auszuführen, dass die Blutadern Gängen haben...,' as if this represents the view of the author of *Spir.*

5, 483b20: 'and in this way heats the blood as in a cauldron' (ὥσπερ ἐν χαλκείῳ θερμαίνειν τὸ αἷμα).

9, 485a35 talks about τὸ χαλκευτικὸν πῦρ. The association here is with a cauldron containing the blood, which is warmed by the vital heat. *Resp.* 7, 474a12 mentions τὰς φύσας ἐν τοῖς χαλκείοις ('bellows in ovens/smithies') to refute Empedocles' theory of respiration.

5, 483b20: 'For blood is not hot by nature, but like metals becomes liquid through heat. That is why it coagulates' (φύσει γὰρ οὐκ εἶναι θερμόν, ἀλλ' ὥσπερ τὰ τηκτὰ διαχεῖσθαι· διὸ καὶ πήγνυσθαι).

We read a full stop after πήγνυσθαι. In Pl. *Tim.* 79a6 τήκειν is 'to make liquid', another function of the 'internal fire' connected with

respiration. On the liquidity and coagulation of blood, cf. *Tim.* 85c–d: the liquidity of blood is increased by heat.

Aristotle himself also believes that the heat of the *pneuma* in the heart stops the blood from coagulating in the veins: *P.A.* II 9, 654b9: 'For it is the heat from the origin which prevents it from coagulating' (ἡ γὰρ ἀπ' ἐκείνης θερμότης κωλύει πήγνυσθαι). III 5, 667b24: 'and this is the cause of the warmth and fluidity of the blood' (αὕτη δ' ἐστὶν αἰτία καὶ τῷ αἵματι τῆς ὑγρότητος καὶ τῆς θερμότητος). Indeed, Aristotle therefore makes 'vital heat' the fundamental principle of life. For him it does not depend in any way on respiration.

5, 483b21: 'And the *artèria* also has moisture in itself and in the coverings which enclose the cavity' (Τὴν ἀρτηρίαν καὶ ἔχειν ὑγρότητα καὶ ἐν αὐτῇ καὶ ἐν τοῖς χιτῶσι τοῖς περιέχουσι τὸ κοίλωμα).

J.F. Dobson notes: 'This passage seems to be out of place.' He is supported only by J. Tricot 185.

But, as in 483b33, we should assume an asyndetic continuation of the argument. This proposal comes from D. Holwerda by letter of October 14, 2005.

5, 483b23: 'the cavity' (κοίλωμα).

H. Bonitz lists *Mund.* 4, 395b34 as the only other occurrence of this word in the Corpus: 'wind, trapped in the hollows of the earth' ((πνεῦμα) ἐγκατειλήθη τοῖς (τῆς γῆς) κοιλώμασιν).

5, 483b23: 'This is shown both by dissections' (φανερὸν δ' ἐκ τε τῶν ἀνατομῶν εἶναι).

This is a remarkable detail. J.F. Dobson translates: 'It is also proved by dissection'. Likewise W.S. Hett 503 and A. Roselli 138. But P. Gohlke 167 opts for: 'Aus den Schnittzeichnungen' and clearly regards this passage as an allusion to the collection of drawings for anatomical instruction in the Peripatos, to which Aristotle frequently refers. Likewise J. Tricot 186. Cf. *Somn.* 3, 456b2; *Resp.* 8, 474b9, which talk about the course of the veins from the heart; 16, 478b1; *P.A.* III 4, 666a8. But in *H.A.* IV 1, 525a8 Aristotle says more explicitly: 'For the disposition of these parts I must refer to my anatomical diagrams' (θεωρεῖσθω ἐκ τῆς ἐν ταῖς ἀνατομαῖς διαγραφῆς).

Cf. W.D. Ross, *Parva naturalia* (1955) 264: 'References in A. to ἀνατομαί are frequent. Sometimes the reference is to actual dissections

(*De Juv.* 474b9; 478a27; *De Part.* 677a9; *De Gener. An.* 746a22, 764a35, 771b32, 779a8); in other cases the reference is to the record of dissections in a work now lost (e.g. ... *Hist. Anim.* 497a32; cf. ibid. 525a9, 566a15, *De Gen. An.* 746a15).'

But although a reference to this collection of drawings is perfectly possible here, it does mean that, in this case, the appeal to the diagrams is made by Aristotle's opponents! The very fact that the passage on fluid in the *artèriai* seems to refer to the study of corpses suggests that we should opt for the translation 'by dissections' here instead of finding a reference to the *Anatomical Atlas*. Cf. the remark 6, 484a37 on the opening up of birds. And see also *P.A.* III 4, 667b8–10: 'But animals which we see dying of diseases and ailments as described here are found on dissection to display injuries in the heart region as the cause of their diseases' (τούτοις ἀνατεμνόμενοις φαίνεται ... πάθη). Cf. also *H.A.* II 1, 497b17: 'when opened up, the animal is found in all internal characteristics to resemble the dog' (ἀνοιχθείς ὅμοια παντ' ἔχει κυνί). II 11, 503b23: ἀνατετμημένος (of a chameleon). II 17, 507a21: διανοιχθέν. In *H.A.* III 1, 510a29 Aristotle himself seems to have shown a diagram during his lecture.

So this appeal to information garnered from dissections seems to derive from the view of Aristotle's opponents, but cannot be traced back to Plato's *Timaeus*. Likewise 483b35–484a3. And perhaps 483b21.

On account of τε in 483b24 we surmise a connection with the following sentence.

5, 483b24: 'and by the fact that both the veins and the *artèriai* ... are connected with the intestines and the belly' (εἰς τὸ ἔντερον καὶ εἰς τὴν κοιλίαν αἵ τε φλέβες καὶ αἱ ἀρτηρίαι συνάπτουσιν).

483a19 had already observed that breath is transported to the belly. For συνάπτειν εἰς in an intransitive sense, cf. *P.A.* II 10, 656b19; *G.A.* I 3, 716b20; *H.A.* I 7, 491b3. Also *Spir.* 5, 484a1. And cf. Pl. *Tim.* 73a3–4; 78a–79a.

5, 483b27: 'not via the sides but via the opening' (οὐ κατὰ τὰ πλάγια ἀλλὰ κατὰ τὸ στόμα).

This seems to be remarked because 5, 483b19 has established that the veins do have pores, through which the heat from the *artèriai* can enter. And the *artèriai* themselves have pores too (1, 481a22). But of course a condition here is that these pores allow only the very smallest

particles through. Food and blood must not be allowed to pass through them. Cf. *Resp.* 7, 473b1–5.

On account of our interpretation of the following sentence we put a full stop after στόμα.

5, 483b28: 'For, as if they were irrigation pipes, thin veins extend [in their view] alongside the veins from the large vein and the *artèria* past every rib' (καθάπερ σωλῆνας ἀποτείνειν γὰρ ἐκ τῶν πλαγίων <τῶν> φλεβῶν φλέβια λεπτὰ ἐκ τῆς μεγάλης φλέβος καὶ τῆς ἀρτηρίας παρ' ἑκάστην πλευράν).

J.F. Dobson has proposed to delete φλεβῶν. This is followed by A. Roselli 105 but not by W.S. Hett 503.

D. Holwerda has remarked by letter of October 17, 2005 that the plural σωλῆνας does not have anything with which it corresponds in the preceding sentence. He therefore proposes to start a new sentence after στόμα in 483b28. It is not an overriding objection that γάρ then comes in fourth position in the sentence. Cf. *Eth. Nic.* VIII 14, 1163b11. In his view, moreover, a τῶν has dropped out before φλεβῶν.

Aristotle is also familiar with a 'large vein' (the hollow vein or *vena cava*)—*H.A.* III 3, 513b14. In this context he also talks about the *artèria* (513b24). But the reference there is clearly to the wind-pipe. He also talks there about veins which branch out from the large vein 'past every rib' (παρὰ τε τὴν πλευρὰν ἑκάστην φλέβια—513b29). As far as this is concerned, the reference by J. Tricot 186 n. 4 is correct. But he should have added that, for Aristotle, no *artèriai* are found there. As in 5, 483a18–22, we are dealing here with the position rejected by Aristotle.

5, 483b28: 'as if they were irrigation pipes' (καθάπερ σωλῆνας).

The term σωλῆνας refers to shellfish with double, elongated shells. Cf. *H.A.* IV 4, 528a17; *P.A.* IV 7, 683b14–17. Irrigation watercourses are still made in mediterranean countries from gutter-shaped tiles which are laid on top of each other to form a kind of pipe. In his *Tim.* Plato regularly uses the term ὀχετοί: 70d2; 77c7; 78c8; 79a2. He never uses the term σωλῆνες. He does have 'perforated from inside with holes as of a sponge' (σήραγγας...οἷον σπόγγου κατατετρημένας) *Tim.* 70c6 and in 79a4: 'as through a pipeline' (ὥσπερ αὐλῶνος).

5, 483b30: 'and the *artèriai* and the veins lie side by side' (καὶ ἀρτηρίαν καὶ φλέβα παρακεῖσθαι).

In *Resp.* 21, 480b6 Aristotle has the more correct view that the lungs are full of veins running alongside the alveoli, for an intensive refrigeration of the blood: '(the inhaled air) enters numerous alveoli like pipelines, and veins run alongside each of them' (εἰς πολλοὺς γὰρ οἷον αὐλῶνας τὰς σύριγγας ἐμπίπτειν τὰς ἐν τῷ πνεύμονι, ὧν παρ' ἑκάστην παρατέτανται φλέβες).

5, 483b31: 'Moreover, the bones are attached to the sinews and the veins by being joined in the middle and in the connections of the head of the bones, and they [the bones] thus take in food from the veins' (καὶ τὰ ὀστέα δὲ καθάπτειν τὰ νεῦρα καὶ τὰς φλέβας καὶ εἰς μέσα καὶ εἰς τὰς συμβολὰς τῶν κεφαλῶν δι' ὧν τὴν τροφὴν δέχεσθαι).

Unlike all modern editors, we read a full stop after δέχεσθαι. This is followed by a new theme regarding fish.

A striking feature here is the uncontracted form of ὀστέα. Cf. 7, 484b28: ὀστᾶ.

J.F. Dobson: 'The sinews and veins form the connexion between the bones, joining them with the centre of the body, and also form the meeting-place between the head and the body through which fishes receive nutriment and breathe.' The *Revised Oxford Translation* (1984) I 769 still has exactly the same nonsense. W.S. Hett 503: 'The bones, too, are connected by sinews and veins, but to the middle parts and to the junction of the head, through which fishes admit food and breathe,' is more comprehensible, but also untenable. P. Gohlke 167: 'Weiter ist noch zu zeigen, dass die Knochen mit den Sehnen und den Blutadern in Verbindung stehen, sowohl in der Mitte als auch an den Knochenköpfen', with the note on p. 197: 'Die Infinitive, die sich von hier an häufen, muss man sich abhängig denken von einer an sich selbst gerichteten Aufforderung des noch planenden Verfassers.' A. Roselli 138 places inverted commas around this passage. She sees it as representing the view of the opponents. J. Tricot 186 has: 'Les nerfs et les veines opèrent la connexion des os entre eux, ainsi qu'au centre du corps, et aux jointures de la tête par où les poissons reçoivent la nourriture et la respiration.'

We should take 6, 484a16–17 into account here: 'because the sinews are nourished from the bones. For they are attached to them' (τὰ νεῦρα ἀπὸ τῶν ὀστῶν τρέφεσθαι· καθάπτει γὰρ αὐτά). J.F. Dobson has here: 'for they join the bones together'; P. Gohlke 168: 'mit denen sie

wesensgleich sind' (Gohlke seems to translate the reading καθάπερ, but fails to mention this anywhere).

The primary question is what the subject and what the object is of καθάπτειν. H. Bonitz, *Index* 354a50 notes that καθάπτειν is transitive here, whereas καθάπτειν εἰς and καθάπτειν πρός in *H.A.* III 4, 514b30 and 515a3 are intransitive. In that case the bones must be subject and the sinews object.

A. Roselli 106 assumes a lacuna after κεφαλῶν in 483b32. But the words 'and they [the bones] thus take in food' (δι' ὧν τὴν τροφὴν δέχεσθαι) seem to return in 6, 484a16: 'because the sinews are nourished from the bones' (τῷ τὰ νεῦρα ἀπὸ τῶν ὀστῶν τρέφεσθαι).

On the basis of *H.A.* III 4, 514b28–30 we can establish that, according to Aristotle too, there is a connection between the veins and the bones. We will have to assume, as regards the question in *Spir.* 5, that Aristotle's opponents there assume a conjunction of veins and *artèriai.* But for Aristotle the venous system is clearly separate from the respiratory system.

For συμβολαί, cf. *De audibilibus* 802b16: τὰς συμβολὰς...τὰς τῶν νεύρων—'the joinings of the strings' (W.S. Hett 67). Cf. Pl. *Tim.* 74e4: κατὰ τὰς συμβολὰς τῶν ὀστῶν—'the places where the bones come together'.

τῶν κεφαλῶν—must metaphorically mean 'the heads' of bones, as P. Gohlke surmised (not mentioned by H. Bonitz, *Index* 387a50) and not the head of a living creature, as Dobson, Hett, and Tricot thought.

Cf. *H.A.* I 15, 494a4: 'Of this limb the double-knobbed part is the thigh, the sliding part is the knee-cap' (σκέλους δὲ τὸ μὲν ἀμφικέφαλον μηρός, τὸ δὲ πλανησίεδρον μύλη). Aristotle also talks about the 'head' (top) of testicles—*H.A.* III 1, 510a12–21.

5, 483b34: 'Fishes also breathe [in their opinion]' (Τοὺς ἰχθύας καὶ ἀναπνεῖν).

This sentence, though very abrupt, can be understood as a separate and independent statement. That fishes also breathe was argued by Democritus, Anaxagoras, and Diogenes of Apollonia. Their position is very critically discussed in *Resp.* 2 and 3. In 3, 471b15–19 Aristotle also states that, in the view of Diogenes, fishes which are taken out of the water die *as a result of a surplus of air*!

That fishes breathe, however, is also a proposition in Pl. *Tim.* 92a7–b6: 'But the fourth kind, which lives in the water, is formed from the most utterly foolish and undeveloped. The transfigurers thought these

creatures unworthy even to inhale pure air:... Instead of light and pure inhalation of air, the makers condemned them to inhale the muddy water of the depths' (τὸ δὲ τέταρτον γένος ἔνυδρον γέγονεν ἐκ τῶν μάλιστα ἀνοητοτάτων..., οὓς οὐδ' ἀναπνοῆς καθαρᾶς ἔτι ἠξίωσαν οἱ μεταπλάττοντες... ἀλλ' ἀντὶ λεπτῆς καὶ καθαρᾶς ἀναπνοῆς ἀέρος εἰς ὕδατος θολερὰν καὶ βαθεῖαν ἔωσαν ἀνάπνευσιν). This passage underlines Aristotle's criticism in 2, 482a21, where, starting from his own position, he declares that fishes do not breathe and that there is no air to inhale under water.

It is a moot point whether the view that fishes possess respiration was still argued by anybody after Aristotle's refutation! In any case the Gnostic Basilides was already better informed (in Hippolytus, *Refutatio omnium haeresium* VII 22, 13).

This sentence, too, clearly represents the views of Aristotle's opponents, as A. Roselli 138 well indicates.

5, 483b35: 'The veins and the *artèriai* are connected with each other, and in their view this can be established by perception too' (τὰς δὲ φλέβας καὶ τὰς ἀρτηρίας συνάπτειν εἰς ἀλλήλας καὶ τῇ αἰσθήσει φανερὸν εἶναι).

None of the modern translators makes it clear what the intention of this reference to perception may be. Perhaps the allusion is to the fact that veins and *artèriai* are both present throughout the skin (5, 483b15–19) or to the fact that the heat of *pneuma* is also present in the blood (5, 483b19–23). It may also be that the author is again referring to the dissection of dead people, as in 5, 483b24.

For συνάπτειν εἰς in an intransitive sense, cf. 5, 483b24–25.

5, 484a3: 'on account of the heat in the sinew, in the *artèria*, and in the vein, a heat which is hottest and most fiery in the sinew' (τῷ θερμὸν εἶναι ἐν νεύρῳ καὶ ἀρτηρίᾳ καὶ φλεβί, θερμότατον δὲ καὶ οἷον φλογωδέστατον τὸ ἐν τῷ νεύρῳ).

The mss. have φλεβωδέστατον. J.F. Dobson: 'because there is warmth both in sinew, in air-duct, and in vein, and that which is in the sinew is hottest and most similar to that of the veins.' Likewise W.S. Hett 503 and J. Tricot 186. P. Gohlke: 'da Wärme in Sehnen, Luft- und Blutadern erfordert wird, die grösste Wärme und die sozusagen am meisten durchblutete in den Sehnen.' A. Roselli 107 opts to replace φλεβωδέστατον with φλογωδέστατον, at the suggestion of D. Furlanus,

with reference to *Mirab.* 38, 833a17 and *Mund.* 2, 392a35. We have adopted this suggestion.

Cf. Pl. *Tim.* 79d1: 'In every living creature the internal parts which are close to blood and veins are the hottest: as if they contain a source of fire' (πᾶν ζῷον αὐτοῦ τἀντὸς περὶ τὸ αἷμα καὶ τὰς φλέβας θερμότατα ἔχει, οἷον ἐν ἑαυτῷ πηγήν τινα ἐνοῦσαν πυρός).

Objection 1

5, 484a5: 'Now this vital heat is not suited to the *artèria* as the location of the inhaled air, especially not if respiration exists for the purpose of refrigeration' (ἄτοπον οὖν τῇ τοῦ πνεύματος χώρᾳ τὸ θερμόν, ἄλλως τε καὶ καταψύξεως χάριν).

J.F. Dobson: 'Now the heat seems unsuited to the space where the breath is located, especially with a view to refrigeration'; likewise W.S. Hett 503; J. Tricot 186; A. Roselli 138. P. Gohlke 168 has: 'Dagegen wäre die Wärme für den Sitz der Lebensluft unangebracht, zumal wenn diese der Abkühlung dienen soll.'

This sentence poses a number of difficulties. The word οὖν suggests that a conclusion is drawn from the foregoing, which also talks about the vital heat. But no specific location of this heat is indicated there, but rather the entire visible body is identified as being pervaded by it. On the other hand we read in 2, 481b12 that the 'concoction' of the inhaled air was situated by 'Aristogenes' and his supporters in the lungs and in the *artèria*. In their view, this means not that an independent principle of heat is situated in the lungs, but that the inhaled air is heated by the *movement* of <the lungs> [ms D^1; most mss read τοῦ πνεύματος!]. We should therefore consider whether perhaps the same mistake has been made here and that our text has πνεύματος, whereas πνεύμονος is to be preferred.

Also, Plato in *Tim.* 70 c–d expressly mentions *the lungs* as a cushion that serves to cool the heart. Cf. *Tim.* 70d1: ψύχουσα, d5: ἀναψυχομένη and 78e5: ἀναψυχομένῳ. To identify the lungs as the location of the vital heat is to combine, as it were, a fridge and a central-heating boiler.

But we could also say that 484a3 has in any case mentioned the *artèria* too, and according to 'Aristogenes' the *artèria* was the only location containing *pneuma* (5, 483a12; a18). We could retain the reading πνεύματος, if we assume that Aristotle here is criticizing the combination of vital heat with *pneuma* in the *artèria*, because he knows that this

respiration also has a cooling function. According to Aristotle, it makes more sense to situate the vital heat, too, in the heart.

5, 484a6: 'But if the vital heat is the producing agent and kindles life, as it were, through heat, it would be possible' (εἰ δὲ ποιεῖ καὶ οἷον ἀναζωπυρεῖ θερμῷ τὸ θερμόν, γίγνοιτ' ἄν).

It is unclear here what the subject is of ποιεῖ καὶ ἀναζωπυρεῖ. J.F. Dobson suggests 'the living creature': 'but if the animal produces and as it were re-kindles the heat by heat from without, then there may well be heat there.' Likewise W.S. Hett 503, J. Tricot 186. P. Gohlke opts for 'Die Lebensluft'. A. Roselli 138 probably does too.

But we should also consider here that Aristotle in 2, 481b12–15 seemed to be saying that 'the movement of the air heats the inhaled air (, which is cold).'

