

Texts and Documents

Blood, Monsters, and Necessity in Malpighi's *De Polypo Cordis*

DOMENICO BERTOLONI MELI*

Introduction

The recent laudable translation of Malpighi's *De polypo cordis* has made widely available one of the most significant anatomical texts of the seventeenth century.¹ One of the treatise's most noteworthy features is the idea that the study of morbid states not only helps in the investigation of disease and therapy, but also in the understanding of the normal processes and constituents of the body, notably growth and blood. Malpighi's analysis of the formation of heart polyps led him to a tentative explanation of normal growth, one of the natural faculties of the Galenic tradition, on the basis of "the necessity of matter", without any teleological principle acting to the animal's benefit. In addition, the study of heart polyps provided Malpighi with the opportunity for investigating their constituents and therefore the constituents of blood.

This essay details the circumstances of composition and publication date of Malpighi's work, shedding light on the peculiar publishing practices adopted. Secondly, I focus on the methodological significance of Malpighi's work, arguing that the difficulties he encountered in his research on the spleen and the heart polyp led him to develop a method of inquiry which I call the "microscope of disease". Lastly, I provide new translations and interpretations of some crucial passages in *De polypo cordis*. The first two deal with the polyp's formation process and its general significance in revealing how the body works, the other with the material forming the polyp and the constituents of blood.

The Publication Background

De polypo cordis appeared as the fifth and last essay of *De viscerum structura exercitatio anatomica. Accedit dissertatio de polypo cordis* (Bologna, ex Typographia Iacobi Montij, 1666). In the introduction to his Italian translation of *De polypo cordis*, Luigi Belloni acutely surmised that the date appearing on the title page was

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especially Anita Guerrini. I claim sole responsibility for all remaining errors and inaccuracies.

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¹ J M Forrester, 'Malpighi's *De polypo cordis*: an annotated translation', *Med. Hist.*, 1995, 39: 477–92.

Domenico Bertoloni Meli

DE VISCERVM
STRUCTVRA
EXERCITATIO
ANATOMICA
MARCELLI MALPIGHII

Philos. & Med. Bononien. in Massa-
nensi Academia Medicinæ
Primarij.



B O N O N I Æ,

Ex Typographia Jacobi Montij. MDCLXVI.

Superiorum permissa.

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Figure 1: Title-page of the three-treatise edition of Malpighi's *De viscerum structura* of 1666. Courtesy, The Lilly Library, Indiana University, Bloomington, Indiana.

not correct, namely the work was not published in 1666 but two years later.² Belloni also noticed that *De polypo cordis* and *De liene* referred to dissection reports which he was able to identify among Malpighi's manuscripts. The reports are generally dated around 1667, but one of them mentioned both in *De liene* and *De polypo cordis* refers to an unnamed woman who had died at the Bolognese "Ospedale della

² M Malpighi, *Opere scelte*, Turin, UTET, 1967, introduction and notes by L Belloni (hereafter *MOB*), pp. 189–216, on p. 193. Forrester does not quote the Italian translation of *De polypo cordis* by Belloni, whose works on

Malpighi in my opinion come second only to Adelman's. Belloni's introduction, pp. 191–4, reconstructs the background of Malpighi's researches on blood.

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Figure 2: Title-page of the five-treatise edition of Malpighi's *De viscerum structura* containing *De polypo cordis* and *De liene*, probably published in 1668 with a 1666 imprint. Courtesy of the National Library of Medicine.

Vita" and is dated 5 January 1668.³ Therefore, neither work could have appeared before that date.

Belloni's views can be proved beyond doubt on the basis of two additional elements. First, we have copies of *De viscerum structura* where the last two treatises on the spleen

³ Malpighi's manuscripts, Bologna, Biblioteca Universitaria, 2085 vol. XII, fol. 61v. L Münster, 'Anatomica sive in cadaveribus sectis observationes', in Università di Bologna, *Celebrazioni malpighiane. Discorsi e scritti*, Bologna, Azzoguidi, 1966, pp. 170–209, on p.

194. *MOB*, pp. 419–20. Forrester, op. cit., note 1 above, p. 488; M Malpighi, *Opera omnia*, 2 vols, London, R Scott & G Wells, 1686, vol. 2, p. 129, where the crucial passage is identified by the words: "ut in Virgine novissimè deprehendi".

and heart polyp are missing from the text and the words “*Accedit dissertatio eiusdem de polypo cordis*” are lacking from the title page, where a different printer’s device has been used⁴ (Figures 1 and 2). Secondly, several letters by Malpighi confirm that *De viscerum structura* was completed in two stages and that in 1667 he was working on the still unpublished *De liene*.⁵ The same must have been true for the treatise following it, namely *De polypo cordis*. Thus only a portion of the work appeared in 1666.