Another possibility is that τὸ θερμόν is the subject of ποιεῖ καὶ ἀναζωπυρεῖ! In that case Aristotle casually introduces here his own concept of τὸ θερμὸν τὸ ἐργαζόμενον, which he sets out at length in chap. 9. We can compare the remark in 2, 481b4: 'If this is the case, the vital heat is probably the cause of concoction.' In that case the vital heat does not serve the purpose of cooling but the production of the new living creature. The brooding of eggs is a good example of this.

5, 484a7: 'and kindles life' (ἀναζωπυρεῖ).

According to H. Bonitz, *Index*, this verb occurs only here in the Corpus. But the idea is soundly Aristotelian. Cf. *Resp.* 8, 474b10–13 'nature has set it aglow' (ἡ φύσις ἐμπεπύρευκεν αὐτήν), and 16, 478a28: 'all animals by nature need refrigeration on account of the heat which ignites the soul in the heart' (καταψύξεως μὲν οὖν ὅλως ἡ τῶν ζῴων δεῖται ἡ φύσις διὰ τὴν ἐν τῇ καρδίᾳ τῆς ψυχῆς ἐμπύρευσιν). See also *Iuv.* 4, 469b6–17. The subject there is also the σύμφυτον θερμότητα φυσικήν (b7). And 'it works upon... and concocts all the food through the natural heat' (ἐργάζεται... καὶ πέττει τῷ φυσικῷ θερμῷ τὴν τροφὴν πάντα...) (b11); and τῆς ψυχῆς ἐμπεπυρευμένης ἐν τοῖς μορίοις τούτοις (i.e. the heart), in b15. There Aristotle even says explicitly that the soul is 'ignited' by the vital heat. Thus we can translate ἀναζωπυρεῖ in our text as 'to kindle life'. Cf. also *P.A.* III 7, 670a23–25: 'The heart and the liver are necessary for all animals. The heart is necessary because it is the origin of heat; for there must be a kind of hearth, in which the source of fire can reside; it needs to be well protected, because it forms, as it were, the citadel of the body' (Καρδία μὲν οὖν καὶ ἧπαρ

πᾶσιν ἀναγκαῖα τοῖς ζῴοις, ἡ μὲν διὰ τὴν τῆς θερμότητος ἀρχήν (δεῖ γὰρ εἶναί τινα οἷον ἑστίαν, ἐν ᾗ κείσεται τῆς φύσεως τὸ ζωπυροῦν, καὶ τοῦτο εὐφύλακτον, ὥσπερ ἀκρόπολις...).

Objection 2

5, 484a7: 'Moreover, what about the maintenance of all living creatures that possess this innate vital heat, if there is no opposite, nor anything that cools?' (ἔτι πάντων τῶν ἐχόντων θερμότητα σύμφυτον πῶς ἡ διαμονή μηδενὸς ἀντικειμένου μηδὲ καταψύχοντος;)

A soundly Aristotelian viewpoint is put forward here, presumably as a second objection to the view of others. W. Jaeger has therefore rightly turned the sentence into a question by reading πῶς. Neither J.F. Dobson nor W.S. Hett 503 has adopted this proposal. Hence Dobson arrives at a nonsensical translation: 'Besides this, permanence is in a sense natural to all things which have warmth, provided that nothing resists or cools it.' P. Gohlke 168 does accept Jaeger's reading. A. Roselli 138 correctly has: 'E ancora, come possono conservarsi tutti gli esseri dotati di calore naturale, se non c'è nulla che si opponga ad esso e che raffredi?' In that case the comma after διαμονή can be omitted.

The need for an opposing force against the vital heat, i.e. refrigeration by respiration or something analogous, is argued at length by Aristotle in *Resp.* 9–13. In *G.A.* II 1, 732b32 the lungs are called 'the limiter of the natural heat' (τῆς δὲ θερμότητος τῆς φυσικῆς ὅρος) for blooded animals.

For this problem of what is opposite to the vital heat, cf. also *Long.* 3, 465b1–32 and *Iuv.* 5, 469b26–6, 470b5.

5, 484a9: 'For it is clear, I think, that all living creatures need refrigeration' (ὅτι γὰρ πάντα δεῖται καταψύξεως, σχεδὸν φανερόν).

At the suggestion of D. Holwerda (October 17, 2005) we read a full stop after φανερόν. The connection with the next sentence is based on a conjecture by W. Jaeger. But after σχεδὸν, which H. Bonitz describes as '*modeste affirmantis*', we would not expect a new proof to be furnished.

5, 484a10: 'The blood [in their view] retains the vital heat in the veins and shelters it as it were' (Τὸ αἷμα κατέχειν ἐν τῇ φλεβὶ τὸ θερμὸν οἷον ἀποστέγον).

W. Jaeger has combined two different readings of the manuscripts, viz. τό and τῷ, into τῷ τό. But this is far from obvious.

5, 484a11: 'Hence it [the blood], when it flows out, also lets [the heat] go and the animal dies, because the liver has no *artèria*' (διὸ καὶ ὅταν ἐκρυῇ, μεθιέναι καὶ θνήσκειν †τῷ τὸ ἧπαρ οὐκ ἔχειν οὐδεμίαν ἀρτηρίαν†).

Cf. *H.A.* VII 10, 587a16: 'the embryo dies when the blood has flowed out' (ἀποθνήσκει τοῦ αἵματος ἐκρυέντος τὸ ἔμβρυον) and 587a19: 'often a baby seems to have been born dead, when... the blood has flowed out to the umbilical area' (πολλάκις δ' ἔδοξε τεθνεὸς τίκτεσθαι τὸ παιδίον ὅταν... τὸ αἷμα ἔξω εἰς τὸν ὀμφαλὸν καὶ τὸ πέριξ τύχῃ ἐξερρυηκός). Cf. also *H.A.* I 4, 489a20: 'moisture, and if the animal is deprived of the same... death ensues' (ὑγρότητα... ἧς στερισκόμενον... φθείρεται).

The subject of ἐκρυῇ is doubtless 'the blood'. Of θνήσκειν most probably 'the living creature'. J.F. Dobson translates: 'when the blood has flowed out it loses its heat, and the creature dies, through the liver having no air-duct.' W.S. Hett 505 corrects to some extent: 'So too when it flows out, the animal loses its heat and dies, because the liver has no air-duct.'

Aristotle is probably thinking of an arterial haemorrhage. This bleeding is fatal, because the vital heat, which is present in the blood (from the very first growth processes), also disappears.

The second half of the sentence is highly problematical. Because it mentions 'the liver', scholars have made various proposals linking up with the statement in our text that there are no *artèriai* in the liver, and that the liver therefore can only receive vital heat via the blood. Thus J.F. Dobson and J. Tricot 186. Perhaps we should delete τῷ here and see the end of the sentence as an independent statement about the liver.

In *P.A.* III 4, 666a28 Aristotle says of the liver: 'Nor does it have a receptacle for blood like the heart: as in the other viscera, it is contained in a vein. Moreover, a vein extends through it...' Cf. *H.A.* I 17, 496b16–34 with 496b29: 'Again, the liver is attached to the great vein, but it has no communication with the aorta' (προσπέφυκε δὲ τῇ μεγάλῃ φλεβὶ τὸ ἧπαρ, τῇ δ' ἀορτῇ οὐ κοινωνεῖ). However, the manuscript reading here is: 'it has no communication with the *artèria*! (The same textproblem in *H.A.* III 1, 510a30). These textproblems were brought to our attention by Patrick MacFarlane.

Pl. *Tim.* 71 ff. describes the liver, but says only of the spleen that it is 'hollow and bloodless' (72d1). According to *Tim.* 71b3, 'the power of thoughts which come from the mind' do reach the liver.

CHAPTER SIX

[Problems relating to the nutrition of bones, sinews, and the flesh of living creatures]

6, 484a14: 'Does the semen pass through the *artèria* and is it also compressed, and does this happen only in emission?' (Πότερον δὲ τὸ σπέρμα διὰ τῆς ἀρτηρίας ὡς καὶ συνθλιβόμενον, καὶ ἐν τῇ προέσει μόνον;)

J.F. Dobson translates: 'Does the seed pass through the air-duct? Is its passage due also to pressure, and does it take place only in process of emission?,' adding in a note: 'There seems to be no connexion between this and what has gone before; we must assume a lacuna,' as W. Jaeger had also remarked in his critical apparatus. P. Gohlke 168: 'Geht der Same durch die Luftader, um dort zusammengepresst zu werden und erst im Erguss sich zu entfalten?' He notes on p. 197: 'Der erste Satz des Kapitels ist eine einzeln stehende Notiz.' A. Roselli 108 indicates a lacuna after this sentence.

We must concede to the translators that the question is very unexpected. There is nevertheless a possible connection in the fact that the preceding sentence talks about the *artèria*.

This passage, at the beginning of chap. 6, is again evidence that the term *artèria* belongs to the system of Aristotle's opponents.

The author now seems to raise a question connected with this subject. Does the movement of the vital breath in the *artèria*, as the source of all vital processes, perhaps also explain the production of semen, and in particular its emission? It is worth considering that Plato in the *Tim.* also connects the respiratory process with the distribution of the 'life-generating marrow': 77d2: 'They placed the seminal marrow between them, in order that it might thrive best. Moreover, the flow to the other parts would pass off smoothly from there..., which was to effect a regular irrigation' (καὶ τὸν γόνιμον μεταξὺ λαβόντες μυελόν, ἵνα οὗτός τε ὅτι μάλιστα θάλλοι, καὶ ἐπὶ τἆλλα εὔρους ἔντευθεν... παρέχοι τὴν ὑδρείαν ὁμαλήν). Cf. 73b2 ff. But even more explicitly in 91a4: 'In the channel which receives the drink that ends up in the bladder via the lungs under the kidneys, and which partly by pressure of the air discharges the drink, the gods drilled a hole to the marrow' (τὴν τοῦ ποτοῦ διέξοδον, ᾗ διὰ τοῦ πλεύμονος τὸ πῶμα ὑπὸ τοὺς νεφροὺς

εἰς τὴν κύστιν ἐλθὸν καὶ τῷ πνεύματι θλιφθὲν συνεκπέμπει δεχομένη, συνέτρησαν) and 91b2: 'Because it is ensouled and finds an outlet here, it has created, in the part by which it can escape, a lively desire for emission and has thus produced an urge to procreate' (ὁ δὲ, ἅτ' ἔμψυχος ὢν καὶ λαβὼν ἀναπνοήν, τοῦθ' ᾗπερ ἀνέπνευσεν,... τοῦ γεννᾶν ἔρωτα ἀπετέλεσεν). In *G.A.* II 4, 737b29–30 Aristotle states that the semen goes to its appropriate place 'without the exertion of any force from the breath' (οὐθὲν ἀποβιαζομένου τοῦ πνεύματος). Here and in b32 *pneuma* clearly means 'breath'. And this could be criticism of the passage in Pl. *Tim.*

σύνθλιψις seems to derive from the philosophy of Democritus. Cf. *Resp.* 4, 471b30–472b5, which sets out his theory of respiration. According to this theory, inhalation is a means by which a living creature withstands the 'pressure' (σύνθλιψις) which the atmosphere exerts on the small, circular soul-atoms. Owing to this pressure, the soul-atoms leave the living creature unless inhalation provides counter-pressure: 'Democritus states that respiration serves a certain purpose in animals that respire; he alleges that it prevents the soul from being crushed out' (transl. W.S. Hett) (Δημόκριτος δ' ὅτι μὲν ἐκ τῆς ἀναπνοῆς συμβαίνει τι τοῖς ἀναπνέουσι λέγει, φάσκων κωλύειν ἐκθλίβεσθαι τὴν ψυχήν). Cf. also 472a5: 'So he contends that when these particles are being separated out by the pressure of the surrounding air, breathing intervenes to help them' (ἐκκρινομένων οὖν αὐτῶν ὑπὸ τοῦ περιέχοντος ἐκθλίβοντος, βοήθειαν γίνεσθαι τὴν ἀναπνοήν φησιν—text W.D. Ross 1955). 472a12: 'relieving the pressure prevents the soul which is in the animal from passing out' (ἀνείργοντα τὴν θλίψιν κωλύειν τὴν ἐνοῦσαν ἐν τοῖς ζῴοις διιέναι ψυχήν). 472a9: 'the pressure of the surrounding air' (τὸ περιέχον συνθλῖβον). 472a15: 'owing to the pressure of the surrounding air' (ἐκ τῆς τοῦ περιέχοντος ἐκθλίψεως). 472a25; 472b1: 'to check the compression' (κωλύειν τὴν σύνθλιψιν). Plato has θλίβω only in *Tim.* 60c4 and 91a6, and συνθλίβω only in *Tim.* 92a1.

6, 484a15: 'emission' (πρόεσις).

This is a term which Aristotle often uses to designate the discharge of semen, urine, menstrual fluid etc. Cf. *G.A.* I 20, 728b15; 728a10: 'the fact that not only semen is discharged, but also *pneuma*, which brings about the emission by compressing itself' (τοῦ σπέρματος προϊεμένου... ἀλλὰ καὶ πνεύματος... ἀποσπερματίζει). IV 1, 765b20; 8, 776b27–28.

6, 484a16: 'So the <bones> also show the change from blood' (ἐν οἷς δὴ φαίνεται καὶ ἡ ἐξ αἵματος μεταβολή).

W. Jaeger remarked that this sentence has no connection with the previous one. J.F. Dobson and A. Roselli 109 assume a lacuna between μόνον and ἐν οἷς.

According to Aristotle, however, semen is a high-quality residue of the concoction of blood, and as such an example of the 'change from blood'. Cf. *Resp.* 20, 479b29 for this expression. But for Aristotle's opponents semen is produced by the fertilizing marrow and does not result from the transformation of blood.

According to Aristotle, bones and sinews, too, are parts of the visible body which are not simply nourished by blood, but are formed from residues: cf. *G.A.* II 6, 744b22: 'in this way nature forms from the purest matter the flesh... and from the residues bones, sinews' (ἡ φύσις ἐκ μὲν τῆς καθαρωτάτης ὕλης σάρκας..., ἐκ δὲ τῶν περιττωμάτων ὀστᾶ καὶ νεῦρα).

An attempt to make sense of this sentence would be to read ἐν <ὀστ>οῖς δὴ. The author thus takes up a new subject, to which he devotes a large part of chap. 6 and chap. 7.

6, 484a17: 'because the sinews are nourished from the bones' (τῷ τὰ νεῦρα ἀπὸ τῶν ὀστῶν τρέφεσθαι).

In 3, 482b7 it had been said that the flow of nutrition from the *artèria* 'is also distributed to the bones' (καὶ εἰς τὸ ὀστοῦν διαδίδοται). 5, 483b33 talked about the nutrition of the *bones* from the veins. Cf. Pl. *Tim.* 74d2: 'He made the nature of the sinews from a mixture of bone and unfermented flesh' (τὴν δὲ τῶν νεύρων φύσιν ἐξ ὀστοῦ καὶ σαρκὸς ἀζύμου).

Perhaps τρέφεσθαι means: 'owe their formation'. Cf. *H.A.* III 5, 515b17: 'the sinews are nourished by this, and we can see them being formed out of it' (ᾗ τρέφεται καὶ ἐξ ἧς γινόμενα φαίνεται (τὰ νεῦρα)). Aristotle's interest in nutritive processes derives from his concentration in this work on the *anima vegetativa.*

6, 484a17: 'For they are attached to them' (καθάπτει γὰρ αὐτά).

See earlier 5, 483b31: 'Moreover, the bones are attached to the sinews and the veins' (καὶ τὰ ὀστέα δὲ καθάπτειν τὰ νεῦρα καὶ τὰς φλέβας). According to H. Bonitz, these are the only two examples of a transitive use of καθάπτειν in the Corpus.

Objection

6, 484a17–18: 'For there are sinews in the heart too' (καὶ γὰρ ἐν τῇ καρδίᾳ νεῦρον).

The sinews in the heart do not have any contact with bones and so cannot receive their nutrition from the bones. The importance of this conclusion emerges in 8, 485a7–8. See the commentary there.

Cf. *H.A.* III 5, 515a27: 'The sinews of animals are arranged as follows. Their starting-point, like that of the blood vessels, is the heart: the heart has sinews within itself, in the largest cavity, and the aorta, as it is called, is a sinewy blood vessel' (Τὰ δὲ νεῦρα τοῖς ζώοις ἔχει τόνδε τὸν τρόπον. Ἡ μὲν ἀρχὴ καὶ τούτων ἐστὶν ἀπὸ τῆς καρδίας· καὶ γὰρ ἐν αὐτῇ ἡ καρδία ἔχει νεῦρα ἐν τῇ μεγίστῃ κοιλίᾳ καὶ ἡ καλουμένη ἀορτὴ νευρώδης ἐστὶ φλέψ) and *G.A.* V 7, 787b15: 'bulls are the most sinewy, their heart too' (μάλιστα δ' οἱ ταῦροι νευρώδεις, καὶ ἡ καρδία).

It remains unclear why the heart and the aorta possess sinews. But we can be fairly sure of Aristotle's opinion that, in this way, the *pneuma* in the heart can act directly on the sinews, which effect movement.

6, 484a20: 'But this means nothing. For the food for the sinews could still come from the bone. But would the food for these bones themselves rather come from the sinews?' (ἢ τοῦτο γ' οὐδὲν· εἴη γὰρ ἂν οὐθὲν ἧττον ἀπὸ τοῦ ὀστοῦ ἡ τροφή. αὐτοῖς δ' ἀπὸ τοῦ νεύρου τοῖς ὀστοῖς μᾶλλον τὴν τροφήν;)

A problem here is how the parts of this passage are to be divided and whether the text requires correction.

J.F. Dobson: 'Or does this amount to nothing, and would those which connect the bones be nourished by the bones? But we might say, that rather the bones themselves get their nutriment from the sinew.' He and J. Tricot 187 turn the sentence εἴη... τροφή into a question. W. Jaeger has an ordinary full stop after τροφή. P. Gohlke 169 also reads a full stop there and goes on to translate: 'Man sollte jedoch eher annehmen, dass die Knochen durch die Sehnen ernährt würden.' However, A. Roselli 109 reads τροφὴ αὐτοῖς and then replaces δ' with ἢ, as the beginning of a question.

The best solution, it seems to us, is to retain Jaeger's text, but to add a question mark after τὴν τροφήν.

6, 484a22: 'For this is strange too' (ἄτοπον γὰρ καὶ τοῦτο).

'For' is curious as a reaction to Aristotle's own suggestion. This is possible only if we can take 'for' to indicate the reason why Aristotle makes his suggestion. It is more natural to assume that Aristotle calls bones rather than sinews 'dry' in 484a22.

6, 484a22: 'For bone is by nature dry and has no passages for liquid' (ξηρὸν <γὰρ> φύσει καὶ οὐκ ἔχον πόρους ὑγροῦ).

The mss have ὑγρούς here. Likewise W. Jaeger. J.F. Dobson proposes to read ὑγροῦ.

J.F. Dobson, W.S. Hett 505, J. Tricot 187, and P. Gohlke 169 relate this to the bones. But A. Roselli 139 has: 'infatti il *neuron* è secco e non ha canali per i liquidi.'

6, 484a23: 'and food is liquid' (ἡ τροφὴ δ' ὑγρόν).

Cf. *PA.* II 2, 647b25: 'Other parts which are moist serve to nourish the heterogeneous parts: for they all owe their growth to moisture' (τὰ δὲ τροφὴ τούτοις τῶν ὑγρῶν ἐστί (παντὰ γὰρ ἐξ ὑγροῦ λαμβάνει τὴν αὔξησιν)).

6, 484a25: 'In many bones these passages are clearly visible, particularly those leading to the spine' (καὶ ἐν πολλοῖς μὲν εὔδηλοι, μάλιστα δ' εἰς τὴν ῥάχιν).

Aristotle probably discovered this visibility while dissecting corpses. Cf. *H.A.* III 3, 513a20: 'and this one some call the aorta, because even in dead bodies they have observed the sinewy part of it' (ἣν καλοῦσί τινες ἀορτὴν ἐκ τοῦ τεθεᾶσθαι καὶ ἐν τοῖς τεθνεῶσι τὸ νευρῶδες αὐτῆς μόριον).

The subject here must be πόροι. As regards the blood vessels, Aristotle also believes that 'there run small blood vessels along each rib and to each vertebra' (τείνουσι παρά τε τὴν πλευρὰν ἑκάστην φλέβια καὶ πρὸς ἕκαστον τὸν σφόνδυλον)—*H.A.* III 3, 513b29. But he certainly does not hold this view for the *artèria*.

6, 484a26: 'But [in their view] the veins and *artèriai* leading from the bones form a continuous whole, for instance along the ribs' (τὰς δ' ἀπὸ τῶν ὀστῶν γίνεσθαι συνεχεῖς, ὥσπερ ταῖς πλευραῖς).

Whereas the preceding passage seemed to deal with πόροι in the veins and the *artèriai*, Aristotle now seems to switch to 'the veins and

artèriai'. But J.F. Dobson has proposed to read τοὺς δὲ. This is accepted by W.S. Hett 504 and J. Tricot 187, but not by A. Roselli 110. The next sentence talks once again about τούτους (a27). The πόροι themselves are of course (small) veins and *artèriai* too.

In our view, this sentence should be read in conjunction with 3, 482a35, which talked about the unity of the system of blood vessels and air-ducts, and with 5, 483b30, which said that branches of the aorta and the *artèriai* run along every rib. The continuity of the vessels makes it impossible for them to end in the bones. In Aristotle πλευραί often stands for 'the sides'. Here, as in 5, 483b30, 7, 484b17 and b18, it stands for 'ribs'.

6, 484a27: 'But in what way do these passages receive their food from the belly, or how does the drawing-in take place?' (τούτους δ' ἀπὸ τῆς κοιλίας τίνα τρόπον, ἢ πῶς τῆς ὁλκῆς γινομένης;)

Cf. 6, 484b4: 'Moreover, how and and through what passages does transport from the belly take place?' (ἔτι δὲ ποία καὶ διὰ τίνων ἡ ἐκ τῆς κοιλίας δίοδος;) The author again switches here from τὰς δ' to τούτους. J.F. Dobson translates 'these ducts' (*poroi*). Likewise W.S. Hett 505. J. Tricot 187: 'ces canalisations'. P. Gohlke 169 reads a statement rather than a question: 'Diese werden dann aus dem Magen irgendwie gespeist oder wie sonst die Nahrung aufgesogen wird.' A. Roselli 139: 'questi canali'.

6, 484a29: 'not elastic (cartilaginous)' (ἄχονδρα).

Only here in the Corpus. Elsewhere Aristotle does use the terms ὑποχόνδριον, χονδρῶδες, χονδρός. Cf. *PA.* III 3, 664a35: ἐκ χονδρώδους σώματος: 'out of cartilage' and II 9, 655a23–655b2.

The apparent purpose of this argument is to show that bones cannot in any way have a drawing function. Every form of attraction/drawing is seen by Aristotle as resulting from the effect of the sinews guided by *pneuma*—*M.A.* 10, 703a4 ff. Cf. G.L. Duprat (1898) 310–311.

6, 484a29: 'But it does not serve the purpose of movement either' (ἀλλ' οὔτοι πρὸς τὴν κίνησιν).

The author of *Spir.* seems to to be suggesting here that, according to his opponents, the function of movement is made possible by nutrition with *pneuma* from the *artèriai*. To refute this position, he will expand on the nature and function of bones in chaps. 7 and 8 and emphasize that not bones but sinews effect movement.

6, 484a32: 'But *we* say that a sinew is nourished by the sticky fluid which surrounds it' (ἡμεῖς δέ φαμεν ἐκ τῆς ὑγρότητος γλίσχρας οὔσης τῆς περὶ [τὸ] αὐτό).

Cf. *G.C.* II 1, 329a24: 'But we say that there is an underlying matter of the visible bodies' (Ἡμεῖς δὲ φαμὲν μὲν εἶναι τινα ὕλην τῶν σωμάτων τῶν αἰσθητῶν). Here speaks the head of a school who is clearly aware of his strong position. However, the head is not Erasistratus, as A. Roselli 111 thinks, but the author of *H.A.* III 5, 515b16: 'Round the sinews a mucous liquid is formed, which is white and sticky; the sinews are nourished by this and we can see them being formed out of it' (transl. by D'Arcy W. Thompson) (Ὑγρότης δὲ περὶ αὐτὰ [τὰ νεῦρα] μυξώδης γίνεται, λευκὴ καὶ κολλώδης, ᾗ τρέφεται καὶ ἐξ ἧς γινόμενα φαίνεται). Cf. 7, 485a2. See also *G.A.* II 3, 737a36-b3: 'All bodies are kept together by a certain elasticity. When animals grow older and larger, sinews also acquire this elastic nature and these keep the parts of the animals together: in some animals it is the sinews, in others their analogue' (πάντα δὲ τὰ σώματα συνέχει τὸ γλίσχρον· ὅπερ καὶ προϊοῦσι καὶ μείζοσι γιγνομένοις ἡ τοῦ νεύρου λαμβάνει φύσις ἥπερ συνέχει τὰ μόρια τῶν ζῴων, ἐν μὲν τοῖς οὖσα νεῦρον ἐν δὲ τοῖς τὸ ἀνάλογον). This passage is put between square brackets by A.L. Peck (1942) and H.J. Drossaart Lulofs (1965) as being foreign to this context.

6, 484a33: 'And whence and how this fluid arises is yet to be discussed' (πόθεν δ' αὐτὴ καὶ πῶς, λεκτέον).

None of the modern translators indicates whether this intention is followed up. Yet we can certainly assume a relationship with 7, 485a1: 'For what fastens them together is serum and mucous fluid' (καὶ γὰρ ἡ πρὸς ἄλληλα κόλλησις ἰχώρ ἐστι καὶ ὑγρότης μυξώδης) as the connection between bones. This also implies that the nutrient is 'blood', but blood that has not been fully concocted.

Objection

6, 484a34: 'because blood issues from any point where it is pricked' (ὅτι πανταχόθεν αἷμα τῇ κεντήσει).

Cf. 5, 483b16: 'for when the skin is pricked, it emits blood' ([τὸ δὲ δέρμα] ἐκ φλεβὸς μὲν ὅτι κεντηθὲν αἷμα ἀναδίδωσιν).

The underlying idea is that blood keeps moving in the living creature owing to pressure from the respiratory process. Hence this phenomenon is an argument for the pervasive presence of both veins and *artèriai*.

6, 484a36: 'But this is a specific feature of full-blooded animals' (τῶν πολυαίμων τοῦτ' ἴδιον).

This does not include birds. Cf. *H.A.* III 19, 520b27: 'Of blooded animals, those which are both internally and externally viviparous have more blood than the blooded ovipara' (Ἔστι δὲ τῶν ἐναίμων ταῦτα πολυαιμότερα ἃ καὶ ἐν αὑτοῖς καὶ ἔξω ζῳοτοκεῖ τῶν ἐναίμων μὲν ᾠοτοκούντων δέ).

6, 484a38: 'serum issues, not blood' (ἰχώρ, οὐχ αἷμα).

Cf. *H.A.* III 19, 521a12: 'If it becomes too fluid, they fall ill, because the blood becomes like serum' (Ἐξυγραινομένου [sc. τοῦ αἵματος] λίαν νοσοῦσιν· γίνεται γὰρ ἰχωροειδές) and a17: 'Blood is formed by a process of concoction from serum, and likewise fat from blood' (Γίνεται δὲ πεττόμενον ἐξ ἰχῶρος μὲν αἷμα, ἐξ αἵματος δὲ πιμελή), 521b2: 'Serum is blood that has not been (sufficiently) concocted' (ἰχὼρ δ' ἐστὶν ἄπεπτον αἷμα). Cf. 8, 485a1 and *H.A.* III 2, 511b2: 'blood and veins, and also their analogues, serum and fibres' (τὸ αἷμα καὶ... φλέβες... ἔπειτα δὲ τὸ ἀνάλογον τούτοις, ἰχὼρ καὶ ἶνες).

6, 484a38: 'But Empedocles assumes that nails are formed from sinews, by a process of hardening' (Ἐμπεδοκλῆς δὲ ἐκ νεύρου τὸν ὄνυχα τῇ πήξει).

Cf. Empedocles, Diels—Kranz 31 A 78 = Aetius V 21, 1: 'the nails of animals were formed from sinews, when they came together with air and were cooled' (τοὺς δὲ ὄνυχας τοῖς ζῴοις γεννᾶσθαι τῶν νεύρων καθ' ὃ τῷ ἀέρι συνέτυχε περιψυχθέντων). So the 'process of hardening' is said to occur when the external parts of the visible body are cooled. The question which Aristotle connects with this in *Spir.* 6, 484b1: 'Is the relation of skin to flesh the same?' pursues this train of thought. The difference between flesh and skin is also to be explained as a result of cooling and hardening.

Cf. by way of contrast *P.A.* II 9, 655b2: 'The following parts feel almost like bones: nails, hooves, claws, horns, and the beaks of birds' (σύνεγγυς δὲ κατὰ τὴν ἁφὴν ἐστι τοῖς ὀστοῖς καὶ τὰ τοιάδε τῶν μορίων οἷον ὄνυχές τε καὶ ὁπλαὶ καὶ χηλαὶ καὶ κέρατα καὶ ῥύγχη τὰ τῶν ὀρνίθων).

Objection

6, 484b1: 'But how is it possible for shellfish and crustaceans...' (ἀλλὰ τοῖς ὀστρακοδέρμοις καὶ μαλακοστράκοις).

Here, as at the end of chap. 2 (482a7–27), Aristotle discusses the group of animals not possessing a respiratory system. Again it is important to notice the order in which the subject is treated: 5, 483b1–3: insects; 5, 483a33–34: fishes; and here shellfish and crustaceans.

For the description of these kinds, cf. *H.A.* IV 1, 523b5–8: 'These have their hard part on the outside, and the soft fleshy part inside. This hard substance cannot be broken by a clean crack; it has to be crushed' (transl. by A.L. Peck) (ταῦτα δ' ἐστὶν ὅσων ἐκτὸς τὸ στερεόν, ἐντὸς δὲ τὸ μαλακὸν καὶ σαρκῶδες· τὸ δὲ σκληρὸν αὐτῶν ἐστιν οὐ θραυστὸν ἀλλὰ θλαστόν) and 523b8–12.

6, 484b2: 'how is it possible...that nutrition takes place from outside by means of respiration? It seems on the contrary that it takes place from inside rather than outside' (πῶς ἀπὸ τῶν ἐκτὸς ἡ τροφή; τοὐναντίον γὰρ δοκεῖ μᾶλλον ἀπὸ τῶν ἐντὸς ἢ τῶν ἐκτός).

J.F. Dobson translates the words soundly enough, but it is unclear what meaning he assigns to them: 'But how can hard and soft-shelled creatures get their nutriment from outside? On the contrary it seems that they get it from inside rather than out.' Likewise W.S. Hett 507; P. Gohlke 170; J. Tricot 188. But the latter notes by way of explanation: 'Rappelons qu'il s'agit de la nourriture des nerfs.'

A. Roselli 112–113 does not agree with him. In her view, the author wants to underline that the theory of nutrition centring on respiration cannot be applied to animals without respiration.

The issue here being how various parts of living creatures get their nutrition, Aristotle's criticism is likely to relate to the fact that, for the distribution of food throughout the living creature, his opponents attach crucial significance to respiration and the introduction of *pneuma* from outside.

Objection

6, 484b4–5: 'Moreover, how and through what passages does transport from the belly take place? And, next, how do they bend back to the flesh?' (ἔτι δὲ ποία καὶ διὰ τίνων ἡ ἐκ τῆς κοιλίας δίοδος; καὶ πάλιν ἡ ἐκείνων ἀναστροφὴ πρὸς τὴν σάρκα;)

J.F. Dobson has here: 'Again, how and by what course does the passage of foods from the belly take place, and again their return into the form of flesh...' Likewise W.S. Hett 507; P. Gohlke 170; J. Tricot 188.

Apparently the plural 'foods' in Dobson and Hett is meant to do justice to ἐκείνων. But ἐκείνων here must refer to the passages for food *and* the vital breath, which are distributed together throughout the living creature according to the theory of Aristotle's opponents.

It might seem that 5, 483a18–22 had already answered the question διὰ τίνων asked here: there is a passage along the loins. But the question here relates to the 'transport from the belly' (ἡ ἐκ τῆς κοιλίας δίοδος).

6, 484b7: 'Is this then food for some animals and something else for others, and is the blood not food for all? But the other parts are nourished from it' (ἆρα γε ἄλλοις ἄλλη τροφὴ καὶ οὐ πᾶσι τροφὴ τὸ αἷμα; πλὴν ἐκ τούτου τἆλλα).

J.F. Dobson has: 'Do different things, then, have different nutriment, not all things being nourished by the blood except indirectly?' W.S. Hett 507 translates the final words as: 'and it is not blood in all cases; and yet the other forms are derived from blood.' P. Gohlke 170 is striking: 'Haben die einzelnen Glieder ihre besondere Nahrung und doch nicht alle aus dem Blute? Vielleicht entstehen die andern Nährstoffe nur aus dem Blute.' But in that case the text would have to read ἐκ τούτου αἱ ἄλλαι.

J. Tricot 188 is different again: 'La nourriture est donc, de toute façon, différente pour des êtres différents, et le sang n'est pas une nourriture universelle, sinon indirectement.' A. Roselli 139 also has: 'diverso in animali diversi'. But she translates the final words as: 'ma da qui scaturiscono le altre considerazioni che si sono gia fatte.'

The conclusion here is similar to the one at the end of chap. 2, 482a24–25: 'so that the method is either not the same for all, or the other living creatures with respiration are also nourished and increase by means of ordinary food.' (ὡς οὐχ ὁμοίως πᾶσιν, ἢ κἀκεῖνα διὰ τὴν τροφῆς). See also 2, 482a10–11 and 8, 485a11–12 (with commentary).

Aristoteles had already said in 1, 481a12: 'blood is food in its last phase, which is the same for all living creatures' (τὸ γὰρ αἷμα ἡ ἐσχάτη τροφὴ καὶ ἡ αὐτὴ πᾶσιν).

With regard to chap. 6 we must conclude that the transitions in the author's train of thought are the hardest to grasp here. It is unclear how many of the questions which remain open are due to the text's poor condition.

CHAPTER SEVEN

[The various functions of the bones]

7, 484b9: 'We therefore need to consider whether bones...' (Τὴν τῶν ὀστῶν φύσιν ἄρα σκεπτέον).

Cf. *P.A.* II 9, 654a32: 'The nature of bones and that of veins are similar' ('Εχει δ' ὁμοίως ἥ τε τῶν ὀστῶν καὶ ἡ τῶν φλεβῶν φύσις). Why does this subject have to be discussed now? It seems rather capricious. The previous chapter seemed mainly concerned with how bones and sinews are nourished. The opponents appeared to argue that the bones are nourished directly from the *artèriai* and the blood vessels, with the suggestion that this is necessary for the locomotion of living creatures. Sinews, on the other hand, are not. They receive their nutrition from the bones. It was also noted that sinews cannot contain *pneuma* (5, 483b13). But 6, 484a29 also mentioned the spine, commenting that it does not have a motor function.

But Aristotle is clear that sinews cause the movement of the bones, directly acted upon by *pneuma*. This seems to be the reason why he now inquires whether the bones are used for movement or not. His conclusion will be that the bones are not directly guided by *pneuma*, as his opponents seem to claim. For the heart and the belly, too, are in motion. And they do not have bones, but they do have sinews!

ἄρα seems motivated by 484a29 and everything that was said about sinews in chap. 6.

Chap. 7 is inspired throughout by Pl. *Tim.* 73b–76e6.

7, 484b10: 'for support' (πρὸς ἔρεισμα).

Cf. 484b14 and *P.A.* II 9, 655a10, IV 10, 689b16–19: 'four legs' (τεττάρων ἐρεισμάτων), *H.A.* IV 7, 532b3; *P.A.* II 9, 655a25 and Pl. *Tim.* 91e6–8: 'their front limbs...were drawn to the ground...and they rested these parts on the ground' (τά τ' ἐμπρόσθια κῶλα...εἰς γῆν ἑλκόμενα...ἤρεισαν).

7, 484b10: 'as a protective covering' (πρὸς τὸ στέγειν καὶ περιέχειν).

See also b15. The focus here is on one function of bones, that of 'protective covering'. Cf. *Meteor.* I 14, 352b8: Mountainous districts...catch,

contain and produce most water' ((οἱ ὑψηλοὶ τόποι) πλεῖστον ὕδωρ καὶ στέγουσιν καὶ ποιοῦσιν). *Probl.* VIII 19, 889a11. In 5, 484a11 we already had ἀποστέγον. Cf. Pl. *Tim.* 73d7: 'a bone covering' (στέγασμα... ὀστείνον).

7, 484b10: 'and moreover whether some of them are a kind of origin' (ἔτι δ' εἰ ὥσπερ ἀρχαὶ ἔνια).

J.F. Dobson: 'and further, whether some bones are as it were originators of motion.' Likewise W.S. Hett 507 and J. Tricot 189. P. Gohlke 170 has: 'Ferner erhebt sich die Frage, ob einige Knochen etwa die Bedeutung eines Drehpunktes haben.' A. Roselli 140 is more precise: 'e ancora se alcune sono come principi.'

There is no reason to take ἀρχαί as 'principles *of movement*'. According to Aristotle, the axis of the universe, to which the next sentence refers, is not a principle of movement either (cf. *M.A.* 3, 699a20–22). A. Roselli 114 points out that Plato attached great importance to the brain and the spine.

However, Aristotle does regard some parts as 'more fundamental' than others. Cf. *I.A.* 5, 706b11: 'It is logical for the starting-points also to be in these parts, for a starting-point is valuable' (εὐλόγως δὲ καὶ αἱ ἀρχαί εἰσιν ἀπὸ τούτων τῶν μορίων. Ἡ μὲν γὰρ ἀρχὴ τίμιον).

7, 484b11: 'like the celestial axis (in the cosmos)' (καθάπερ ὁ πόλος).

J.F. Dobson: 'like the axis of the universe'; likewise W.S. Hett 507 and J. Tricot 189, with reference to Pl. *Tim.* 40c1: 'the axis through all things' (τὸν διὰ παντὸς πόλον τεταμένον) and Arist. *Cael.* II 13, 289b30 [this should be read as: 293b31]; A. Roselli 140: 'come il polo'. The remark does not seem to represent Aristotle's own view, but is probably a reference to Plato's *Timaeus*. In *Tim.* 73d6 Plato notes that the entire human body was constructed around the spine. Aristotle talks about 'polar points' (πόλοι) in the plural in *M.A.* 3, 699a20; 24; 30; *Mund.* 2, 391b19; b25 and 392a2–3. And his criticism of the mythical figure Atlas being interpreted as the celestial axis (διάμετρος) in *M.A.* 3, 699a27–b11 and *Cael.* II 1, 284a18–35 is found in a context where Plato's theory of the World Soul is disputed. In *Mund.* 2, 391b26 the term 'axis' (ἄξων) is used for 'celestial axis'.

7, 484b11: 'By "for movement" I mean for instance the bone of a foot, or a hand' (λέγω δὲ πρὸς μὲν κίνησιν, οἷον ποδὸς ἢ χειρός).

J.F. Dobson: 'By motion I mean, e.g., that of the foot, the hand'; J. Tricot 189: 'j'entends, par exemple, le mouvement du pied ou de la main.'

But we should consider that the question is not whether the foot is used for movement but whether '*the bone* of the foot' is used for movement. A foot and an arm are much more than bone(s). A. Roselli 140 correctly has: 'come nel caso delle ossa del piede o della mano.'

7, 484b12: 'both the movement of bending and locomotion' (ὁμοίως τὴν τε καμπτικὴν καὶ τὴν κατὰ τόπον).

Cf. Pl. *Tim.* 74a6: 'to make movement and bending possible' (κινήσεως καὶ κάμψεως ἕνεκα).

7, 484b13: 'For the latter is impossible without bending' (οὐδὲ γὰρ τὴν τοπικὴν οἷόν τε ἄνευ κάμψεως).

Cf. *I.A.* 9, 708b26 ff.: 'But without bending, it would be impossible to walk, swim, or fly' (Ἀλλὰ μὴν κάμψεώς γε μὴ οὔσης οὔτ' ἂν πορεία οὔτε νεῦσις οὔτε πτῆσις ἦν). Repeated in 12, 711a8–10.

7, 484b14: 'The legs (the "supporting parts"), we can say, belong to these as well' (σχεδὸν δὲ καὶ τὰ ἐρείσματα ἐν τούτοις).

J.F. Dobson: 'and usually the supporting functions belong to these same bones'; W.S. Hett 507 and A. Roselli 140 are comparable. But P. Gohlke 170 has: 'Dabei bedarf man auch der Stützen.'