The first unequivocal evidence that the whole five-treatise work was completed comes from Malpighi’s letter of 1 April 1668, to the Secretary of the Royal Society, Henry Oldenburg. Thus the complete *De viscerum structura* was most likely published in March 1668. Oldenburg received it late that year and reviewed it immediately in the *Philosophical Transactions*.⁶ Although Malpighi had criticized the views of several English anatomists, the review appreciated both his great “modesty” and important contributions to anatomy, and announced that John Martyn was reprinting the book in London, where it appeared in 1669. *De viscerum structura* was reprinted many more times in the seventeenth century in Italy, France, the Netherlands, Germany, and England, thus becoming one of the most widely known and influential anatomical texts of its time.

An examination of the three-treatise and five-treatise editions shows how the book was produced. The former consists of a title page and one hundred quarto pages. The latter was produced by replacing the old title page with a new one followed by a dedication, index, and imprimatur information without a date. In addition, pages 97–100 were also removed and replaced with pages 97–172. This explains why the three-treatise edition is so rare as to have been omitted in Carlo Frati’s *Bibliografia malpighiana*, i.e., most of its copies were incorporated in the five-treatise edition.⁷

The Microscope of Disease

This reconstruction of the book’s production phases is not merely a bibliographic curiosity. Malpighi considered *De liene* as more problematic than his three preceding treatises and therefore devoted additional research to it relying on elaborate experimental techniques including blowing air into the splenic vein, maceration in

⁴ The correspondence of Marcello Malpighi, ed. by H B Adelman, 5 vols, Ithaca, Cornell University Press, 1975 (hereafter *MCA*), vol. 1, pp. 325–6, n. 1. These copies are located at the Lilly Library, Bloomington, and Yale Medical Library, New Haven. See also Indiana University, Lilly Library, *Medicine. An exhibition of books relating to medicine and surgery from the collection formed by J.K. Lilly*, prepared by David A Randall, assisted by J Q Bennett, Bloomington, Indiana, [1966], p. 38.

⁵ *MCA*, vol. 1, pp. 348–9, Malpighi to Henry Sampson, May 1667. The crucial passage reads (my emphasis): “Gaudeo Virum Clarissimum difficillimam de liene et ipsum assumpsisse provinciam in cuius structura visceris licet ego aliqua detexerim nundum tamen typis committere licuit ob otij indigentiam et quoniam in animo est

haec consimilibus et analogis reliquarum partium structuris confirmare ideo procrastinatur editio. Habeas interim opusculum quod elapso anno de viscerum structura evulgavi”. Ibid., p. 336 and p. 377, Capucci to Malpighi, 21 January 1667 and 24 July 1668.

⁶ *Philosophical Transactions*, 1668/9, 3: 888–91. *MCA*, vol. 1, pp. 373–6, n. 22.

⁷ The three-treatise edition has signatures A–M⁴N². Pages 97–100, N1–N2, were replaced with pages 97–172 with signatures N–X⁴ Y². A comparison between pages 97–100 in the two editions readily shows that those pages were reset for the five-treatise edition, i.e. some of the words are spelt differently. The three-treatise edition is omitted in C Frati, *Bibliografia malpighiana*, London, Dawson’s of Pall Mall, no date, originally published in 1897.

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water, and injections of air, mercury, and ink. His main aim was to identify analogous fundamental micro-structures in the liver, cerebral cortex, kidneys, and spleen, namely glands filtering blood.⁸ Thus from this perspective, *De hepate*, *De cerebri cortice*, *De renibus*, and *De liene* form a cohesive whole based on the identification of the structure of the respective organs as glandular.