By τὰ ἐρείσματα Aristotle means specifically the legs. Though these serve to support the body of the living creature when they are not moving, in many cases the same legs also have a locomotive function (with shellfish as an exception, witness 8, 485a21–22).

7, 484b15: 'But bones also serve as a protective covering' (τὴν δὲ τοῦ στέγειν καὶ περιέχειν).

A. Roselli 114 remarks on τὴν δὲ: sc. χρείαν (?). But this word does not occur before 484b23.

Modern translators offer very free renderings here. In our view, φύσιν from 484b9 needs to be added. The line of reasoning is: τὴν τῶν ὀστῶν φύσιν...σκεπτέον (a). The first option is indicated in 484b11: λέγω δὲ πρὸς μὲν κίνησιν (b). Then 'the support' (c). Then in 484b15: τὴν δὲ τοῦ στέγειν καὶ περιέχειν (τῶν ὀστῶν φύσιν) (d).

Pl. *Tim.* 73d7 calls the spine a 'covering' (στέγασμα) for the spinal marrow.

7, 484b16: 'and those who regard the marrow as the origin, as is well known, assign the same function to the spine' (καὶ ὅσοι δὴ τὸν μυελὸν ἀρχήν).

J.F. Dobson: 'and those who make the marrow the originator of motion treat the bones as primarily meant to protect it.' Likewise W.S. Hett 507; J. Tricot 189. P. Gohlke 170 has: 'oder auch die Markknochen', as if the text reads ὅσα. A. Roselli 114–115 reconstructs this text by cutting lines 484b20 and 21 in two and pasting them on either side of this clause. But this lacks any foundation.

It is clear that the author of *Spir.* is thinking and writing here in a very elliptical and telegram-like style. The thrust of the passage must be: 'and all those who regard the marrow as a principle [assign this function to the spine].' Again the primary reference is probably to Pl. *Tim.* 73b ff.: 'They all owe their existence to the formation of the marrow' (τούτοις σύμπασιν ἀρχὴ μὲν ἡ τοῦ μυελοῦ γένεσις), as Dobson rightly notes.

7, 484b16–17: 'And the ribs are for enclosing' (αἱ δὲ πλευραὶ τοῦ συγκλείειν). Cf. b18: 'to which the ribs are attached for the purpose of enclosing' (ἀφ' ἧς καὶ αἱ πλευραὶ πρὸς τὴν σύγκλεισιν).

A. Roselli 140: 'le costole hanno la funzione di racchiudere.'

By way of explanation we can cite *PA.* II 9, 654b32: 'Thus we find all the fleshy parts, with one exception, supported by bones, which serve, when the parts are organs of motion, to facilitate flexure, and, when the parts are motionless, act as a protection. The ribs, for example, which enclose the chest are intend to ensure the safety of the heart and neighbouring viscera' (transl. by W. Ogle) (τοῖς μὲν οὖν ἄλλοις ὕπεστιν ὀστᾶ τοῖς σαρκώδεσι μορίοις, τοῖς μὲν κινουμένοις διὰ κάμψιν τούτου χάριν, τοῖς δ' ἀκινήτοις φυλακῆς ἕνεκεν, οἷον αἱ συγκλείουσαι πλευραὶ τὸ στῆθος σωτηρίας χάριν τῶν περὶ τὴν καρδίαν σπλάγχνων).

7, 484b17: 'The primary and stable factor is the spine' (ἀρχὴ δὲ καὶ μένον ἡ ῥάχις).

After illustrating the various functions of bones with examples, as announced in 484b9–10, he now addresses the second question, mentioned in 484b11: what is primary in the osseous system? See *PA.* II 9, 654b11: 'The origin of blood is the heart, that of the bones... the so-called backbone; the other bones form a coherent whole which starts there' (Ἀρχὴ δὲ τῶν μὲν φλεβῶν ἡ καρδία, τῶν δ' ὀστῶν ἡ καλουμένη ῥάχις... ἀφ' ἧς συνεχὴς ἡ τῶν ἄλλων ὀστῶν ἐστι φύσις). He connects

this with his theory from *M.A.* 1, 698a15: 'movement proves impossible if there is nothing at rest' (ἀδύνατον κινεῖσθαι μηδενὸς ἠρεμοῦντος) and 4, 700a6–11; 6, 700b35–701a1; 10, 703a4–6. See also *I.A.* 12, 711a10, to which A. Roselli 115 refers, and 9, 708b21.

7, 484b20: 'Some therefore find the origin here, in the spinal marrow and the brain' (ἐν ᾧ δὴ καὶ τὴν ἀρχὴν ἔνιοι τόν τε ῥαχίτην καὶ τὸν ἐγκέφαλον).

J.F. Dobson's translation is in line with his translation of ἀρχαί in 484b11, but nonsensical: 'under which head some class the originator of motion; i.e. the spinal marrow and the brain.' Similarly W.S. Hett 509 and J. Tricot 189. P. Gohlke 170: 'In Wirbelsäule und Gehirn sehen manche den Lebensquell.' A. Roselli 115 deletes this sentence here and splits it into two parts, which she inserts in b16 and b17.

The author had announced an inquiry into the origin or origins of the osseous system (484b11). He then identified the spine as *archè* in b17. Here he adds that the final cause, too, can always be identified in living creatures, and it always has an *archè* too. Plato and his supporters find this primary final principle in the brain and the spinal marrow (*Tim.* 73b–d). In their view, therefore, the spine does not function as the principle of the osseous system, but serves to protect the marrow.

In *G.A.* II 4, 740a1–21 Aristotle states that the heart functions as the origin of a new living creature.

7, 484b21: 'the spinal marrow' (τὸν ῥαχίτην).

Elsewhere in the Corpus only in *P.A.* II 6 and 7. In II 7 Aristotle discusses the relation between brain and spinal marrow and disputes Plato's view that the two form a unity (*Tim.* 73c) and that the brain is the origin of the marrow (II 7, 652a25). This suggests that we should search for a relationship with Plato's theory in this text too.

7, 484b22: 'for joining' (ἐπισυναφῆς...χάριν).

Cf. 6, 484a30: 'for connecting' (συνάψεως χάριν).

7, 484b22: 'for joining and enclosing, like the collar-bone. Perhaps its name (key-bone) derives from this' (ἐπισυναφῆς καὶ συγκλείσεως χάριν, οἷον ἡ κλεῖς, ὅθεν ἴσως καὶ τοὔνομα).

Cf. *H.A.* I 13, 493a22: 'As a brace for the rear parts is the pelvis—indeed this circumstance provides its name *osphys*: as we can see, it is symmetrical (*isophyues*)' (transl. by A.L. Peck) (τῶν δ' ὄπισθεν διάζωμα μὲν ἡ ὀσφύς (ὅθεν καὶ τοὔνομα ἔχει· δοκεῖ γὰρ εἶναι ἰσοφυές)).

7, 484b28: 'for turning' (ἕνεκα τῆς στροφῆς).

I. Bekker has rightly corrected the reading τροφῆς of the mss.

7, 484b31: 'if there were not two radii functioning in the lower leg' (εἰ μὴ δύο αἱ ἐν τῇ κνήμῃ κερκίδες).

The Greek text of W. Jaeger has κινήσει in stead of κνήμῃ. J.F. Dobson: 'if there were not the two radii which are used in these motions.' Likewise W.S. Hett 509 and J. Tricot 190. A. Roselli reads with ms Z: αἱ ἐν τῇ κνήμῃ κερκίδες. P. Gohlke 171 also translates: 'wenn nicht zwei Knochen im Unterschenkel sich befänden.'

Cf. 7, 484b28 on the radius in the forearm.

7, 484b31: 'Just so we should consider for the other bones, for instance the movement of the neck, whether this is one bone' (ὡσαύτως δὲ καὶ τὰ ἄλλα σκεπτέον, οἷον ἡ τοῦ τραχήλου κίνησις, εἰ ἕν τὸ ὀστοῦν).

Aristotle touches upon this question in *P.A.* IV 10, 686a20: wolves and lions have no neck vertebrae but one neck-bone: μονοστοῦν τὴν αὐχένα ἔχουσι. Nature has arranged it thus for the purpose of giving them more strength. See also *H.A.* II 1, 497b16: 'the lion has one bone in his neck, but no vertebrae' (ὅ γε λέων τὸ τοῦ αὐχένος ἔχει ἓν ὀστοῦν, σφονδύλους δ' οὐκ ἔχει). A.L. Peck (1965) 75 n. 6 comments here: 'This is true of the whale, but not of the lion.'

7, 484b33: 'to connect' (σύνδεσμον).

Cf. b37. And see *P.A.* II 6, 652a16: 'on account of its separate vertebrae (the spine) requires something that holds it together' (δεῖται συνδέσμου διὰ τὰς διαλήψεις).

7, 484b33: 'the kneecap' (ἡ μύλη).

Elsewhere in this sense only in *H.A.* I 15, 494a5: 'The double-headed part of the leg is the thigh-bone, the sliding part is the knee-cap' (Σκέλους δὲ τὸ μὲν ἀμφικέφαλον μήρος, τὸ δὲ πλανησίεδρον μύλη).

7, 484b35: 'All bones with a motor function have sinews' (ὅσα μὲν οὖν κινητικά, πάντα μὲν μετὰ νεύρων).

J.F. Dobson: 'Now all parts which are capable of motion...'; likewise J. Tricot 190. A better translation is W.S. Hett 509: 'All bones which are concerned with movement'.

Here Aristotle anticipates his important thesis in 8, 485a6–7. Bones do not possess movement themselves, but are set in motion by the sinews.

7, 484b35: 'and perhaps in particular those which are suitable for doing something' (ἴσως δ' ὅσα πρακτικὰ ὡς μάλιστα).

The motor system of human beings, who are alone in being capable of *praxis*, is the most refined. Cf. *I.A.* 12, 711b11: 'for the use of his hands and for taking food' (πρός τε τὴν χειρῶν χρῆσιν καὶ πρὸς τὴν τῆς τροφῆς λῆψιν).

7, 484b37: 'The other bones with a connective function have sinews to the extent that they need them' (τὰ δ' ἄλλα συνδέσμου χάριν, ὅσα δεῖται).

J.F. Dobson takes τὰ δ' ἄλλα to refer to the sinews of b35: 'the other sinews are for the purpose of fastening together all those bones which require fastening.' W.S. Hett 509 puts a different construction on the sentence: 'The rest have sinews for connexion, if they need them at all.' Likewise J. Tricot 190. P. Gohlke 171 interprets δεῖται as a form of δέω, 'to bind': 'während andere nur binden sollen, wo sie als Bänder dienen.' Cf. A. Roselli 140: 'nei casi in cui le ossa sono legate tra di loro.'

συνδέσμου χάριν, as in 484b33: πρὸς... σύνδεσμον, must be a function of the bones here. So we must translate as if the text reads: τὰ δ' ἄλλα [ὀστᾶ ὅσα] συνδέσμου χάριν [ἐστιν], [μετὰ νεύρων ἐστι] ὅσα δεῖται [νεύρων]. A connective function of the sinews is not mentioned until 485a2.

7, 484b38: 'for instance the spine' (οἷον ἡ ῥάχις).

The spine is said here to be held together by few or no sinews, because it has little use for them.

In *P.A.* I 1, 640a19–26 Aristotle notes that Empedocles was ignorant of the purpose of the spine and explained the many vertebrae as resulting from breakage in the womb due to bending.

7, 484b38: 'But hinge joints do' (ἀλλ' ἡ κάμψις).

J.F. Dobson: ('for perhaps some, e.g. the spine, have little or no function) except that of bending', explaining: 'Read ἀλλ' ἢ κάμψις.' W.S.

Hett 509 follows in his footsteps but tacitly corrects ἀλλ' ἢ. Likewise J. Tricot 190: 'en dehors la flexion.' P. Gohlke 171: '(Manche Knochen haben vielleicht keine Sehnen oder nur wenige, wie die Wirbelsäule.) Aber die Krümmung erfordert sie.' A. Roselli 117 puts the above three Greek words between *cruces interpretum* and leaves them untranslated on p. 140.

Because we already encountered κάμψις in 7, 484b14; b24; b25al in the sense of 'bending movement', it is understandable that interpreters find this meaning here too. But H. Bonitz, *Index* 362b29 notes very pertinently: 'significat enim κάμψις et actionem τοῦ κάμπτεσθαι et eam partem in qua fit.' The word can also mean 'hinge *joint*'. Cf. *P.A.* II 9, 654b25: 'There is also cartilage between the joints' (Καὶ χονδρώδη δὲ μόρια μεταξὺ τῶν κάμψεών εἰσι). Unlike the spine, these joints do need sinews to perform their useful task. Aristotle says as much in the preceding sentence II 9, 654b23: 'Certain bones of which the extremities—the beginning of one and the end of the other—resemble each other are connected by sinews' (Ἔνια δ' αὐτῶν ὁμοίαν ἔχοντα τὴν ἀρχὴν τὴν θατέρου τῇ τελευτῇ θατέρου συνδέδεται νεύροις). Cf. also *H.A.* III 5, 515b3: 'The sinews are stretched around the joints and the hinges of the bones' (τὰ δὲ νεῦρα διεσπασμένα περὶ τὰ ἄρθρα καὶ τὰς τῶν ὀστῶν ἐστι κάμψεις) and 515b10–11.

7, 485a2: 'a mucous fluid' (ὑγρότης μυξώδης).

Cf. 6, 484a32: 'the sticky fluid' (ὑγρότης γλίσχρα) and *H.A.* III 5, 515b16: 'Round the sinews a mucous liquid is formed, white and sticky, by which they are nourished and from which they seem to be formed' (Ὑγρότης δὲ περὶ αὐτὰ [τὰ νεῦρα] μυξώδης γίνεται, λευκὴ καὶ κολλώδης, ᾗ τρέφεται καὶ ἐξ ἧς γινόμενα φαίνεται). III 11, 517b28; *P.A.* II 9, 655a28.

7, 485a2: 'The others are moreover connected by sinews, for instance those about the joints' (τὰ δέ καὶ συνδεῖται νεύροις, οἷον τὰ περὶ τὰ ἄρθρα).

J.F. Dobson: 'others are bound together by sinews—thus we find sinews in the joints of the limbs'; likewise W.S. Hett 511; J. Tricot 190 and A. Roselli 140. P. Gohlke 171 translates here: 'Anders ist überhaupt nur durch Sehnenbänder zusammengehalten, wie der Unterleib', probably because he interprets ἄρθρα as 'private parts'.

Cf. Pl. *Tim.* 75d4: 'he distributed the rest among all the limbs to connect one member with the other' (τὰ δ' ἄλλα [νεῦρα] εἰς ἅπαντα τὰ μέλη διέσπειρε, συνάπτων ἄρθρον ἄρθρῳ). 74d6: 'With these materials the god covered the bones and the marrow. By means of the sinews he connected the bones to each other' (οἷς συμπεριλαβὼν ὁ θεὸς ὀστᾶ καὶ μυελόν, δήσας πρὸς ἄλληλα νεύροις).

CHAPTER EIGHT

[The functionality of all things in nature]

8, 485a4: 'A better explanation of all things is obtained by an investigation like the present' (Πάντων δ' ἐστὶν λόγος ὁ βελτίων ὡς καὶ νῦν ζητεῖν).

J.F. Dobson: 'The best description of everything may be obtained by an investigation like the present'; W.S. Hett 511 and J. Tricot 190 are comparable; P. Gohlke 172: 'Überall liegt der Grund darin, dass es so besser ist. Dies gilt auch hier.' A. Roselli 117 puts the words ὁ βελτίων ὡς between *cruces interpretum* and translates on p. 140: 'La ragione di ogni cosa (?) *** ricercare anche ora.'

By letter of August 23, 2005 D. Holwerda has proposed to read: Πάντων δ' 'εἰς τί;' λόγος ὁ βελτίων ὡς καὶ νῦν ζητεῖν and to translate: 'In all matters it is the best method of inquiry to ask: "for what purpose?" Likewise now.'

8, 485a5: 'But we must study as far as adequate the final causes for the sake of which things exist.' (ἀλλὰ τὰς ἀρχὰς ἐφ' ἱκανόν, ὧν χάριν, σκεπτέον).

J.F. Dobson: 'but we must adequately investigate the final causes.' Likewise W.S. Hett 511; P. Gohlke 171: 'Bei den Grundlagen genügt es, den Zweck zu untersuchen.' J. Tricot 190: 'Mais nous devons examiner d'une manière suffisante les causes finales.'

For the priority of the final cause as an explanatory principle in Aristotle, cf. *PA.* I 1, 639b14: 'The first cause seems to be that which we call "for the sake of". For this is the logical reason, and the logical reason is the starting-point' (Φαίνεται δὲ πρώτη ἣν λέγομεν ἕνεκά τινος· λόγος γὰρ οὗτος, ἀρχὴ δ' ὁ λόγος).

The idea here seems comparable with *Eth. Nic.* I 3, 1094b11: 'Our treatment will be adequate if it is as accurate as befits the subject treated. We should not aspire to the same degree of precision in all scientific studies' (Λέγοιτο δ' ἂν ἱκανῶς, εἰ κατὰ τὴν ὑποκειμένην ὕλην διασαφηθείη· τὸ γὰρ ἀκριβὲς οὐχ ὁμοίως ἐν ἅπασι τοῖς λόγοις ἐπιζητητέον) and 1094b23–28. In this connection Aristotle rejects any search, in the style of Plato and his supporters, for the 'ultimate

principles' of every subject. See also *E.N.* I 13, 1102a24: 'The student of politics must also study the soul, but study it with a view to politics and to the extent that is adequate to the questions he is addressing' (θεωρητέον δὴ καὶ τῷ πολιτικῷ περὶ ψυχῆς, θεωρητέον δὲ τούτων χάριν, καὶ ἐφ' ὅσον ἱκανῶς ἔχει πρὸς τὰ ζητούμενα).

8, 485a5: 'In our view, it is not the bones which exist for the sake of movement but rather the sinews or their analogues, the primary part containing the *pneuma* which causes movement' (οὐκ ἂν δόξειε κινήσεως ἕνεκα τὰ ὀστᾶ, ἀλλὰ μᾶλλον τὰ νεῦρα ἢ τὰ ἀνάλογον, ἐν ᾧ πρώτῳ τὸ πνεῦμα τὸ κινητικόν).

Cf. *P.A.* II 9, 654b27: 'The bones exist for the sake of the flesh' (αἱ σάρκες... ὧν ἕνεκεν τὸ τῶν ὀστῶν ἐστι γένος).

This is an important passage. Order now emerges in what seemed at first sight to be a chaotic discussion of *pneuma*, respiration, the three movements of *pneuma* (only in the *artèria* and not in the sinews), the nutrition of the bones, etc. For Aristotle makes it clear here that the sinews are much more important for him than for his opponents. In Aristotle's view, sinews are primarily responsible for carrying out and passing on the action (*energeia*) of the innate *pneuma*, which is the first agent to undergo the effect of the soul. The connection with the previous sentence is: if we carefully examine what the final cause of the bones is, with a view to the inquiry we are conducting, we will have to conclude that the bones do not have movement as their real final cause.

8, 485a7: 'their analogues' (τὰ ἀνάλογον).

Cf. *P.A.* III 5, 668a4: 'in a vein or its analogue' (ἐν φλεβὶ καὶ τῷ ἀνάλογον).

Aristotle leaves room here for various forms of things which correspond to the sinews of higher, vertebrate animals. ἐν ᾧ again classifies all these things under one heading: the primary bearer of *pneuma* as the cause of movement.

8, 485a7: 'For even the belly moves and the heart has sinews' (ἐπεὶ καὶ ἡ κοιλία κινεῖται καὶ ἡ καρδία νεῦρα ἔχει).

See earlier 6, 484a17–18: 'For there are sinews in the heart too' (καὶ γὰρ ἐν τῇ καρδίᾳ νεῦρον). Cf. *H.A.* III 5, 515a28: 'The heart has sinews within itself, in the largest cavity; and the so-called aorta is a

sinewy blood vessel' (καὶ γὰρ ἐν αὐτῇ ἡ καρδία ἔχει νεῦρα ἐν τῇ μεγίστῃ κοιλίᾳ, καὶ ἡ καλουμένη ἀορτὴ νευρώδης ἐστὶ φλέψ). However, whereas a modern reader (since William Harvey) may be inclined to think that these sinews are required in the heart to keep the blood circulating, Aristotle sees them as necessary for the motor system of the living creature. Cf. *P.A.* III 4, 666b13: 'The heart also has many sinews. This is logical. For movements start from the heart and these are brought about by contraction and relaxation. For this the heart therefore requires the help and power of muscles' ('Εχει δὲ καὶ νεύρων πλῆθος ἡ καρδία, καὶ τοῦτ' εὐλόγως· ἀπὸ ταύτης γὰρ αἱ κινήσεις, περαίνονται δὲ διὰ τοῦ ἕλκειν καὶ ἀνιέναι· δεῖ οὖν τοιαύτης ὑπηρεσίας καὶ ἰσχύος). Cf. *M.A.* 7, 701b7–10 and 10, 703a4–28.

This is a crucial point for Aristotle. If there is movement in the belly and the heart contains sinews, the sinews must be responsible for this movement and for all movement, and not the bones. And in that case the principle of movement, i.e. *pneuma*, must also be active in the sinews. This refutes the position of Aristotle's opponents that *pneuma* does supply food to the bones but not to the sinews (3, 482b7; 6, 484a16).

8, 485a8: 'Bones are not present in all living creatures, but in some they are necessarily present' (τὰ δ' οὐ πᾶσιν, ἀλλ' ἐνίοις ἀνάγκῃ).

Thus A. Roselli 119, correcting ἀνάγκη to ἀνάγκῃ. W. Jaeger read: ἐνίοις, ἀνάγκη καὶ...J.F. Dobson: 'but only some, not all parts have bones.' Likewise W.S. Hett 511; J. Tricot 190. A. Roselli 141: 'E le ossa (?) non si trovano in tutte le parti ma sono in alcune, per necessità.' Clearly the superior translation is provided here by P. Gohlke 172: 'Knochen dagegen haben nur einige Tiere, nicht alle.' The octopus that follows directly in 485a10 is an example of such a boneless animal.

8, 485a9: 'And such a living creature requires sinews for such a movement or for...' (καὶ πρὸς τὴν τοιαύτην κίνησιν νεῦρα ἔχει ἢ εἰς τὸ <.....>).

Thus A. Roselli 119, commenting in the critical apparatus: 'post τὸ spatium aliquot litterarum praebent codd.' Jaeger read the same, but accepted the correction ἔχειν by I. Bekker. In her commentary Roselli notes that the lacuna offers room for five or six letters, but that this is highly uncertain. J.F. Dobson has: 'every part must have sinews appropriate for performing such motion or for <performing it well>,' adding

in n. 3: 'My conj. τὸ <εὖ> is not quite suitable, but is suggested by κακῶς of foll. line. Didot reads τὸ <βαδίζειν>.' J. Tricot adopts this suggestion. P. Gohlke, 21 n. 8 proposes <καλῶς>.

By letter of August 23, 2005 D. Holwerda proposes to add το<ιαύτην>: 'for this movement or that'.

8, 485a10: 'For an octopus can walk, if only small distances and with difficulty' (ὁ γὰρ πολύπους ἐπ' ὀλίγον καὶ κακῶς βαδίζει).

The octopus occurs frequently in Aristotle. For a list of places in the biological works, see *Aristote, Marche des animaux. Mouvement des animaux. Index des traités biologiques*, texte établi et traduit par P. Louis (Paris 1973) 107. It belongs to the lowest group of animals, without blood, breath, or bones. *Resp.* 9, 475b7–11 says that squids and octopuses, if taken out of the water, are adequately cooled by the outer air because they do not possess much vital heat. They are mentioned again in 12, 477a4–5 as animals without much heat. But the text adds that they secrete liquid via the cavity above 'what is called their "head"' (but which in actual fact is the channel of their waste products). In *H.A.* I 5, 489b33 the '*polypous*' is compared with other aquatic animals which swim, and most rapidly so in a backward direction. Of these others it is said: 'Neither of these is able to walk as the octopus can' (βαδίζει δὲ τούτων [viz. the σηπία and the τευτίς] οὐδέτερον, ὥσπερ πολύπους). The implication is that although 'octopuses' can use their feet for locomotion, they prefer to swim. They are discussed again in IV 1, 523b21 ff. They use their tentacles as feet and as hands. And they can discharge a dark liquid. A '*polypous*' does not have hard (bone-like) parts. Cartilage is found only about their head, where it gradually hardens (524b28). *H.A.* IV 1, 525a13 talks about various kinds of '*polypodes*'. See also IV 8, 534b25–29.

Therefore, because they do not have legs, they must possess (an analogue of) sinews to use their tentacles.

8, 485a11: 'For we should assume as a principle that the bones of all animals serve the purpose of movement, or some other purpose, but contributing to their characteristic movement' (δεῖ γὰρ τοῦτο λαβεῖν ὥσπερ ἀρχήν, ὅτι πᾶσιν ἢ ἄλλου τινὸς χάριν ἀλλὰ πρὸς τὴν κίνησιν τὴν οἰκείαν).

Thus the reading of the manuscripts. J.F. Dobson recalibrates: 'We must take as a starting-point the fact that all animals have different organs for different purposes with a view to the peculiar motion

of each' (he apparently adopts the corrections of W. Jaeger, who reads ἄλλα and deletes ἢ); likewise W.S. Hett 511 and J. Tricot 191; P. Gohlke does not follow Jaeger: 'In solchen Fällen muss man nämlich das Grundsätzliche erfassen, das alle brauchen, oder man muss den Zweck anders fassen, etwa dass die Knochen zu einer besonderen Bewegung erforderlich sind.' A. Roselli 119 replaces ἢ with οὐκ (!), and retains ἀλλὰ. She translates on p. 141: 'Bisogna infatti assumere come punto di partenza che in tutti gli animali essi non servono a nient'altro se non a compiere il movimento che è loro proprio.' But she sympathizes with Jaeger's corrections.

It is highly questionable whether the corrections of Jaeger and Roselli deserve support. As from 485a5 the issue is the role of bones. For Aristotle's opponents, bones are used for the movement of the living creature. But in chap. 7 Aristotle indicated a much broader range of functions for the bones. And he now launches his decisive attack. Perhaps bones do not serve the purpose of movement. This function belongs to the sinews (a5–6). Many kinds of animals do not have bones (a8). Since the text passes down πᾶσιν ἢ, we should consider that Aristotle is again applying his universality principle, which we also found used in 2, 482a10–11; 482a24; 6, 484b7–8. The idea might be: 'The proposition that bones exist for the sake of movement holds good for *all* living creatures *or does not hold good.* In the second case they serve a different purpose, but do contribute to the movement proper to the living creature.' For πρὸς (τὴν κίνησιν), cf. 4, 483a18: πρὸς τὴν ἐνέργειαν.

This other purpose is explicitly identified in 485a18: animals have feet *for the provision of food* and for standing upright. Just as perception exists for the sake of self-preservation (*Anim.* III 12, 434b13–27), so locomotion exists for the getting of food.

8, 485a13: 'For instance the feet for land animals, two for those that stand erect, but more for animals which move entirely on the ground' (τοῖς μὲν ὀρθοῖς δύο, τοῖς δὲ παντελῶς ἐπὶ τῆς γῆς πλείους).

J.F. Dobson: 'those that are upright having two; others which move altogether upon the earth... have several.'

But the contrast here is not between human beings and reptiles, but between human beings, who are alone in not walking with their head bowed to the ground (because they possess the most pure and hot *pneuma*), and all other animals with four (or more) feet (of which the *pneuma* is less pure and hot). Cf. Pl. *Tim.* 91e2–92a, with e7: 'bowed to the ground' (εἰς γῆν ἑλκόμενα).

See also Arist. *I.A.* 1, 704a12 and 5, 706b3: 'in bipeds "above" corresponds with what is "above" in the universe' (τὰ μὲν δίποδα τὸ ἄνω πρὸς τὸ τοῦ ὅλου ἄνω ἔχει), b9: 'bipeds are upwards oriented because they stand upright; man in particular' (τὰ δὲ δίποδα πρὸς τὸ ἄνω διὰ τὸ ὄρθα εἶναι, μάλιστα δ' ὁ ἄνθρωπος). *P.A.* II 10, 656a10–13; *I.A.* 15, 712b31; *Resp.* 13, 477a15–23.

So there is a distinction between these living creatures and the 'many-footed' referred to in 485a26, 'whose bodies move entirely on the ground' (ἐπὶ γῆς ὅλα τὰ σώματα).

8, 485a15: 'other animals can even move without feet, for they move in their situation with a movement all of their own' (τὰ δὲ καὶ ἄποδα ὅλως ἐγχωρεῖ· βίᾳ γὰρ οὕτω κινεῖσθαι).

Thus the text in W. Jaeger, who brackets this sentence as a parenthetical remark. J.F. Dobson: 'Some creatures again may be entirely without feet, for it is possible for them under these conditions to be moved only by external force,' explaining that he takes the meaning to be: ἐγχωρεῖ εἶναι. Similarly W.S. Hett 511 and J. Tricot 191. P. Gohlke 21 corrects the text to: διὰ γὰρ τὸ οὕτω κινεῖσθαι, but adds on p. 197 that this is highly uncertain. A. Roselli 120 puts βίᾳ γὰρ οὕτω between *cruces interpretum.*

Only now do the reptiles come up for discussion. Perhaps Aristotle is saying here: 'footless animals are entirely earthy and cold as regards their *hylè.* For they can move with a movement all of their own.' Perhaps we should therefore read:...ὅλως. ἐγχωρεῖ <ἰδ>ίᾳ [sc. κινήσει] γὰρ οὕτω κινεῖσθαι.

On the locomotion of snakes, see *I.A.* 7, 707b7 ff. This interest in τὰ ἴδια ἑκάστου is underlined by Aristotle in 485a24.

Cf. Pl. *Tim.* 92a6: 'the most senseless of all among them, which stretch their entire body at length on the earth, were created by the gods as animals that crawl, footless' (ἄποδα αὐτὰ καὶ ἰλυσπώμενα ἐπὶ γῆς ἐγέννησαν).

8, 485a17: 'but they differ for the faster and heavier flyers' (διάφορα δὲ τοῖς πτητικωτέροις καὶ βαρυτέροις).

J.F. Dobson: 'The parts differ as they are to fly faster or slower.' He follows the text of W. Jaeger, who read βραδυτέροις, proposed by U.C. Bussemaker. The mss have βραχυτέροις. W.S. Hett 511 follows Dobson. P. Gohlke p. 21 n. 10 proposes to read βαρυτέροις and translates on

p. 172: 'Dabei unterscheiden sich die flugtüchtigeren von den schwereren.' J. Tricot 191 goes along with Hett.

Gohlke opted for a reading which was also proposed by Bussemaker and is doubtless correct. A. Roselli adopts it too (not from Gohlke, whom she has not used). She demonstrates that this contrast is characteristic of Aristotle's generally acknowledged works: *P.A.* II 13, 657b7; IV 12, 694a6; *H.A.* II 12, 504b8; *G.A.* III 1, 749b19 ff.

Aristotle uses this contrast in *I.A.* 10, 710a16–710b4 for the distinction between winged insects and ordinary birds, because as regards body weight and flying capacity these kinds relate to each other as a cargo ship to a racing yacht!

To the open-minded this may be a remarkable indication for Aristotle's authorship of *Spir.*

8, 485a18: 'They have feet for the purpose of getting food and for standing, except in the case of the bat. That is why the bat gets its food from the air. And that is why it does not need to rest. For they do not need to alternate' (πόδας δὲ τροφῆς χάριν καὶ ἀναστάσεως, πλὴν τῆς νυκτερίδος· διὸ καὶ τὴν τροφὴν ἐκ τοῦ ἀέρος. καὶ μὴ δεῖσθαι διαναπαύσεως· οὐ δέονται γὰρ δι' ἄλλων).

Cf. *I.A.* 19, 714b10: 'Or should we regard this entire class as mutilated and assume that they move in such a way as if one had cut off the feet of limbed creatures, like the seal and the bat?' ("Η ὥσπερ ἀνάπηρον δεῖ τιθέναι πᾶν τὸ τοιοῦτον γένος [sc. of crustaceans], καὶ κινεῖσθαι ὁμοίως οἷον εἴ τις ἀποκόψειε τῶν ὑποπόδων τὰ σκέλη, ὥσπερ ἡ φώκη καὶ ἡ νυκτερίς) and *P.A.* IV 13, 697b1–14, where it is argued that the bat is intermediate between winged and land animals. See also *H.A.* I 1, 487b21.

δι' ἄλλων—J.F. Dobson: 'for they certainly do not need to do so for any other reason.' But Dobson reads: δὴ ἄλλως. He is followed by W.S. Hett 511 and J. Tricot 191. P. Gohlke corrects to: <εἰ μὴ> δι' ἀναπαύσεως· 'sie braucht sie... nur zum Ausruhen, zu etwas anderem nicht.' A. Roselli 120 does not introduce changes into the text, and translates the end: 'le zampe infatti non servono per altri scopi' (141).

Bats do not need to rest because they do not have to interrupt their flight to search for food on the ground. Cf. *I.A.* 18, 714a20–22, which states that birds cannot always remain in mid air. We should therefore read διαλλ<αγ>ῶν. Manuscript L has δι' ἀλλήλων.

8, 485a21: 'But among aquatic animals shellfish have feet on account of their weight [and not for locomotion]. Thus far on locomotion' (τὰ δὲ ὀστρακόδερμα τῶν ἐνύδρων ὑπόποδα διὰ τὸ βάρος. καὶ ταῦτα μὲν πρὸς τὴν κατὰ τόπον ἀλλαγήν).

J.F. Dobson's translation is wide of the mark: 'The hard-shelled aquatic animals have feet on account of their weight; thus they are enabled to move from place to place'; W.S. Hett 511: 'These members serve for locomotion'; P. Gohlke 172: 'und zwar zur Fortbewegung'. Likewise J. Tricot 191.

In fact it is perfectly clear to Aristotle that shellfish *do not move*! If they did, the remark διὰ τὸ βάρος would be very strange. The remark is entirely in keeping with *I.A.* 19, 714b14: 'Shellfish do move, but against their nature: it is not in their nature to move, only measured against animals which stay in one place and are attached do they move, but measured against locomotive animals they do not move' (Τὰ δ' ὀστρακόδερμα κινεῖται μὲν, κινεῖται δὲ παρὰ φύσιν· οὐ γάρ ἐστι κινητικά, ἀλλ' ὡς μὲν μόνιμα καὶ προσπεφυκότα κινητικά, ὡς δὲ πορευτικὰ μόνιμα). The translation by A. Roselli 141 of the last part of the above-cited sentence is therefore excellent: 'Queste sono dunque le observazioni relative al movimento locale.' The sentence καὶ ταῦτα μὲν πρὸς τὴν κατὰ τόπον ἀλλαγήν has the same conclusory function as 1, 481a27: 'These are roughly the arguments for the growth and preservation of the innate *pneuma* on the basis of food' (ἡ μὲν οὖν ἐκ τῆς τροφῆς αὔξησις καὶ διαμονὴ σχεδὸν ταῦτα).

8, 485a23: 'But for everything which serves other purposes the governing principle (for our inquiry) is what is specific to each living creature' (ὅσα δὲ πρὸς τὴν ἄλλην χρείαν, ὥσπερ ὑφηγεῖται καὶ ἑκάστου τὰ ἴδια).

A. Roselli 141: 'Per quanto riguarda le altre funzioni, come si è detto; ed ogni parte ha le sue proprietà.' But Aristotle is saying here that an investigator must accurately observe the specific characteristics of animals. Cf. *P.A.* I 3, 643b10: 'Instead we must try to divide the animals into classes after the example of the standard classification of birds and fishes' ('Αλλὰ δεῖ πειρᾶσθαι λαμβάνειν κατὰ γένη τὰ ζῷα, ὡς ὑφήγηνθ' οἱ πολλοὶ διορίσαντες ὄρνιθος γένος καὶ ἰχθύος).

8, 485a25: 'why many-footed insects are the slowest' (διὰ τί τὰ πολύποδα βραδύτατα).

Cf. *I.A.* 7, 707a17: 'locomotion occurs either exclusively or principally among animals which perform it on two or four points of support'

(μάλιστα τούτοις ὑπάρχει τῶν ζῴων ἡ κατὰ τόπον κίνησις, ἃ δυσὶν ἢ τέτταρσιν ποιεῖται σημείοις τὴν κατὰ τόπον μεταβολήν). For Aristotle this no doubt has to do with the fact that all animals with more than four feet are bloodless creatures, whose nature is colder and earthier and therefore less suited to movement than bipeds and quadrupeds.

This chapter 8 demonstrates the same broad knowledge of the animal kingdom as *De incessu animalium.*

CHAPTER NINE

[Vital heat as the only and multi-functional life-bearing principle]

For this chapter, see also E. Neustadt, *Hermes* 44 (1909) 60–69, who is convinced that it is Stoic (in the line of Chrysippus), with an Aristotelian slant. W. Jaeger (art. 1913) defended the same position. A. Roselli 122 firmly rejects any contrast with the preceding chapters.

9, 485a28: 'Our opponents' (Οἱ ἀναιροῦντες).

Cf. *Metaph.* A 9, 990b17: 'the theory of Ideas is radically at odds with views which we prefer to the existence of the Ideas' (ὅλως τε ἀναιροῦσιν οἱ περὶ τῶν εἰδῶν λόγοι ἃ μᾶλλον εἶναι βουλὸμεθα τοῦ τὰς ἰδέας εἶναι). *Phys.* I 2, 185a1–2: 'a mathematician cannot argue with someone who rejects his principles' (τῷ γεωμέτρῃ οὐκέτι λόγος ἔστι πρὸς τὸν ἀνελόντα τὰς ἀρχάς). I 8, 191b12: 'the denial of all becoming' (ἀνέλειν πᾶσαν τὴν γένεσιν). *Cael.* III 8, 306b28: 'it becomes obvious that they banish becoming from the world' (ἀναιροῦντας (sc. τοὺς λόγους) ὄψεται τὴν γένεσιν ἐκ τῶν ὄντων).

Spir. also turns on a radical opposition between the author and those with whom he is in debate. The author is referring here to the two views considered in chap. 1. After a dialectical debate in eight chapters he arrives at his own thetic discussion, the theory to which he has constantly alluded in the previous chapters, that of the innate *pneuma* or vital heat, which under the guidance and direction of the vital principle (the soul) produces the living entity in all its facets.

In various ways the opponents have designated respiration and vital breath as the fundamental efficient cause. Aristotle now shows once and for all that only the innate *pneuma* is primary and forms a unity with the soul, and is the instrument of the soul, and that all other vital processes depend on this 'efficient principle'. So chap. 9 is the positive complement of the critical analysis conducted throughout the preceding work.

9, 485a28: 'the vital heat... the efficient principle' (τὸ θερμὸν τὸ ἐργαζόμενον).

Aristotle here firmly rejects the position of his opponents that the inhaled air in the *artèriai* is responsible for the movement which supplies and digests the food (4, 482b15–16: ἐπάγουσα καὶ κατεργαζομένη), and sets out his own alternative. Cf. *G.A.* II 3, 736a27: 'acts by the power residing in it' (ἐργάζεται τῇ δυνάμει τῇ ἐνούσῃ ἐν αὐτῷ).

This is the fundamental theory of all Aristotle's biological works: *Anim.* II 4, 416b28: 'the vital heat brings about concoction. That is why every ensouled being has vital heat' (ἐργάζεται δὲ τὴν πέψιν τὸ θερμὸν· διὸ πᾶν ἔμψυχον ἔχει θερμότητα), to which he adds: 'We have now dealt with the subject of food in general. We must clarify it in more specific discussions' (τύπῳ μὲν οὖν ἡ τροφὴ τί ἐστιν εἴρηται· διασαφητέον δ' ἐστὶν ὕστερον περὶ αὐτῆς ἐν τοῖς οἰκείοις λόγοις). In 416a9–18 Aristotle had rejected the view of those who identify 'fire' as the principle of life and growth by qualifying that it is always 'fire under the guidance of the soul as *logos*'. The position which Aristotle adopts in chap. 9 is anticipated in 5, 484a6–7: 'But if vital heat is the productive agent and generates life through heat as it were' (εἰ δὲ ποιεῖ καὶ οἷον ἀναζωπυρεῖ θερμῷ τὸ θερμὸν); see the commentary there. See also 2, 481b4.

9, 485a29: 'and who claim that fire has only one direction of movement and only a capacity to cut' (ὅτι μία τις φορὰ καὶ δύναμις ἡ τμητικὴ τοῦ πυρός).

In his critical apparatus W. Jaeger proposed the conjecture 'to melt' (τηκτική). Cf. his article (1913; repr. 1960) 88 n. 1 and 98 with n. 1. But there is no basis for this correction.