From another perspective, however, *De liene* and *De polypo cordis* share a common feature, namely both refer for the first time in Malpighi's published work to specific evidence from dissection reports in order to investigate normal function. Thus they show similarities with regard to the method of inquiry. This important feature requires elaboration. Diseased states had been studied for centuries through post-mortem dissections in order to investigate the nature of disease and how it affects body parts. Autopsies were performed in order to investigate cases of poisoning, hereditary diseases, and even in cases of plague.⁹ This is how William Harvey emphasized their significance in his first reply to Jean Riolan the younger in 1649:¹⁰

For just as the dissection of healthy and well-conditioned bodies is of very great help in advancing natural knowledge and correct physiology, so is the inspection of diseased and cachectic bodies of very great assistance in the understanding of pathology. The contemplation of those things which are normal is physiology, and it is the first thing to be learned by medical men. For that which is normal is right and serves as a criterion for both itself and the abnormal. By defining in its light departures from it and unnatural reactions, pathology becomes more clearly obvious for the future, and from pathology the practice and art of therapeutics and opportunities for discovering multiple new remedies, derive. Nor would one readily believe the extent to which the inner parts are corrupted in diseases, especially those of long standing, and what horrible monstrosities are produced in those parts by disease. And, if I may so state, one dissection and opening up of a decayed body, or of one dead from chronic disease or poisoning, is of more value to medicine than the anatomies of ten people who have been hanged.

Harvey is following a two-track system, dissections of healthy bodies establish correct physiology, dissections of diseased bodies are crucial to pathology. The former is the foundation of the latter, but pathology does not help physiology.

By contrast, Malpighi consciously used pathology in the study of physiology and closed the methodological circle. *De polypo cordis* is a treatise on blood where the diseased states found in dissected cadavers are described as monsters and *ludus Naturae*, or a joke of nature. Interestingly, monstrosities were mentioned by Harvey too in the passage quoted above. According to Malpighi, these diseased states shed light on the body's normal operations for two main reasons. They monstrously enlarge body parts and thus reveal their inner structures. Both the spleen and the blood are investigated in this fashion, and diseased states reveal glandular structures

⁸ See the letter to Sampson in *MCA*, vol. 1, pp. 348–9. H B Adelman, *Marcello Malpighi and the evolution of embryology*, 5 vols, Ithaca, Cornell University Press, 1966 (hereafter Adelman), vol. 1, pp. 307–11.

⁹ Useful examples are in K Park, 'The criminal and saintly body: autopsy and dissection in Renaissance Italy', *Renaiss. Q.*, 1994, 47:1–33,

and *idem*, 'The life of the corpse: division and dissection in late medieval Europe', *J. Hist. Med. Allied Sci.*, 1995, 50:111–32.

¹⁰ W Harvey, *Exercitationes duae anatomicae de circulatione sanguinis*, Cambridge, Roger David, and Rotterdam, Arnold Leers, 1649, transl. by K J Franklin, Oxford, Blackwell, 1958, p. 10 (original Latin at p. 106).

in the former, and the components of blood in the latter. Throughout his life, Malpighi was concerned with making minute body parts visible and therefore available to investigation in a variety of ways. Besides using several optical devices, he had recourse to a wide range of healthy animals and then selected those whose organs allow easiest access. In his studies on the lungs he famously had recourse to frogs, in his study of the liver he started with snails, and virtually all his works reveal how he employed this method. Belloni pointed out that later in the century Johann-Conrad Brunner aptly called this way of researching “microscopium naturae”, the microscope of nature. In the same way as the lens microscope enlarges and at times reveals body parts which would otherwise be indistinct or invisible, nature provides anatomists with a way of accomplishing the same task by moving across different species of the animal kingdom. In his work Malpighi combined the optical microscope and the microscope of nature.¹¹ By analogy with Brunner’s denomination, one could say that in *De liene* and *De polypo cordis* Malpighi started to employ a new method of inquiry, the “microscope of disease”, namely he used disease, with due caution and constantly comparing diseased states with normal ones, as a magnifying lens.

Moreover, according to Malpighi’s claims in *De polypo cordis*, diseased states reveal the *necessitas materiae et motus* and *determinata inclinatio* at work. The operations of the body are the same in health and disease and depend on the laws governing matter. Implicit in these views is the rejection of teleology and of the role of the soul and its faculties. Unfortunately, although we know that Malpighi’s teacher Andrea Mariani was about to publish a treatise on the heart polyp when he died in 1662, we do not know whether the teacher inspired the pupil in the method of investigation as well as the subject matter.¹²