Cf. Pl. *Tim.* 56d1: 'Earth may meet fire and be dissolved by its keenness' (Γῆ μὲν συντυγχάνουσα πυρὶ διαλυθεῖσά τε ὑπὸ τῆς ὀξύτητος αὐτοῦ). 56d6; 57a2–3; 61d7; 61e3; 80d3: 'Fire cuts the food into pieces. Moreover, it floats up and down inside us and follows the breath' (τέμνοντος μὲν τὰ σιτία τοῦ πυρὸς, αἰωρουμένου δὲ ἐντὸς τῷ πνεύματι συνεπομένου). 80d6; 80e3. The same criticism of Plato can be found in *Cael.* III 5, 304a7–18 and 8, 307a26, to which A. Roselli 123 refers.

9, 485a30: 'For even in inanimate things it does not always produce the same effect in all cases' (οὐδὲ γὰρ ὅλως τοῖς ἀψύχοις ταὐτὸ ποιεῖ πᾶσιν).

The text of the mss has ὅλα. J.F. Dobson corrects to ὅλως and translates: 'For in the case of inanimate things the action of fire is not universally the same on all.' He is followed by W.S. Hett 513, J. Tricot 192, and A. Roselli 123. A correction does in fact seem necessary.

9, 485a31: 'but some things it condenses, others it rarefies, others it dissolves, yet others it hardens' (τὰ μὲν πυκνοῖ, τὰ δὲ μανοῖ καὶ τήκει, τὰ δὲ πήγνυσιν).

A. Roselli 124 refers to *P.A.* II 2, 649a29: 'The vital heat seems both to harden and to dissolve' (Δοκεῖ δὲ τὸ θερμὸν καὶ πηγνύναι καὶ τήκειν). The entire section from II 2, 648b11 to 649a33 deals with the different effects of 'heat'. See also *G.A.* II 1, 734b28–735a4 with b31: 'Hardness, softness, elasticity, brittleness, and all such properties... can be caused by heat and cold' (σκληρὰ μὲν οὖν καὶ μαλακὰ καὶ γλίσχρα καὶ κραῦρα... θερμότης καὶ ψυχρότης ποιήσειεν ἄν) and *M.A.* 8, 702a9: 'that they can change from solid to liquid and from liquid to solid, and from soft to hard and vice versa' (μεταβάλλοντα ἐκ πεπηγότων ὑγρὰ καὶ ἐξ ὑγρῶν πεπηγότα καὶ μαλακὰ καὶ σκληρὰ ἐξ ἀλλήλων).

9, 485a33: 'the fire which nature uses' (φύσεως πῦρ).

τὸ τῆς φύσεως in 486a4 probably means the same as τὸ φύσεως πῦρ. Cf. *G.A.* II 3, 736b33–737a7, where Aristotle explicitly contrasts 'that which we call heat' (τὸ καλούμενον θερμὸν) and 'the heat of animals' (ἡ ἐν τοῖς ζῴοις θερμότης) with 'fire' (πῦρ).

9, 485a34: 'of the goldsmith' (χρυσοχοικός).

Only here in the Aristotelian Corpus.

9, 485a35: 'of the coppersmith' (χαλκευτικός).

Elsewhere only in *P.A.* IV 6, 683a24 and *G.A.* V 8, 789b10, in both cases in passages dealing with efficiency in nature and the smith's art, and in the latter passage with the πολύχρηστα character of hammer and anvil in the smithy and *pneuma* in nature.

9, 485a35: 'of the cook' (μαγειρικός).

Only here in the Corpus.

9, 485a36: 'But perhaps it is more correct to say that the crafts accomplish this' (ἴσως δ' ἀληθέστερον ὅτι αἱ τέχναι).

Cf. *G.A.* II 4, 740b25: 'And just as the products of craft are made with tools—it is more correct to say by their movement—and this movement is the activity of craft and craft is the form of things which are made in something else—so the capacity of the nutritive soul also acts,... using heat and cold as tools' (ὥσπερ δὲ τὰ ὑπὸ τῆς τέχνης γιγνόμενα γίγνεται

διὰ τῶν ὀργάνων—ἔστι δ' ἀληθέστερον εἰπεῖν διὰ τῆς κινήσεως αὐτῶν. αὕτη δ' ἐστὶν ἡ ἐνέργεια τῆς τέχνης, ἡ δὲ τέχνη μορφὴ τῶν γιγνομένων ἐν ἄλλῳ—οὕτως ἡ τῆς θρεπτικῆς ψυχῆς δύναμις... χρωμένη οἷον ὀργάνοις θερμότητι καὶ ψυχρότητι). The view of *Spir.* 9 is identical with that of *G.A.* Cf. also *P.A.* II 7, 652b7–14.

9, 485a36: 'for they use fire as an instrument' (χρῶνται γὰρ ὥσπερ ὀργάνῳ).

Cf. 485b6; b16. The various crafts use (the natural body of) fire as their *sôma organikon*, their instrumental body. The comparison used by the author here shows that he holds that the life forms of living creatures use 'vital heat' as 'instrumental body' in the same way.

9, 485b2: 'and also to shape some things' (ἔνια δὲ καὶ ῥυθμίζουσαι).

J.F. Dobson: 'and some they temper.' Likewise W.S. Hett 513; J. Tricot 192, who refers to *Phys.* VII 3, 245b9 and notes: 'Le feu *régularise* la chose une fois l'achèvement de l'oeuvre réalisé.' P. Gohlke 173: 'und zuweilen zum Gestalten.' A. Roselli 141: 'e in alcuni casi anche per dare forma.' Again this probably refers to the activity of smiths. There is no reference to glassblowing in Aristotle.

We should take into account here 485b8: τὸν ῥυθμὸν ἀποδώσει, where A. Roselli 126–127 refers to *Cael.* III 8, 306b18 (citing Pl. *Tim.* for the theory of the '*pandeches*'. But Plato only has ῥυθμὸς... ἐδόθη in 47d7–e2) and *Phys.* VII 3, 245b9; *Metaph.* Λ 10, 1075b12 (ed. W. Jaeger).

ῥυθμίζειν—only three other occurrences in the Aristotelian Corpus. But *Cael.* III 8, 306b18 is a good parallel place. See also *Phys.* II 1, 193a11: ἀρρύθμιστον <ὄν> and *Metaph.* Δ 4, 1014b27.

9, 485b2: 'the natural vital principles (of living creatures)' (αἱ φύσεις).

J.F. Dobson: 'individual natures'; P. Gohlke's 'die Natur' is incorrect. See earlier 1, 481a19. Identical here with 'soul' in Aristotle. Cf. *G.A.* II 1, 735a2–4: 'For craft is the origin and the form of the object made, but it exists in something else, whereas the movement of nature exists in the thing itself, though it issues from another nature which possesses the form in actuality' (ἡ γὰρ τέχνη ἀρχὴ καὶ εἶδος τοῦ γιγνομένου, ἀλλ' ἐν ἑτέρῳ· ἡ δὲ τῆς φύσεως κίνησις ἐν αὐτῷ ἀφ' ἑτέρας οὖσα φύσεως τῆς ἐχούσης τὸ εἶδος ἐνεργείᾳ).

This assumes that there is a unity between φύσις and ἔμφυτον θερμὸν. Cf. *Anim.* II 4, 416b25: 'The expression "wherewith it is fed"

is ambiguous... what produces digestion is warmth' (ἔστι δὲ ᾧ τρέφει διττὸν... ἐργάζεται δὲ τὴν πέψιν τὸ θερμὸν.)

9, 485b3: 'Hence their products differ' (ὅθεν δὴ καὶ πρὸς ἄλληλα διαφοραί).

Bussemaker and Jaeger have proposed to add <αἱ> before πρός. But if we accept this, it is still somewhat surprising that that text reads πρὸς ἄλληλα and not πρὸς ἀλλήλας. Perhaps we should accept the neuter πρὸς ἄλληλα in connection with 485b5: 'the products will be different' (διαφόρως ἕξει τὰ ἔργα). Interestingly, a variant διαφοράν has been passed down in three manuscripts. Perhaps the correction διάφορα as an adjective with τὰ ἔργα is therefore more plausible.

9, 485b3: 'It is therefore ridiculous to judge by externals only' (διὸ γελοῖον πρὸς τὸ ἔξω κρίνειν).

This seems a reference to the fact that craft always operates on material which differs from the craftsman. But in all products of nature the formative principle operates internally. Cf. *G.A.* II 1, 735a2–4. This idea also underlies the proposition that the vital form not only uses the vital heat as instrument, but also as matter (485b7). Cf. *Mund.* 6, 399b14: 'for the soul, by which we possess life, is also invisible, but is seen by what it achieves' (καὶ γὰρ ἡ ψυχὴ, δι' ἣν ζῶμεν... ἀόρατος οὖσα τοῖς ἔργοις αὐτῆς ὁρᾶται).

9, 485b5: 'the products will be different for the users (διάφορα ἕξει τὰ ἔργα τοῖς χρωμένοις).

Thus W. Jaeger. But διάφορα is a correction by E. Neustadt, who also finds the Stoic technical term ἕξις in ἕξει (1909) 60 n. 1 and 63. The mss have διάφοραν. A. Roselli 126 has a sounder proposal: διαφὸρως. There appears to have been interference between the passage in b3 and that in b5.

9, 485b7: 'nature, on the other hand, also uses it as matter' (ἡ δὲ φύσις ἅμα καὶ ὡς ὕλῃ).

See also 485b16 below. A. Roselli 126 only talks about parallels in post-Aristotelian literature. But in Aristotle's basic theory the 'natural instrumental body that potentially possess life' is also the *hylè* for the soul. *Anim.* II 1, 412a7; a8; b28; II 2, 414a12–17; a25–28.

9, 485b8: 'but rather it is hard to understand that nature herself uses the vital heat' (τὸ τὴν φύσιν αὐτὴν νοῆσαι τὴν χρωμένην).

W.S. Hett 513: 'rather the difficulty lies in the fact that nature, which uses the fire, should herself be an intelligent agent,...'; thus earlier E. Neustadt (1909) 61; J.F. Dobson. P. Gohlke 173–4: 'Aber nicht hierin liegt eine Schwierigkeit, vielmehr darin, dass die Natur, die sich des Feuers bedient, selber denken solle,...;" J. Tricot 192: 'que la nature, qui se sert de l'instrument, soit elle-même un agent doué de pensée'; A. Roselli 142: 'che la natura stessa, che fa uso del fuoco, sia dotata di intelligenza.'

But Aristotle never says that Nature thinks. And he is not saying it here either. In that case he would not have used νοῆσαι but νοεῖν. For νοῆσαι, cf. *Phys.* VIII 1, 251b20 and *G.C.* I 5, 321b24. The problem lies in the fact that *we* must understand (νοῆσαι) that the life form is the agent that uses. According to Aristotle, though everything in nature achieves its goal efficiently, it does so in the manner of a winding mechanism. Cf. *G.A.* II 1, 734b10. Nature is efficient, but not goal-oriented. The 'headquarters' of the cosmos is elsewhere. Nature is the executor of God's plan.

This passage should therefore not be explained Stoically, as Roselli 126 does, but is soundly Aristotelian.

9, 485b10: 'For this is no longer a matter of fire or air' (τοῦτο γὰρ οὐκέτι πυρὸς οὐδὲ πνεύματος).

According to Aristotle, the guidance of the soul as a goal-oriented principle is indispensable. Cf. *Anim.* II 4, 416a9–18: 'some believe that fire in itself is the cause of nutrition and growth.... It is, however, an auxiliary cause, but certainly not the absolute cause. Rather this is the soul. For fire grows without limit, but natural things have a limit and a measure to their size and growth. And this is the work of the soul, but not of fire, and rather of a rational principle than of matter' (δοκεῖ δέ τισιν ἡ τοῦ πυρὸς φύσις ἁπλῶς αἰτία τῆς τροφῆς καὶ τῆς αὐξήσεως εἶναι...τὸ δὲ συναίτιον μέν πώς ἐστιν, οὐ μὴν ἁπλῶς γε αἴτιον, ἀλλὰ μᾶλλον ἡ ψυχή· ἡ μὲν γὰρ τοῦ πυρὸς αὔξησις εἰς ἄπειρον...τῶν δὲ φύσει συνισταμένων πάντων ἔστι πέρας καὶ λόγος μεγέθους τε καὶ αὐξήσεως· ταῦτα δὲ ψυχῆς, ἀλλ' οὐ πυρός, καὶ λόγου μᾶλλον ἢ ὕλης), and likewise *G.A.* II 1, 734b28 ff.: 'And just as we cannot say that an axe or another instrument is made only by fire, so neither can we say it of a foot or a hand' (καὶ ὥσπερ οὐδ' ἂν πέλεκυν οὐδ' ἄλλο ὄργανον φήσαιμεν ἂν ποιῆσαι τὸ πῦρ μόνον οὕτως οὐδὲ πόδα οὐδὲ χεῖρα).

9, 485b10–12. Cf. the description in G.E.R. Lloyd, 'The master cook', in id., *Aristotelian explorations* (Cambridge 1996) 83–103 of the way Aristotle uses the notion of 'concoction' by the agency of vital heat. Lloyd notes on p. 100 that 'the effects of digestion in one animal differ from those in another (the blood will vary) and these differences will depend on the form or the essence of the animal in question.' Unfortunately, Lloyd leaves *Spir.* out of account.

9, 485b10: 'It is clearly remarkable that such a power should be combined with these matters' (τούτοις δὴ καταμεμεῖχθαι τοιαύτην δύναμιν θαυμαστὸν).

Cf. 486a3: 'For the vital heat of nature is mixed with it' (ἐγκαταμείγνυται τὸ τῆς φύσεως).

9, 485b11: 'And the case is just as remarkable with the soul. For it is present in them' (ἔτι δέ τοῦτο θαυμαστὸν ταὐτὸν καὶ περὶ ψυχῆς· ἐν τοῦτοις γὰρ ὑπάρχει).

A. Roselli 127 quite wrongly proposes to delete ταὐτὸν in this sentence. The author is saying here: if you look at *pneuma* and the vital heat, it is surprising and wondrous to find that a guiding power (comparable with human *technê*) is operative in them. It is just as surprising that the soul is present in *pneuma* and the vital heat.

The doctrine of the unity of the soul and its instrumental body in Aristotle's biological works is stated very explicitly and emphatically here. If *De spiritu* had received sufficient attention in the Peripatetic tradition, the fatal misinterpretation of Aristotle's psychology by Alexander of Aphrodisias could never have taken place.

9, 485b12: 'Therefore it is not wrong' (οὐ κακῶς).

Wrongly changed to οὐ καλῶς by A. Roselli 127. The idea is that the vital heat and the soul form an indissoluble unity, as Aristotle explicitly says in *Anim.* II 1, 412b6–9.

9, 485b13: 'or one of its parts, the part that forms' (ἢ μόριόν τι τὸ δημιουργοῦν).

The author is referring here to the nutritive and generative part *of the soul.* J.F. Dobson is nonplussed, as his translation shows: 'and therefore there is some sense in referring to the same agent—either generally or to some particular creative part—the fact that its motion always operates in the same way.' W.S. Hett 515 is mystifying too:

'Therefore the fact that its motion always exerts a similar activity may reasonably be referred to the same agent, either absolutely or to some definite effective part.'

9, 485b13: 'and that causes the movement always to be actually the same' (καὶ τὸ τὴν κίνησιν ἀεὶ τὴν ὁμοίαν ὑπάρχειν ἐνεργείᾳ).

W. Jaeger, following D. Furlanus has ἐνεργοῦν. The mss have ἐνέργειαν. The correction ἐνεργείᾳ by A. Roselli 127 is probably better.

So it is the nutritive activity which is continually and steadily active. This seems to answer the question raised in 4, 482b26–29.

9, 485b14: 'the movement' (τὴν κίνησιν).

The movement of the soul in indissoluble unity with its *sôma physikon organikon*, which is the movement of the soul as a whole, but which can also be specifically assigned to the most basic, vegetative part of the soul, of which 4, 483a12–14 determined that it precedes the movement of respiration.

9, 485b14: 'For this also applies to the nature to which generation, too, is owed' (καὶ γὰρ ἡ φύσις, ἀφ' ἧς καὶ ἡ γένεσις).

J.F. Dobson: 'for nature, from which they are generated, is always constant,' is off track again. Likewise W.S. Hett 515: 'for nature, from which they are generated, remains the same.' A better translation is P. Gohlke 174: 'die Natur, von der die Entwicklung ausgeht.' But Gohlke wrongly connects this passage with what goes before.

But perhaps we should strike the comma here and take the relative clause as non-restrictive: 'For this also applies to the living entity to which it owes its generation.' This idea is found expressed in *G.A.* II 4, 740b34–37: 'For the matter by which it grows is the same as that from which it is originally constituted; therefore the power which forms it is also the same as in the beginning, only greater. If this is the nutritive soul, it is also the generative soul; this is the nature of every individual being which is present in all plants and animals' (ἡ γὰρ αὐτή ἐστιν ὕλη ᾗ αὐξάνεται καὶ ἐξ ἧς συνίσταται τὸ πρῶτον, ὥστε καὶ ἡ ποιοῦσα δύναμις ταὐτὸ τῷ ἐξ ἀρχῆς· μείζων δὲ αὕτη ἐστίν. εἰ οὖν αὕτη ἐστὶν ἡ θρεπτικὴ ψυχή, αὕτη ἐστὶ καὶ ἡ γεννῶσα· καὶ τοῦτ' ἔστιν ἡ φύσις ἡ ἑκάστου ἐνυπάρχουσα καὶ ἐν φυτοῖς καὶ ἐν ζῴοις πᾶσιν.... And see also *G.A.* II 1, 735a12 and 3, 737b5–7.

9, 485b15: 'But how are we then to explain the difference of the vital heat in each individual living creature, the heat taken as instrument or as matter or as both?' (ἀλλὰ δὴ τίς ἡ διαφορὰ τοῦ καθ' ἑκάστον θερμοῦ, εἴθ' ὡς ὄργανον εἴθ' ὡς ὕλην εἴθ' ὡς ἄμφω;)

G.A. I 18, 724b4–6 is comparable in terms of both construction and content: 'we must determine in which of the two the semen belongs, whether we must take it as matter and as passive principle or as a kind of form and efficient principle, or as both' (τοῖν δυοῖν δὴ ληπτέον ἐν ποτέρῳ θετέον τὸ σπέρμα, πότερον ὡς ὕλην καὶ πάσχον ἢ ὡς εἶδός τι καὶ ποιοῦν, ἢ καὶ ἄμφω). See R. Mayhew, *The Female in Aristotle's Biology* (Chicago 2004) 30–43.

The entire second part of chapter 9, from 485b15, is devoted to explaining how the large variation in the parts of each living being can be produced by the one principle of vital heat under the guidance of the living creature's soul.

The sentence clearly builds on b6–7. And it seems as if the author interprets the first part of the sentence as: τί ποιεῖ διάφορον τὸ καθ' ἑκάστον θερμόν, εἴθ' ὡς...

9, 485b17: 'For fire displays differences of more and less' (πυρὸς γὰρ διαφοραὶ κατὰ τὸ μᾶλλον καὶ ἧττον).

Cf. *P.A.* II 9, 655a32: 'Cartilage and bones have the same composition, the difference between them is only gradual' (Ἡ δὲ φύσις ἡ αὐτὴ χόνδρου καὶ ὀστοῦ ἐστι, διαφέρει δὲ τῷ μᾶλλον καὶ ἧττον).

On the importance of this distinction, cf. J.G. Lennox, *Aristotle's Philosophy of Biology. Studies in the Origins of Life Science* (Cambridge 2001) chap. 7: 'Kinds, Forms of Kinds and the More and the Less in Aristotle's Biology' (160–181).

9, 485b17: 'This is roughly like mixed or unmixed' (τοῦτο δὲ σχέδον ὥσπερ ἐν μίξει καὶ ἀμιξίᾳ).

On 'mixture', see *G.C.* I 10, with the propositions in 328a10: 'We say that what is mixed is homogeneous' (Φαμὲν δ'...τὸ μιχθὲν ὁμοιομερὲς εἶναι) and 328b22: 'mixture is unification of what is mixed after it has undergone a change' (ἡ δὲ μίξις τῶν μικτῶν ἀλλοιωθέντων ἕνωσις).

9, 485b18: 'For purer fire is more fire' (τὸ γὰρ καθαρώτερον μᾶλλον).