Soon after his return to Bologna from Messina in 1666, Malpighi started recording in his diary the post-mortem dissections he had performed or witnessed. Since none of them dates from his stay at Messina, we may surmise that post-mortems were more common at Bologna. At a later stage he organized these reports by disease or affected organ, copying most of them from his diary to a booklet called *Anatomica*, where the earliest is dated 6 August 1666. If the reports in *Anatomica* are arranged chronologically, it appears that the first eight, to January 1669, show, not surprisingly, an interest in the topics he had just covered, or was still investigating, in *De viscerum structura*, notably the glandular structure of the liver (first two reports), the glandular structure of the spleen (third and sixth reports), and heart polyps (second and fourth to eight reports).¹³ Beginning with his two 1668 tracts, evidence from dissection reports represents an important feature of Malpighi’s works on human anatomy, notably his letter to Jacob Spon, *De structura glandularum conglobatarum* (London, 1689), and the posthumous *Vita a seipso scripta* (London, 1697). In his 1689 work on the structure of glands, Malpighi stated that after he had been unable for several

¹¹ J C Brunner, *Exercitatio anatomico-medica de glandulis in intestino duodeno hominis detectis*, Heidelberg, C E Buchta, 1688, p. 12, referred to in *MOB*, p. 24, n. 8.

¹² Adelman, vol. 1, p. 311.

¹³ *MOB*, pp. 415–22. The third report is not fully transcribed by Belloni. The missing part contains references to the spleen and can be found, together with the original Latin of all reports, in Münster, op. cit., note 3 above, at p. 204.

lustra to advance in his investigations, new light was shed by the glands of oxen pathologically enlarged by obstructions to the size of a hand or a goose egg. His conclusion was that glands consist of blood vessels, a nervous connection and an excretory duct, with a follicle in the centre. Thus in that work he combined two methods of investigation, the microscope of nature and the microscope of disease.¹⁴

The investigations based on morbid anatomy and monsters in order to understand the normal structures and operations of the body in *De liene* and especially *De polypo cordis* became known throughout Europe. By the beginning of the eighteenth century, this method was so widely accepted and recognized, that Bernard de Fontenelle, permanent secretary of the Paris Académie Royale des Sciences, referred to it in his history of the Académie with words closely resembling Malpighi's, emphasizing both the methods of investigating different animals and of using monsters as a key to unlock the secrets of normal bodily operations.¹⁵

The *Necessitas Materiae* in Action

With this background, I now turn to an exegesis of some important passages in *De polypo cordis*. The crucial expression *necessitas materiae* occurs twice in the text, in the opening and about half-way down the essay. Since the two occurrences are related, I treat them in turn. The first reads (my emphases in the original and translation):¹⁶

¹⁴ Malpighi's diary is at Bologna, Biblioteca Universitaria, 2085 vol. II. A description of Malpighi's manuscripts is in D Bertoloni Meli, 'The archive and *consulti* of Marcello Malpighi', in M Hunter (ed.), *Archives of the Scientific Revolution*, Woodbridge, Boydell, 1998, pp. 109–20, on pp. 110–11. The letter to Spon from Bologna, dated 1 November 1681, appeared in *Philosophical Transactions*, 1684–5, 14:601–8 and 630–46. In *MOB* Belloni provided extensive cross-references between Malpighi's publications and his post-mortem reports in *Anatomica. De structura glandularum conglobatarum* can be found with separate pagination in M Malpighi, *Opera posthuma*, London, A & J Churchill, 1697, esp. p. 2.

¹⁵ B de Fontenelle, *Histoire du renouvellement de l' Académie Royale des Sciences*, Amsterdam, Pierre de Coup, 1709, p. 11: "Mais telle partie dont la structure est dans le Corps humain si délicate ou si confuse qu'elle en est invisible, est sensible & manifeste dans le corps d'un certain Animal. Delà vient que les Monstres même ne sont pas à négliger. La Méchanique cachée dans une certaine espece ou dans une structure commune se développe dans une autre espece, ou dans une structure extraordinaire, & l'on diroit presque que la Nature à force de multiplier & de varier ses ouvrages, ne peut s'empêcher de trahir quelquefois son secret". L Daston and K Park,

Wonders and the order of nature, 1150–1750, New York, Zone Books, 1998, p. 204, refer to this passage in dating the establishment of a new role of monsters, outlined by Malpighi in *De polypo cordis*, to the beginning of the eighteenth century.