J.F. Dobson: 'for the purer substance has the proper qualities of its kind in a higher degree'; likewise J. Tricot 193; W.S. Hett 515: 'for the purer is more intense'; P. Gohlke 174: 'grössere Reinheit bedeutet

einen höheren Grad'; A. Roselli 142: 'Ciò che è più puro infatti è più caldo.'

9, 485b19: 'The same rule applies to the other simple bodies' (ὁ αὐτὸς δὲ λόγος καὶ ἐπὶ τῶν ἄλλων ἁπλῶν).

Aristotle means: the same rule as regards 'the natural fire of the vital heat'. He thus sets here 'the vital heat' in 9, 485a28 and 'the fire of nature' in 485a33 alongside 'the other simple bodies' (earth, water, air, and ordinary fire).

It is doubtful whether J.F. Dobson means the same in his translation: 'The same statement applies in the case of all other simple things.' W.S. Hett 515 is clearer in his translation: 'other simple substances.'

9, 485b20: 'For because the bone and flesh of a horse differ from those of an ox' (ἀνάγκη γάρ, ἐπείπερ ἕτερον ὀστοῦν καὶ σὰρξ ἥ ἵππου καὶ ἥ βοὸς).

For a proper understanding of what follows it is important to note that Aristotle is talking about two differences: the difference between bone and flesh *and* the difference between flesh of a horse and flesh of an ox (or bone of a horse and bone of an ox).

In 485b31 Aristotle adds the difference between two bones in the same animal.

We follow the text of W. Jaeger, which seems the *lectio difficilior* here. J.F. Dobson and A. Roselli 128 opt for the variant ἡ ἵππου καὶ ἡ βοὸς.

9, 485b21: '(For...it is necessary that) they consist of different components or differ in the proportion of their mixture' (ἢ τῷ ἐξ ἑτέρων εἶναι ἢ τῇ κράσει διαφέρειν).

A. Roselli 128 follows D. Furlanus here in his correction of χρήσει to κράσει. Cf. b25.

9, 485b21: 'Now if the components are different, what are the differences of each of the simple bodies in itself and what <is their power>? For we are searching for these <differences>' (εἰ μὲν οὖν ἕτερα, τίνες αἱ διαφοραὶ ἑκάστου τῶν ἁπλῶν καὶ τίς *** ταύτας γὰρ ζητοῦμεν).

εἰ μὲν οὖν ἕτερα contrasts here with εἰ δὲ ταὐτά in 485b23. This does not refer to the bone and flesh of 485b20, as J.F. Dobson, W.S. Hett 515, and J. Tricot 193 assume, but to the components which make up flesh and bone or the bone of a horse and the bone of an ox. The

same contrast is presupposed in 485b21: τῷ ἐξ ἑτέρων εἶναι ἢ [τῷ ἐκ τῶν αὐτῶν εἶναι καὶ] τῇ κράσει διαφέρειν. Aristotle says here as succinctly as possible that the bone of an ox and the flesh of an ox differ because they consist of different components, but the bone of a horse and the bone of an ox differ because, though consisting of the same components, they possess these components in a different proportion.

W. Jaeger assumed a lacuna here after τίς and proposed to read ἡ δύναμις. A. Roselli 128 leaves the lacuna empty.

ἕτερα must refer here to ὀστοῦν καὶ σάρξ (thus W.S. Hett 515 and J. Tricot 193).

9, 485b24: 'For it must needs be one of the two, as in the other cases' (ἀνάγκη γὰρ δυοῖν θάτερον καθάπερ καὶ ἐν τοῖς ἄλλοις).

Cf. 2, 482a25: 'For it must needs be one of these three' (τριῶν γὰρ τούτων ἀναγκαῖον ἕν) and 9, 486b2.

9, 485b25: 'for a mixture of wine and honey differs on account of the underlying substance [of a different mixture]' (οἴνου μὲν γὰρ καὶ μέλιτος κρᾶσις διὰ τὸ ὑποκείμενον).

J.F. Dobson has here: 'for the consistencies of wine and honey are different on account of the difference of substance'; W.S. Hett 515: 'for mixtures of wine and honey differ because of their substance.'

Cf. *Sens.* 7, 447a17: 'it is more possible to perceive each individual thing when simple than when mixed with another. For instance it is easier to taste pure wine than wine mixed with water, and so also with honey, or with colour' (ἑκάστου μᾶλλον ἔστιν αἰσθάνεσθαι ἁπλοῦ ὄντος ἢ κεκραμένου, οἷον οἴνου ἀκράτου ἢ κεκραμένου, καὶ μέλιτος καὶ χρόας).

9, 485b26: 'but one quantity of wine differs from another through its constitution' (οἴνου δ' αὐτοῦ εἴπερ ἕτερα, διὰ τὸν λόγον).

Thus the manuscripts. W. Jaeger proposed to read ἑτέρα (with reference to another κρᾶσις). This is accepted by A. Roselli 129. The author means the difference between e.g. a wine from Lesbos and a wine from Rhodes.

9, 485b26: 'Hence Empedocles <speaks> too simply about the formation of bone, since [in his view] all bones have the same proportion in their mixture. In that case there ought to be no difference between

the bones of a horse and a lion or a man' (διὸ καὶ Ἐμπεδοκλῆς αἰτίαν ἁπλῶς τὴν τοῦ ὀστοῦ φύσιν *** εἴπερ ἅπαντα τὸν αὐτὸν λόγον ἔχει τῆς μίξεως ἀδιάφορα ἐχρῆν ἵππου καὶ λέοντος καὶ ἀνθρώπου εἶναι).

The purport of the sentence is entirely clear. The precise wording is by no means so. E. Neustadt (1909) already proposed to read μίαν instead of αἰτίαν. J.F. Dobson, at the suggestion of W.D. Ross, proposed: λίαν ἁπλῶς... φύσιν, <ἐπεὶ> εἴπερ.... A. Roselli 129 adopts λίαν, but retains a lacuna after φύσιν.

Instead of φύσιν it is possible to read: <φησίν>. This proposal comes from D. Holwerda, by letter of September 19, 2005.

Empedocles' exact position is found in D.K. 31 A 78: 'bones consisted of a mixture of two parts of water and earth and four parts of fire' (ὀστᾶ δὲ δυεῖν μὲν ὕδατος καὶ γῆς, τεττάρων δὲ πυρὸς [ἔσω γῆς] τούτων συγκραθέντων μερῶν). See Empedocles' own words in D.K. 31 B 96.

In *G.C.* I 1, 314b6–8 Aristotle specifies that Empedocles did not actually want to talk about 'the *physis* of a thing': 'There is no such thing as the birth of anything... only mixing' (φύσις οὐδενὸς ἐστιν... ἀλλὰ μόνον μίξις). Cf. D.K. 31 B 8 and Arist. *G.C.* II 6, 333b13–16; *Metaph.* Δ 4, 1105a1–3. See also *P.A.* I 1, 642a18–24: 'Empedocles... where he explains what bone is. He says there that it is not one of the elements, or two, or three, or all four, but a certain rational proportion of a mixture of elements. It is thus clear that flesh, too, exists in the same way, and likewise each of the other similar parts' (Ἐ.... ὀστοῦν ἀποδιδοὺς τί ἐστιν... λόγον τῆς μίξεως αὐτῶν (λέγει)) and *Anim.* I 3, 408a13–24.

9. 485b27: ' since [in his view] all bones have the same proportion in their mixture' (εἴπερ ἅπαντα τὸν αὐτὸν λόγον ἔχει τῆς μίξεως).

On Empedocles' theory, cf. *Anim.* I 5, 410a1–10 and I 4, 408a5–28, with 408a14: 'for the mixture of the elements does not have the same ratio for flesh and for bone' (οὐ γὰρ τὸν αὐτὸν ἔχει λόγον ἡ μίξις τῶν στοιχείων καθ' ἣν σὰρξ καὶ καθ' ἣν ὀστοῦν) and 408a22: 'any random mixture' (τῆς τυχούσης... μίξεως).

9, 485b28: 'In that case there ought to be no difference between the bones of a horse and a lion or a man' (ἀδιάφορα ἐχρῆν ἵππου καὶ λέοντος καὶ ἀνθρώπου εἶναι).

See earlier 485b20–21, where only 'horse' and 'ox' are mentioned. *P.A.* I 1, 639a17 mentions 'man, lion, ox' as examples; 639a25 'horses,

dogs, human beings'. As regards the lion, *P.A.* II 9, 655a12 states that it has stronger bones because it is a carnivore that must fight for its food, and *H.A.* III 7, 516b9–11: the bones of a lion are so hard that if you rub them together, they emit sparks.

9, 485b29: 'But in reality they differ in hardness, softness, density, and so on' (νῦν δὲ διαφέρει σκληρότητι, μαλακότητι, πυκνότητι, τοῖς ἄλλοις).

Cf. *P.A.* II 9, 655a10.

9, 485b35: 'But those who speak in this way must know...' (ἀναγκαῖον δὲ τοῖς οὕτω λέγουσιν εἰδέναι...).

This refers not just to people like Empedocles, who assumed one ratio of components in all bones (485b26), but to all Aristotle's opponents who hold that vital heat is not the efficient principle because fire can only work in one way (485a28–30).

9, 485b36: 'how the formative principle may differ because its own quantity varies or because something by itself or mixed or in something else is heated' (πῶς τὸ δημιουργοῦν ἕτερον εἴη ἂν καὶ τῷ τοῦτο πλέον ἢ ἔλαττον εἶναι, καὶ τῷ καθ' αὑτὸ καὶ <τῷ> μεμειγμένῳ ἢ ἐν ἄλλῳ πυροῦσθαι).

Aristotle enumerates the varying effects of heat even more extensively in *P.A.* II 2, 649a34–b8, where he also refers again to *Meteor.* IV 6–8.

As in 485b13, the 'formative principle' is identical with 'the vital heat' in 9, 485a28 and 'the fire of nature' in 9, 485a33. The distinction 'by itself' or 'mixed or in something else' probably also corresponds to the distinction of natural fire as 'instrument' and as 'matter' in 9, 485b6–7 and b16–17. Here, too, this is the instrumental body of the soul in its nutritive function.

9, 486a2: 'like the difference between something that is cooked and that is baked. Perhaps this is true' (καθάπερ τὰ ἑψόμενα καὶ ὀπτώμενα. ὅπερ ἴσως ἀληθές).

At the suggestion of E. Neustadt, W. Jaeger put this sentence between brackets as an interpolation. Likewise J. Tricot 194. J.F. Dobson has no objections and translates: 'like food that is boiled or baked—which last is perhaps the true explanation.' Likewise W.S. Hett 517 and P. Gohlke 175.

Cf. *Meteor.* IV 3, 381b6: 'craft imitates nature, for the concoction of food in the body is like boiling and also takes place in what is moist and hot on account of the body's vital heat' (μιμεῖται γὰρ ἡ τέχνη τὴν φύσιν, ἐπεὶ καὶ ἡ τῆς τροφῆς ἐν τῷ σώματι πέψις ὁποία ἐψήσει ἐστίν· καὶ γὰρ ἐν ὑγρῷ καὶ θερμῷ ὑπὸ τῆς τοῦ σώματος θερμότητος γίγνεται). 381a23: 'Baking takes place through dry external heat' (Ὄπτησις δ' ἐστὶν ὑπὸ θερμότητος ξηρᾶς καὶ ἀλλοτρίας).

9, 486a3: 'For the vital heat of nature is mixed with it and produces at the same time' (ἅμα γὰρ ἐγκαταμείγνυται καὶ ποιεῖ τὸ τῆς φύσεως).

Cf. 485b10: 'But it is remarkable that such a power should be combined with these matters' (τούτοις δὴ καταμεμεῖχθαι τοιαύτην δύναμιν θαυμαστὸν). The activity of the instrumental body is never separate from the soul as life form.

9, 486b1: 'For the same differences occur there, and most probably also in the vein and the *artèria*, and so on' (σχεδὸν δὲ καὶ περὶ φλεβὸς καὶ ἀρτηρίας καὶ τῶν λοιπῶν).

The use of ἀρτηρία here seems clearly to agree with the outlook of the author of *Spir.* So there is no objection to the translation 'windpipe' here. The windpipe of a human being and that of an ox are different in their composition.

9, 486b2: 'So one of the two' (ὥστε δυεῖν θάτερον).

Cf. 2, 482a25–26: 'For it must needs be one of these three' (τριῶν γὰρ τούτων ἀναγκαῖον ἕν) and 9, 485b24.

9, 486b3: 'or we should not try to determine the proportions [of the constitutive parts] for hardness and density and their opposites' (ἢ οὐ σκληρότητι καὶ πυκνότητι καὶ τοῖς ἐναντίοις τοὺς λόγους λήπτέον).

Bussemaker proposed to delete οὐ, but is not followed by J.F. Dobson: 'or the definitions must not be stated in terms of hardness, density, and their opposites.' Likewise W.S. Hett 517 and J. Tricot 194. P. Gohlke 175: 'oder aber man kann Härte und Dichte und deren Gegenteil nicht auf die Mischungsverhältnisse zurückführen.' Aristotle argues against Empedocles here that, if a ratio of the constitutive parts is involved, it must be different for each animal. Someone who does not accept this should not talk about a ratio of constitutive parts—cf. 9, 485a31–32; 485b1; 485b29–30; b32–34.

Cf. *Metaph.* H 2, 1042b31: 'We must therefore comprehend the various kinds of differences—for these will be principles of being—*i.e.* the differences in degree, or in density and rarity' (ληπτέα οὖν τὰ γένη τῶν διαφορῶν (αὗται γὰρ ἀρχαὶ ἔσονται τοῦ εἶναι), οἷον τὰ τῷ μᾶλλον καὶ ἧττον ἢ πυκνῷ καὶ μανῷ).

APPENDIX. *DE PARTIBUS ANIMALIUM* I 1

OPPOSING VIEWS ON RESPIRATION IN PLATO AND ARISTOTLE DISCUSSED IN *DE PARTIBUS ANIMALIUM* I 1, 642A31–B4

An important passage for the study of Aristotle's views on *pneuma* is found in *De partibus animalium* I 1. But so far modern expositors have not reached agreement on the actual purport of the passage. Some hold that it is entirely in keeping with what Aristotle argues in *De respiratione.* (P. Louis, 1956, 110 n. 6). Others deny this categorically and believe that Aristotle took his example from standard theories of the day (D.M. Balme, 1972, 101).

The famous first chapter of *P.A.* I discusses what method is best for investigating nature. In the passage relevant to our inquiry Aristotle seems to have given an example of how he himself thinks that such an investigation should be conducted. This makes it unlikely that the example merely relates to a theory held by others. Aristotle here must be either discussing a theory of respiration which he himself supports or drawing a contrast between a theory which he rejects and a view which he accepts.

P.A. I 1, 642a31–b4:

The Greek text reads as follows:

Δεικτέον δ' οὕτως, οἷον ὅτι ἔστι μὲν ἡ ἀναπνοὴ τουδὶ χάριν, τοῦτο δὲ γίνεται διὰ τάδε ἐξ ἀνάγκης.

ἡ δ' ἀνάγκη ὁτὲ μὲν σημαίνει ὅτι εἰ ἐκεῖνο ἔσται τὸ οὗ ἕνεκα ταῦτα ἀνάγκη ἐστὶν ἔχειν, ὁτὲ δ' ὅτι ἔστιν οὕτως ἔχοντα καὶ πεφυκότα.

τὸ θερμὸν γὰρ ἀναγκαῖον ἐξιέναι καὶ πάλιν εἰσιέναι ἀντικροῦον, τὸν δ' ἀέρα εἰσρεῖν. Τοῦτο δ' ἤδη ἀναγκαῖον ἐστιν, τοῦ ἐντὸς δὲ θερμοῦ ἀντικόπτοντος ἐν τῇ ψύξει τοῦ θύραθεν ἀέρος ἡ εἴσοδος καὶ ἡ ἔξοδος.

ὁ μὲν οὖν τρόπος οὗτος ὁ τῆς μεθόδου, καὶ περὶ ὧν δεῖ λαβεῖν τὰς αἰτίας, ταῦτα καὶ τοιαῦτά ἐστιν.

642b2: ἡ εἴσοδος omittit pr. E

W. Ogle, in *The Works of Aristotle*, translated into English under the Editorship of J.A. Smith; W.D. Ross, vol. V (Oxford 1912):

> Of the method itself the following is an example. In dealing with respiration we must show that it takes place for such or such a final object; and we must also show that this and that part of the process is necessitated by this and that other stage of it. By necessity we shall sometimes mean hypothetical necessity, the necessity that is, that the requisite antecedents shall be there, if the final end is to be reached; and sometimes absolute necessity, such necessity as that which connects substances and their inherent properties and characters. For the alternate discharge and entrance of heat and the inflow of air are necessary if we are to live. Here we have at once a necessity in the former of the two senses. [642b1] But the alternation of heat and refrigeration produces of necessity an alternate admission and discharge of the outer air, and this is a necessity of the second kind. (n. 1)
>
> In the foregoing we have an example of the method which we must adopt, and also an example of the kind of phenomena, the cause of which we have to investigate.

(N. 1: This passage defies all other than a paraphrastic rendering with some expansion.)

Comments on Ogle:

Ogle does more than just paraphrase. His passage 'For the alternate discharge and entrance of heat and the inflow of air are necessary if we are to live. Here we have at once a necessity in the former of the two senses' makes 'life' the final cause of respiration. But there is no basis for this in the Greek text.

Also, it is entirely unclear how Aristotle conceives of 'the alternate discharge and entrance of heat'.

Likewise 'the alternation of heat and refrigeration' is absent in the Greek text.

Aristotle, Parts of animals with an English translation by A.L. Peck (London 1937; repr. 1961).

A.L. Peck proposes to read in 642a34: ἀνάγκη ἐστὶν <οὕτως> ἔχειν.

His translation on p. 79 is as follows:

> Here is an example of the method of exposition. We point out that although Respiration takes place for such and such a *purpose*, any one stage of the process follows upon the others *by necessity*.

> Necessity means sometimes (a) that if this or that is to be the final cause and purpose, then such and such things must be so; but sometimes it means (b) that things are as they are owing to their very nature, as the following shows: It is necessary that the hot substance should go out and come in again as it offers resistance, and that the air should flow in—that is obviously necessary. And the hot substance within, as the cooling is produced, offers resistance, and this brings about the entrance of the air from without and also its exit.
>
> This example shows how the method works and also illustrates the sort of things whose cause we have to discover.

On p. 78 note b Peck notes: 'I have not attempted, except by one insertion, to straighten out the text of this confused account, which looks like a displaced note intended for the paragraph above (ending "realized"—p. 77). If it is to remain in the text, it would follow at that place (after 642a13) least awkwardly. For a more lucid account of the process of Respiration see *De resp.* 480a16–b5.'

Comments on A.L. Peck:

Peck rightly points out that a lucid exposition of Aristotle's theory of respiration can be found in *Resp.* The text in *P.A.* I 1 is by no means simply compatible with it.

Aristote, Les parties des animaux, texte établi et traduit par Pierre Louis (Paris 1956) 10:

> La mode de démonstration à adopter est celui-ci: il faut montrer, par exemple, que d'une part la respiration se produit en vue de telle fin, et que d'autre part cette fin s'atteint par tels moyens qui sont nécessaires.
>
> La nécessité signifie tantôt que la fin étant telle, il est nécessaire que telles conditions soient remplis, tantôt que les choses sont telles et qu'elles le sont par nature. Car il est nécessaire que la chaleur sorte puis rentre, par suite de la résistance qu'elle rencontre, et que l'air à son tour s'introduise. Voilà déjà une nécessité. D'autre part, comme la chaleur intérieure fait obstacle à l'entrée de l'air extérieur, cette entrée se produit quand il y a refroidissement. (n. 6)
>
> Tel est le genre de recherche, tels sont les faits dont il faut établir les causes.

On p. 171 Louis remarks in n. 6: 'Ces idées sont développées dans le traité *De la Respiration*: les principes qu'Aristote y expose sont tout à fait d'accord avec ceux qu'il résume ici.'

Comments on P. Louis:

It is surprising that Louis considers agreement with *Resp.* to be a fact. This work does not say anywhere that 'la chaleur sorte puis rentre'. Aristotle's theory is that the vital heat is present in the centre of the living creature, and, if necessary, is cooled by incoming and outgoing air as a result of the respiratory process.