¹⁶ Forrester, op. cit., note 1 above, p. 479. The most significant difference from Forrester's translation is my explicit rendering of the expression "*necessity of matter, and determined inclination*". A similar expression, "*sola materiae necessitate*", occurs elsewhere in Malpighi's essay and is translated differently by Forrester (see below): "Remarkable morbid states commonly arise in living creatures, through the caprices of Nature or the vagaries of disease. These states I have always considered as shedding much light on the investigation of Nature's true normal method of operation; they indicate the constraints and tendencies of the material which stands revealed in the construction of the animal body. And so monsters, and other mistakes, dissipate our ignorance more easily and reliably than the remarkable perfected mechanisms of Nature. Thus, from the study of insects, fishes, and the first simple stages in the development of animals, the present age has learnt many a lesson denied to its predecessors, preoccupied exclusively as they were with the perfected animal." See also *MOB*, p. 195. *Opera omnia*, vol. 2, p. 123.

Morbosas constitutiones, quas Naturae ludentis, vel vi morbi aberrantis frequenter in animalium corporibus excitatas miramur, plurimum lucis pro rimanda ejusdem genuina operandi norma, & methodo conferre perpetuo credidi, quandam enim *materiae necessitatem, & determinatam inclinationem* demonstrant, quae in compingenda animalium mole elucescit, ita ut monstra, caeterisque errores facilius, & tutius nostram erudiant insipientiam, quam mirabiles, & perpolitae Naturae machinae: hinc plura didicit praesens hoc saeculum insecta, pisces, primaque & rudia nascentium animalium *stamina* lustrans, quam anteaetate priscorum aetates circa sola perfectorum corpora sollicitae.

I have always believed that the morbid states which we see frequently arising in the bodies of animals due to the jokes of Nature or the strength of aberrating disease, shed much light on the investigation of Her true norm and method of operation. In fact those morbid states indicate a *necessity of matter, and determined inclination* revealed in the construction of the animal body. Thus monsters and other mistakes dissipate our ignorance more easily and reliably than the remarkable and perfected mechanisms of nature: hence the present century has learnt more from studying insects, fishes, and the first unformed warps in the development of animals, than have all the preceding ages exclusively interested in the bodies of perfect animals.

This is the striking opening which set the scene for a sustained programme of investigations, by Malpighi and others, using not only generation and lower animals, but also pathological states, jokes of nature, and monsters as keys for understanding the body's normal structures and operations. Here "jokes of nature" have to be interpreted not in Renaissance fashion as bizarre objects resulting from a playful nature, but as the outcome of the same necessary laws governing the normal course of nature and as crucial tools for uncovering those laws.¹⁷

I consider this passage together with the later one where the expression *necessitas materiae* occurs (my emphases in the original and translation):¹⁸

Nec levia haec mirabitur, qui in assidua animalium sectione naturae industriam in morborum tumoribus, aequae ac in

These things will not seem insignificant to anyone who, by assiduously dissecting animals, comprehends the

¹⁷ These issues are investigated in P Findlen, 'Jokes of nature and jokes of knowledge: the playfulness of scientific discourse in early modern Europe', *Renaiss. Q.*, 1990, 43: 292–331.

¹⁸ *Opera omnia*, vol. 2, p. 128. Forrester, op. cit., note 1 above, pp. 486–7: "All this will seem remarkable and significant to anyone who diligently dissects animals, and studies the painstaking work of Nature, both in morbid tumours and in creating the structure of organs; for her pattern is generally the same. For instance, I recall finding that an iron needle, on its way out from the fleshy stomach of a hen, was invested with a strong double membranous covering, and a coating of fat as well. It is hard to believe that all this occurs through mere physical motion and necessity, without any

influence acting for the animal's benefit.

"Similarly, in certain tumours of the lungs, liver, and elsewhere, numerous integuments or bladders progressively build up, one outside another, and the accumulation of similar growths can be regarded as polypous in nature, for presumably the material and mode of production is comparable. Numerous layers can develop from a network of threads, in accordance with a normal law of nature. Then, if what lies between the threads is watery incoagulable ichor, such as abounds in this sort of tumour, the layers can remain separate all round." I find the rendering of "Dubitare possumus" as "It is hard to believe" and the insertion of a new paragraph between the correlative "Ita . . . ; ita . . ." objectionable. See also *MOB*, p. 207.

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partium ducendis *staminibus* apprehendit, cùm ferè eadem incedat methodo. Ità memini ferream acum extra gallinae carnosum ventriculorum erumpentem bino membranoso, hócque valido involucro, inducta etiam pinguedine, munitam vidisse; & dubitare insuper possumus sola *materiae necessitate, & motu* haec omnia contingere, nullo in animalis usum dirigente motore: ità in quibusdam tumoribus in pulmonibus, hepate, & alibi excitatis circumvolutiones seu multiplices vesicae, quarum amplior minorem continet, et ità successivè coagulantur, consimilium tumorum, conglobatio ad Polyposam naturam reduci potest, cum eadem probabiliter materia, & productionis ratio in utrisque consimilis sit, nam ex *filamentorum* implicatione ex consueta *naturae lege* multiplices tunicae efformari possunt, inter quas si mediet non concretescibilis, sed aquosus ichor, qualis in hujusmodi tumoribus abundat, solutae undequaque tunicae permanere valent.

industry of nature both in morbid tumours and in the creation of the parts' *warps*, because her method of proceeding is nearly identical. For instance, I recall noticing that an iron needle bursting out of the fleshy stomach of a hen, was covered with a strong double membrane and a coating of fat as well. Moreover, we can consider whether all these things happen by the *sole necessity of matter and motion*, without anything acting to the animal's benefit. Similarly, in certain tumours arisen in the lungs, liver, and elsewhere, integuments or multiple bladders are joined, where the larger encloses the smaller and thus successively. The conglobation of similar tumours can be regarded as polypous in nature, for the matter and mode of production in both cases is presumably the same. In fact, following the usual *law of nature*, from a network of *threads* several layers can be formed, which can remain everywhere separate if what lies between them is not coagulable, but is the watery fluid which abounds in tumours of this species.

Malpighi establishes a near structural identity between normal growth and the formation of polyps, membranous coverings of external objects, and tumours. Growth was traditionally considered to be one of the natural faculties, together with nutrition and generation.¹⁹ The passage above, however, tentatively accounts for growth in terms of *laws of nature* which are not peculiar to living beings, whether plants or animals. Interestingly, in both passages Malpighi employs a weaving analogy with the word *stamina* or warps, suggesting in this context an analogy between art and nature, and also uses the term *filamenta* or threads. The difference between the formation process of most polyps and tumours is reducible to the fluid interspersed between their layers: if the fluid is watery the product is a series of individual integuments like Russian dolls, if the fluid is coagulable the integuments form a solid whole. Elsewhere in the essay Malpighi draws analogies between the

¹⁹ See, for example, Galen, *On the natural faculties*, Cambridge, MA, Harvard University

Press and London, W Heinemann, 1916, transl. Arthur John Brock, I, 7 and II, 3 (end).

formation of polyps and of deposits in water channels and aqueducts, namely between physiological processes in animals and natural ones.²⁰

A crucial point in the translation above is the expression “dubitare possumus”, which can be rendered both as “it is hard to believe that” and “we can consider whether”. Although both translations of this absolutely fundamental passage are grammatically correct, the former conveys a meaning opposite to that intended by Malpighi. From the context, it is clear that Malpighi cannot have the former in mind, because the entire passage would become meaningless. Since he is comparing the double membrane and fat covering a needle in the stomach of a hen to tumours, he could not possibly be thinking that these formations occur teleologically according to a principle acting to the animal’s benefit (tumours rarely do that). Rather, with the expression “dubitare possumus”, Malpighi is tentatively putting forward his own views. The latter solution makes sense of a passage whose meaning was otherwise unintelligible, and is also coherent with the opening of the essay, where the “*necessitas materiae*” is mentioned.

The expression “*necessitas materiae*” occurs elsewhere in Malpighi’s work, namely several times in *De omento, pinguedine, & adiposis ductibus*, published anonymously in 1665, and *Vita a seipso scripta* in the *Opera posthuma* of 1697. It is lacking, however, in the preceding four *Exercitationes* of *De viscerum structura*. In *De omento* Malpighi’s usage of the same expression is altogether different than in *De polypo cordis* and suggests rather opposite views. In the opening he denies that fat is accumulated from an oily matter sweating through the blood vessels from the necessity of matter, because Nature does not store in bodies that which is unsuitable and useless.²¹ In another passage Malpighi denies that the necessity of matter is at work in the formation of channels he had observed in fat.²² Lastly, while denying a link between fat and heat, and attributing to heat diseases, rather than normal operations, Malpighi tentatively suggests that heat is generated by the necessity of matter alone.²³

In the passage from *Vita a seipso scripta*, recently and authoritatively discussed by Guido Giglioni, Malpighi argued that the necessity of matter and motion was at work in the formation of the body and in all its operations, except those controlled

²⁰ See, for example, Forrester, op. cit., note 1 above, p. 485 (“as happens when stones form in the pelvis, or deposits in water channels” and “[t]his is what happens in aqueducts”) and p. 492 (“as occurs in rivers”).