Aristotle's De partibus animalium I *and* De generatione animalium I *(with passages from II 1–3)*, translated with notes by D.M. Balme (Oxford 1972), 10–11:

> Exposition should be as follows: for example, breathing exists for the sake of *this*, while *that* comes to be of necessity because of *those*. Necessity signifies sometimes that if there is to be *that* for the sake of which, *these* must necessarily be present; and sometimes that this is their state and nature. For the hot necessarily goes out and comes in again when it meets resistance, and the air must flow in; so much is already necessitated.
>
> And when the inner hot beats back, in the cooling occurs the inflow of the outside air and the outflow.
>
> [This then is the manner of the investigation, and these and such are the things about which one must obtain the causes.]

Balme provides an explanation on p. 101.

He calls the example 'obscure'. He also notes: 'This explanation of breathing is not what Aristotle gives as his own at *Resp.* 480a16–b12.... Aristotle often uses examples taken not from his own theories but from common beliefs, and this one may have been a current medical orthodoxy. Plato based his own theory of breathing on a similar account of the actions of hot and cold, though in other respects there is no similarity (*Timaeus* 79DE).'

Comments on Balme:

Precisely because Aristotle emphasizes that he wants to give an example of the right method, it is unlikely that he is merely offering a theory held by others. The allusion to Plato's *Timaeus* is important, though. The great dispute about respiration and breath was between Plato and Aristotle.

The complete Works of Aristotle. The Revised Oxford translation, ed. by J. Barnes, II vols, (Princeton 1984) vol. I 999–1000.

This is the translation by W. Ogle (1912) with modifications.

Aristoteles, Over dieren, vertaald, ingeleid en van aantekeningen voorzien door R. Ferwerda (Groningen 2000) 32–33:

> Een voorbeeld van hoe we onze uiteenzettingen moeten geven is het volgende.
>
> Ademhaling vindt plaats met dit en dit specifieke doel, en dit doel wordt door die en die dingen noodzakelijkerwijs bereikt.
>
> Noodzaak betekent hier nu eens dat, als iets het doel is ter wille waarvan iets anders gebeurt, die bepaalde dingen noodzakelijkerwijs voorhanden moeten zijn, dan weer dat dingen zo zijn als ze zijn, en wel van nature zo zijn. Zo is het noodzakelijk dat warmte naar buiten gaat en dan weer naar binnen gaat wanneer ze tegen lucht opbotst en terugslaat, en dat dan lucht naar binnen stroomt. Dit is alvast één noodzakelijkheid; en hoewel de warmte binnenin weerstand biedt komt bij het afkoelen de lucht van buiten af naar binnen (n. 35).
>
> In deze trant gaat ons onderzoek in zijn werk en dit is het soort verschijnselen waarvan we de oorzaken moeten vaststellen.

On p. 34 he explains in n. 35: 'Heat goes in and out to enable respiration, respiration takes place in order to cool the living creature: this is necessary to stay alive, and is therefore a conditional necessity. The outflow of the heat turns into an inflow as a side effect of refrigeration: this is the outcome of a contest between the contraries of hot and cold, and is therefore a natural necessity.'

Aristotle, On the parts of animals I–IV, translated with an introduction and comm. by J.G. Lennox (Oxford 2001) 8

> One should explain in the following way, e.g. breathing exists for the sake of *this*, while *that* comes to be from necessity because of *these*. But 'necessity' sometimes signifies that if that—i.e. that for the sake of which—is to be, it is necessary for these things to obtain, while at other times it signifies that things are thus in respect of their character and nature. For it is necessary for the hot to go out and enter again upon meeting resistance, and for the air to flow in. This is directly necessary; and it is as the internal heat retreats during the cooling of the external air that inhalation and exhalation occur. This then is the way of investigation, and it is in relation to these things and things such as these that one should grab the causes.

In his commentary on pp. 151–152 Lennox notes:

642a31–32: Cf. *PA.* IV 2, 677a17–18. The discussion is carefully constructed so that the contrast between teleology and necessity is first introduced, followed by the contrast between conditional necessity and a necessity rooted in an element's natural propensities.

642a35–b2: The example unfortunately is highly compressed and does not appear to represent Aristotle's own theory, according to which the lung is expanded by the organism, air naturally flows in to 'fill the void' caused by the expansion, and being cool this air reduces the heat around the heart. The lung then contracts, forcing the warmed air out (*Iuv.* 27 = *Resp.* 21, 480a25–b4).

Here, apparently, 'the hot (air?)' goes out, is 'beaten back' by the cool external air, and as the hot returns, external air flows in with it. This is apparently an example of what occurs necessarily as a consequence of having a certain character and being a certain way of nature. It is, we would say, the 'mechanics' of breathing, and it is to be viewed as embedded within a demonstration that this process of breathing is necessary for a certain end.

Comments on J.G. Lennox:

There is a clear tension between Lennox's claim that 'The discourse is carefully constructed' and his claim that the example given by Aristotle 'does not appear to represent Aristotle's own theory'.

It is also strange that Aristotle puts the main emphasis on teleology, but then discusses only 'the mechanics of breathing'.

Reconsideration

The first matter of importance is that Aristotle wants to give an example of the correct method of investigating natural phenomena in the sphere of living nature.

Another starting-point is that the theory endorsed here must agree with the Aristotelian view argued elsewhere in *P.A.* (and the *Parva naturalia*).

Aristotle wants to make it clear that respiration is a phenomenon which nature supports by means of a number of natural processes.

The passage talks about ψύξις, 'refrigeration'. In explaining it we must consider that Aristotle saw respiration solely as a function which serves to cool the internal vital heat of the living creature.

The passage also talks about τὸ θερμόν, 'vital heat'. We should consider that Aristotle had his own, unique view of vital heat, as the vital heat in every living creature, independent of respiration.

Proposal for a new translation with interpretation:

> We should organize our expositions as follows. For example: respiration functions for the sake of this [viz. for the sake of cooling the internal

vital heat], and this [goal] is necessarily achieved by means of such or such matters.

But 'necessity' [has several meanings. It] sometimes means

(a) that if this goal is to be realized, it must necessarily possess these matters, but sometimes (b) that things are thus and are thus by nature.

[According to Aristotle, an explanation along the lines of (b) is therefore insufficient: an explanation should follow (a).]

[First an explanation along the lines of (b) (rejected) is given.]

For heat necessarily goes out and, when it collides [with cold air], returns, and then air flows in. This [is the theory of Plato's *Timaeus* and this] is in fact necessary.

But [this leaves the goal of respiration out of account. Hence we should say that] because the vital heat offers resistance within, the reason why the outer air enters (and goes out again) lies in the refrigeration [of the internal vital heat].

This is the [right] method of our investigation. And this and the like are the matters of which we are to determine the causes.

For the meaning of ἐν in this explanation, cf. *Phys.* IV 3, 210a21: 'Again, as the affairs of Greece are in the King, and generally events are in their primary motive agent. Again, as a thing is in its good, and generally in its end, i.e. in that for the sake of which' (transl. by R.P. Hardie and R.K. Gaye) (ἐν βασιλεῖ τὰ τῶν Ἑλλήνων καὶ ὅλως ἐν τῷ πρώτῳ κινητικῷ. ἔτι ὡς ἐν τῷ ἀγαθῷ καὶ ὅλως ἐν τῷ τέλει· τοῦτο δ' ἐστὶ τὸ οὗ ἕνεκα).

If the above interpretation cuts ice, Aristotle finds the principal difference between himself and Plato's *Timaeus* in the fact that Plato neglects the 'for the sake of which' in his explanations. Note that the entire section on respiration in the *Timaeus* forms part of Plato's exposition in which he discusses 'Necessity' as cause.

In our interpretation, Arist. *PA.* I 1, 642a35–36: 'For heat necessarily goes out and, when it collides, returns, and then air flows in. This is in fact necessary' (τὸ θερμὸν γὰρ ἀναγκαῖον ἐξιέναι καὶ πάλιν εἰσιέναι ἀντικροῦον, τὸν δ' ἀέρα εἰσρεῖν. Τοῦτο δ' ἤδη ἀναγκαῖον ἐστιν), refers to Pl. *Tim.* 78d, which includes the following passage: 'The network sinks away into the body—for the body is rarefied in composition—and then moves out again. The internal rays of fire connected with the network follow the air in both directions' (τὸ δὲ πλέγμα, ὡς ὄντος τοῦ σώματος μανοῦ, δύεσθαι εἴσω δι' αὐτοῦ καὶ πάλιν ἔξω, τὰς δὲ ἐντὸς τοῦ πυρὸς ἀκτῖνας διαδεδεμένας ἀκολουθεῖν ἐφ' ἑκάτερα ἰόντος τοῦ ἀέρος...). See also *Tim.* 79d: 'We must admit that, by nature, heat goes to its own place, i.e. outside, to what is akin to it' (τὸ θερμὸν δὴ

κατὰ φύσιν εἰς τὴν αὐτοῦ χώραν ἔξω πρὸς τὸ συγγενὲς ὁμολογητέον ἰέναι) and 79e: 'The <air> impelled around which falls into the fire is heated, whereas the air which passes out is cooled' (τὸ δὲ περιωσθὲν εἰς τὸ πῦρ ἐμπῖπτον θερμαίνεται, τὸ δ' ἐξιὸν ψύχεται).

BIBLIOGRAPHY

Aristoteles, *De anima*

Aristotle, De anima, ed. with introd. and comm. by Sir David Ross (Oxford 1961).

Aristote, De l'âme, texte établi par A. Jannone; trad. et notes de E. Barbotin (Paris 1966; repr. 1980).

Aristoteles, De ziel, vertaling, inleiding, aantekeningen B. Schomakers (Leende 2000).

Aristoteles, *Fragmenta*

Aristotelis fragmenta selecta, rec. W.D. Ross (Oxford 1955; repr. 1964).

Aristotelis Librorum deperditorum fragmenta collegit et annotationibus instruxit O. Gigon (Berolini 1987).

Aristóteles, Fragmentos, introd., traducción y notas de Alvaro Vallejo Campos (Madrid 2005).

Aristoteles, *De generatione animalium*

Aristotle, Generation of animals with an English translation by A.L. Peck (London 1942).

Aristoteles, Over voortplanting vertaald, ingeleid en van aantekeningen voorzien door R. Ferwerda (Groningen 2005).

Aristoteles, *De generatione et corruptione*

Aristotle, On Coming-to-be and Passing-away, a revised text with introduction and comm. by H.H. Joachim (Oxford 1922; repr. Olms 1970).

Aristote, De la génération et de la corruption, texte établi et traduit par Ch. Mugler (Paris 1966).

Aristoteles, *Historia animalium*

Aristote, Histoire des animaux, texte établi et traduit par P. Louis, tome 1 (Paris 1964); t. 2 (1968).

Aristotle, Historia animalium in three volumes with an English translation by A.L. Peck and D.M. Balme (London vol. I 1965; vol. II 1970; vol. III 1991).

Aristoteles, *De motu animalium*

Aristote, Marche des animaux. Mouvement des animaux, Index des Traités biologiques. Texte établi et traduit par P. Louis (Paris 1973).

Aristotle's De motu animalium. Text with translation, comm. and interpretive essays by M.C. Nussbaum (Princeton 1978; repr. 1985).

Aristoteles, Over dieren, vertaald, ingeleid en van aantekeningen voorzien door R. Ferwerda (Groningen 2000).

Aristoteles, *De mundo*

Reale, G.; Bos, A.P., *Il trattato Sul cosmo per Alessandro attribuito ad Aristotele.* Monografia introduttiva, testo greco con traduzione, commentario, bibliografia ragionata e indici (Milano 1995).

Aristoteles, *Opera omnia*

The Works of Aristotle, transl. into English under the editorship of W.D. Ross, vol. III (Oxford 1931) *De spiritu* by J.F. Dobson (first edition 1914).

The Complete works of Aristotle. The Revised Oxford Translation, ed. by J. Barnes (Princeton 1984) 2 vols.

Aristoteles, *De partibus animalium*

Aristotle, Parts of animals with an English translation by A.L. Peck; *Movement of animals, Progression of animals* with an English translation by E.S. Forster (London 1937; repr; 1961).

Aristote, Les parties des animaux, texte établi et traduit par P. Louis (Paris 1956).
Aristoteles, Over dieren, vertaald, ingeleid en van aantekeningen voorzien door R. Ferwerda (Groningen 2000).
Aristoteles, *Parva naturalia*
Aristoteles, Kleine Schriften zur Seelenkunde, übers. von P. Gohlke (Paderborn 1947; repr. 1953).
Aristotle, On the soul; Parva naturalia; On breath with an English transl. by W.S. Hett (London 1936).
Aristote, Parva naturalia suivis du Traité Ps.-aristotélicien De spiritu, trad. nouvelle et notes par J. Tricot (Paris 1951).
Aristotle, Parva naturalia, a revised text with introduction and comm. by W.D. Ross (Oxford 1955).
Aristotelis Parva naturalia graece et latine ed., versione auxit, notis illustravit P. Siwek s.j. (Romae 1963).
Aristoteles, *De spiritu*
Aristotelis De animalium motione et De animalium incessu; Pseudo-Aristotelis de Spiritu libellus, ed. V.G. Jaeger (Leipzig 1913).
[Aristotele] De spiritu a cura di A. Roselli (Pisa 1992) [with a revised Greek text based on a collation of additional manuscripts and with a critical apparatus, translation and commentary].

Annas, J.E., *Hellenistic Philosophy of Mind* (Berkeley/Los Angeles/Oxford 1992).
Bechtel, F., *Die historischen Personennamen des Griechischen bis zur Kaiserzeit* (Halle 1917; repr. Darmstadt 1964).
Bonitz, H., *Index Aristotelicus* (Berlin 1870; repr. Graz 1955).
Bos, A.P., *De ziel en haar voertuig. Aristoteles' psychologie geherinterpreteerd en de eenheid van zijn oeuvre gedemonstreerd* (Leende 1999; 2nd ed. Budel 2005).
——, '"Fire above": the relation of soul to its instrumental body in Aristotle's *De longitudine et brevitate vitae* 2–3', *Ancient Philosophy* 22 (2002) 303–317.
——, *The Soul and its Instrumental Body. A Reinterpretation of Aristotle's Philosophy of Living Nature* (Leiden 2003).
——, 'Aristotle on dissection of plants and animals and his concept of the instrumental soul-body', *Ancient Philosophy* 27 (2007) 95–106.
Bos, A.P.; Ferwerda, R., 'Aristotle's *De spiritu* as a critique of the doctrine of *pneuma* in Plato and his predecessors', *Mnemosyne* 55 (2007) 565–588.
Bremmer, J., *The Early Greek Concept of the Soul* (Princeton 1983).
Claghorn, G.S., *Aristotle's Criticism of Plato's* Timaeus (The Hague 1954).
Coles, A., 'Biomedical Models of Reproduction in the Fifth Century BC and Aristotle's *Generation of animals*', *Phronesis* 46 (1995) 48–88.
Damascius, In Platonis Phaedonem, ed. L.G. Westerink (Amsterdam 1977).
Duprat, G.L., 'La théorie du πνεῦμα chez Aristote', *Archiv für Geschichte der Philosophie* 12 (1899) 305–321.
Empedokles, Aarde, lucht, water en vuur, vertaald en toegelicht door R. Ferwerda (Amsterdam 1997; 2nd ed. Budel 2006).
Eijk, P.J. van der, 'Between the Hippocratics and the Alexandrians: Medicine, philosophy and science in the fourth century BCE', in R.W. Sharples (ed.), *Philosophy and the Sciences in Antiquity* (London 2005) 72–109.
——, *Medicine and Philosophy in Classical Antiquity. Doctors and Philosophers on Nature, Soul, Health and Disease* (Cambridge 2005).
Ferwerda, R., 'Het inwendig oventje. De rol van warmte in het denken van Aristoteles over spijsvertering en voortplanting en over de positie van de vrouw', *Filosofie* 11 (2001) 3, 17–26.
Freudenthal, G., *Aristotle's Theory of Material Substance. Heat and Pneuma, Form and Soul* (Cambridge 1995).

Gohlke, P., *Die Entstehung der Aristotelischen Prinzipienlehre* (Tübingen 1949).
Harris, C.R.S., *The Heart and the Vascular System in Ancient Greek Medicine* (Oxford 1973).
Hein, C., *Definition und Einteilung der Philosophie. Von der spätantiken Einleitungsliteratur zur arabischen Enzyklopädie* (Frankfurt am Main/Bern/New York 1985).
Jaeger, W., 'Das *Pneuma* im Lykeion', *Hermes* 48 (1913) 29–74; repr. in id. *Scripta minora* (Roma 1960) 57–102.
Kenny, A., *The Aristotelian Ethics. A Study of the Relationship between the Eudemian and Nicomachean Ethics of Aristotle* (Oxford 1978).
——, *Essays on the Aristotelian Tradition* (Oxford 2001).
King, H., 'Making a man. Becoming human in early Greek medicine', in G.R. Dunstan (ed.), *The Human Embryo. Aristotle and the Arabic and European Traditions* (Exeter 1990) 10–19.
Lennox, J.G., *Aristotle's Philosophy of Biology. Studies in the Origins of Life Science* (Cambridge 2001).
Liddell, H.G., Scott, R., Jones, H.S., *A Greek English Lexicon* (Oxford, 9th ed. 1940; repr. 1961) (L.S.J.)
Lloyd, G.E.R., *Aristotelian Explorations* (Cambridge 1996).
Longrigg, J., 'A Seminal 'Debate' in the Fifth Century B.C.?', in: A. Gotthelf (ed.), *Aristotle on nature and living things. Philosophical and historical studies presented to D.M. Balme* (Bristol 1985) 277–287.
Mayhew, R., *The Female in Aristotle's biology* (Chicago 2004).
Moraux, P., *Les listes anciennes des ouvrages d'Aristote* (Louvain 1951).
Neustadt, E., 'Ps.-Aristoteles, *Peri pneumatos* c. IX und Athenaios von Attalia', *Hermes* 44 (1909) 60–69.
Nicolaus Damascenus, De plantis. Five Translations, ed. and introd. by H.J. Drossaart Lulofs; E.L.J. Poortman (Amsterdam 1989).
Nussbaum, M.C.; Oksenberg Rorty, A. (eds), *Essays on Aristotle's* De anima (Oxford 1992).
Onians, R.B., *The Origins of European Thought. About the Body, the Mind, the Soul, the World, Time and Fate* (Cambridge 1951; repr. 1973).
Platon, Timée/Critias, traduit par L. Brisson (Paris 1992).
Plato's cosmology. The Timaeus *of Plato* transl. with a running commentary by F.M. Cornford (London 1937).
Plato, Verzameld werk. Nieuwe, geheel herziene uitgave van de vertaling van Xaveer de Win, bewerkt door Jef Ector, Rein Ferwerda, Ko Kleisen, Carlos Steel en anderen (Kapellen/Baarn 1999).
Pohlenz, M., *Die Stoa. Geschichte einer geistigen Bewegung* II vols (Göttingen 2nd ed. 1959).
Preus, A., 'Aristotle's *Parts of animals* II 16, 659b13–19: is it authentic?', *Classical Quarterly* 18 (1968) 270–278.
Regenbogen, O., 'Theophrastos', in *P.W.-R.E.* supplem. vol. VII (Stuttgart 1940) 1354–1562.
Rose, V., *De Aristotelis librorum ordine et auctoritate* (Berlijn 1854).
Solmsen, F., 'The vital heat, the inborn *pneuma* and the aether', *Journal of Hellenic Studies* 77 (1957) 119–123; repr. in id., *Kleine Schriften* vol. I (Hildesheim 1968) 605–611.
——, 'Cleanthes or Posidonius? The basis of Stoic physics', in *Meded. der Kon. Nederl. Akademie van Wetenschappen*, afd. Letterkunde, Nieuwe Reeks vol. XXIV (1961) 265–289; repr. in id. *Kleine Schriften*, vol. I (Hildesheim 1968) 436–460.
Thivel, A., 'Air, pneuma and breathing from Homer to Hippocrates', in Ph.J. van der Eijk, *Hippocrates in Context* (Leiden 2005) 239–249.
Wellmann, M., 'Aristogenes', in *P.W.-R.E.* II 1 (Stuttgart 1895) cols. 932–933.
Zeller, E., *Die Philosophie der Griechen in ihrer geschichtlichen Entwicklung*, Zweiter Teil, Zweite Abteilung, 'Aristoteles und die alten Peripatetiker' (Leipzig, 4th ed. 1921; repr. Hildesheim 1965).

INDEX LOCORUM

INDEX NOMINUM