²¹ *Opera omnia*, vol. 2, p. 33: “Non enim acquiescebam congeri pinguedinem transudante oleosa materia à sanguineis vasis, ex naturae necessitate, & vasorum conditione, ad fovenda scilicet viscera alimentis destinata, cum non assuescat Natura, incongrua, & inutilia in corporis penitioribus cumulare”.

²² *Opera omnia*, vol. 2, p. 37 (quoted by K Heinemann, ‘Zur Geschichte der Entdeckung der roten Blutkörperchen’, *Janus*, 1939, 43:1–41, on p. 9, and in part by Forrester, op. cit., note 1 above, p. 487, n. 81: “Postremò haesitari potest,

an haec corpora sint communiones striarum factae à pinguedine, quae calore fusa cuniculosas sibi vias inter membranas efformet, sola materiae necessitate, nullo intercedente naturae fine. Hoc autem destitui potest, si consideremus haec corpora, ubi solum rete vasorum absque membranis observatur, ut in histrice, sinuoso tractu, quin & lateraliter propagatis ramis, hoc rete per longum spatium excurrere, in insignem altitudinem, si in calenti adhuc animali observentur, elevari.”

²³ *Opera omnia*, vol. 2, p. 44: “Quoniam tamen non tantum calori tribuendam censeo, quantum vulgò jactatur, & in animantibus fortassè sola materiae necessitate excitatur; unde calorem morborum faciliùs auctorem observamus, quàm tranquillae vitae opificem”.

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by the rational soul. Therefore, it had to be reckoned with by the anatomist as the key for understanding bodily processes.²⁴

Thus in the months between Malpighi's return from Messina and his completion of *De polypo cordis*, we witness his adoption of a novel and influential method of investigation, which I have called here the "microscope of disease". Morbid anatomy and the study of monsters took centre stage in understanding the normal constituents and operations of the body according to laws of nature and the *necessitas materiae et motus*.

Phlegm and the Components of Blood

Malpighi had a long-standing interest in the blood's constituents. In the late 1650s he composed some dialogues, now lost, in Galilean style discussing this subject, among other medical issues. The same topic was also raised in the correspondence with Borelli. Part of the material from the dialogues was later used in the 1665 diatribe against the Galenists at Messina, the *Risposta al trionfo dei galenisti*,²⁵ where Malpighi attacked the traditional humoral doctrine. Although the *Risposta* was published in the 1697 *Opera posthuma*, its date of composition and contents are close to *De polypo cordis*. The former can therefore help elucidate the latter. In an important passage on the constituents of the heart polyp, Malpighi states (my emphases in the original and translation):²⁶

Pluribus pinguedinis frustulum esse
arrisit; alii autem pituitam in corde
concretam credidere, ignotam tamen in
Scholis hucusque video pituitosi humoris

The view that the polyp is a piece of fat
pleased many; others believed it to be
phlegm congealed inside the heart.
However, I find the Schools up to now

²⁴ M Malpighi, *Vita a seipso scripta*, in *Opera posthuma*, op. cit., note 14 above, p. 42: "Summi enim opificis industria animal fabrefecit, & particulis minimis plasmavit, quarum aliae mutua adaptatione consistunt, reliquae perpetuò fluunt pro functionibus edendis; hinc ad statum tempus à Natura totum consistit, decrescit & solvitur; ita ut sensim moriamur. Haec autem omnia necessitate materiae et motus contingunt." G Giglioni, 'The machines of the body and the operations of the soul in Marcello Malpighi', in D Bertoloni Meli (ed.), *Marcello Malpighi, anatomist and physician*, Florence, Olschki, 1997 (hereafter *MAP*), pp. 149–74, on p. 171.

²⁵ Malpighi, *Vita*, op. cit., note 24 above, *Risposta all'opposizione registrata nel trionfo de Galenisti contro i Filosofi, e Medici, che modernamente sono stati inventori nel corpo humano, d'alcune parti, e d'operazioni incognite a gl'antichi Professori della Medicina. Del Dottor Placido Papadopoli Messinese*, pp. 8–83 (separate pagination). Papadopoli was a student of Malpighi at Messina under whose name Malpighi

published the *Risposta*. The discussion on blood is at pp. 36–45. The letter by Borelli to Malpighi dated from Pisa, 5 March 1660, and referring to their experimentation on blood, is in D Bertoloni Meli, 'Additions to the correspondence of Marcello Malpighi', *MAP*, pp. 279–312, at pp. 281–2.

²⁶ *Opera omnia*, vol. 2, p. 124. I agree with Forrester, op. cit., note 1 above, p. 482 n. 45, that this sentence is "syntactically obscure". His translation reads: "The view that it is a piece of fat has found favour with many; others have regarded it as phlegm, solidified within the heart. Yet the particular nature of the phlegmatic humour is, I find, up to now unknown to the Schools; the disorders assigned to the influence of this one of the four humours accord poorly with the juice which we call phlegm when we perceive it. The phlegm may be supposed to be a faculty residing in the mass of blood, like a nourishing humour, but resembling the faculty of an ideal entity, imperceptible to sense, whose properties are generally known."

existentiam,²⁷ & *proprietatem*, cum passiones, quae huic vi quaternariae humorum divisionis assignantur, non congruant succo, qui dum sensus nostros incurrit, Pituita appellatur; & licet ut alimentalis humor in massa sanguinis potentia contineri credatur, velut idealis tamen entis sensum effugientis; *proprietates* depraedicantur.²⁸

ignorant about the *existence* and *property* of the phlegmatic humour, because the affections which are assigned to it by virtue of the quaternary division of the humours do not correspond to the juice perceived by our senses and called Phlegm; moreover, although it is believed to be virtually contained in the blood as a nourishing humour, the *properties* [of phlegm] are illustrated as of an ideal entity escaping *sensation*.

The opening is unproblematic. At first it would seem absurd to interpret the following words as meaning that the existence of phlegm was unknown in the Schools. However, in the *Risposta* Malpighi referred to phlegm as a dream and therefore it seems justified to take the gist of the following words to be that the Schools have been unable to establish the *existence* and *property* of phlegm. In the *Risposta* Malpighi argued polemically that the Galenists had been unable to ascertain whether the four humours exist in our bodies *formaliter* or *virtualiter*, adding that in his own view the blood's constituents are not four, but more than forty, and include all those fluids such as saliva and pancreatic juice secreted by the glands.²⁹ In *De polypo cordis* Malpighi then explains why the phlegm's *existence* and *properties* have not been established, or the reason for the Schools' ignorance. This important passage challenges the traditional doctrine of the four humours, specifically about phlegm, because it lacks sensory foundations, hence the importance of terms such as *sensus* and *proprietates*.³⁰

In conclusion, it is also worth noticing that in his attack on phlegm, Malpighi used disease as an investigative tool in normal anatomy. Although he did not refer to specific cases or dissection reports, with the word "passiones" or "affections" he opened a gulf between the fluid perceived by our senses and called phlegm and the diseases associated with it.

²⁷ Forrester points out that this term does not occur in classical Latin, op. cit., note 1 above, p. 482, n. 43. In *Thesaurus linguae Latinae. Editus auctoritate et consilio academiarum quinque Germanicarum Berolinensis, Gottingensis, Lipsiensis, Monacensis, Vindobonensis* (Leipzig, Teubner, 1900–), "existentia" or "existentia" is defined as "status ex(s)istendi". In *Risposta al trionfo dei Galenisti*, op. cit., note 25 above, p. 37, Malpighi refers to a passage from Hippocrates, *De flatibus*, with the verb "existere". In the edition of *De flatibus* I checked, by Ianus Cornarius, Basel, per Hieronymum Frobenium, et Nicolaum Episcopium 1554, the same verb occurs several times. The translation "existence" seems perfectly legitimate. Another difficult Latin term referred to by Forrester, op. cit., note 1 above, p. 482, n. 48, is "minera". This too occurs in

Risposta al trionfo dei Galenisti, op. cit., note 25 above, p. 44, and is rendered in Italian as "miniera" or "mine".

²⁸ For this verb see *Thesaurus linguae Latinae*, op. cit., note 27 above, which gives "denuntiare" and "preedicare", and M Malpighi, *De liene, Opera omnia*, vol. 2, p. 108: "Praecipuae in animalium operibus officinae sunt viscera, quae naturae micrologiam depraedicant, & fovent", where the meaning is "to illustrate".

²⁹ Forrester, op. cit., note 1 above, p. 482, n. 43. See also *MOB*, p. 198 and Malpighi, *Risposta*, op. cit., note 25 above, pp. 38 and 41–2.

³⁰ For this reason, with respect to Forrester's translation, I emphasize Malpighi's disagreement with the opinion he is reporting and the key role of those terms.