

**Herophilus of Chalcedon and the Hippocratic Tradition
in Early Alexandrian Medicine**

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Abstract

Herophilus of Chalcedon (c.330-250 BC) is famous as one of the leading figures in the development of medicine in Ptolemaic Alexandria around the first half of the third century BC. However, his medical science seems to have intrinsic continuity of thought with Hippocratic medicine. Herophilus followed the medical principle formulated in the Hippocratic treatise *On the Nature of Man*, when he made his methodological pronouncement to the effect that primary parts of the human body should be perceptible by the senses. Herophilus rejected cardiocentrism, introduced by his teacher Praxagoras into the medical school of Cos, and returned to Hippocratic encephalocentrism, as represented by the author of the Hippocratic treatise *On the Sacred Disease*. Herophilus differentiated between the faculties of the soul and the ones attributed to the nature. In his differentiation between these two faculties, Herophilus probably had in mind the Hippocratic conception of nature as specifically applied to the domain of the human body, as distinct from the soul. Herophilus' commitment to Hippocratic medicine is confirmed by his literary works on some of the Hippocratic texts. It is probable that Herophilus regarded himself as a more faithful successor than his teacher to the tradition of Hippocratic medicine. His anatomical researches on the structure and functions of the brain, motivated by his loyalty to the Hippocratic tradition, led him to innovative contributions to the development of medicine.

Key words:

Herophilus of Chalcedon, Anatomical Researches on the Human Body, Encephalocentrism, Conception of Nature

Introduction

The aim of my discussion is to examine new aspects of early Alexandrian medicine in terms of its relationship to the tradition of Hippocratic medicine. In doing so, I want to make a specific focus on medical achievements attributed to Herophilus of Chalcedon (c.330-250 BC), one of the leading figures in the development of medical science in Alexandria around the first half of the third century BC. Through a conceptual analysis of his methodology and anatomical physiology of the human being, which I think to illuminate his intellectual background, I will make it clear that Herophilus' medical science has intrinsic continuity of thought with Hippocratic medicine.

Before I start with my discussion, I want to make some preliminary remarks on modern scholarship concerning Herophilus and early Alexandrian medicine in general. Herophilus, who is always connected with the discovery of nerves and many other medical achievements in early Alexandria, has been highly evaluated by modern historians of medicine as one of the greatest physicians in antiquity. However, the whole structure of his medical theory and methodology remained unclear, until Heinrich von Staden published in 1989 a monograph on Herophilus, which deals comprehensively with all aspects of his medical science.¹ Of course, we have before him a monumental work on Alexandria in Ptolemaic Egypt, which was published by Peter Marshall Fraser in 1972. Fraser discusses almost all fields of intellectual activities, including medicine, done by many scholarly people under the patronage of Ptolemaic Kings around the first half of the third century BC, though his discussion of Herophilus is somewhat limited to his medical achievements, which he made through his anatomical researches on the human body. As regards his connection with Hippocratic medicine, which will be the subject matter of my discussion below, Fraser is satisfied with a reference to some historical facts that Herophilus was trained by his teacher Praxagoras, who belonged to the Hippocratic medical school of Cos around the second half of the fourth century BC, and that Herophilus wrote literary works on some of the medical texts in the Hippocratic Corpus, and also with a brief comment that he followed the Hippocratic tradition in therapeutics and other relevant fields.²

One of the greatest contributions made by Von Staden in his monograph mentioned

¹ H.von Staden, *Herophilus: The Art of Medicine in Early Alexandria* (Cambridge University Press, 1989), p.242 ff. References to testimonies concerning Herophilus will be made on the basis of the texts cited in his book with Text numbers.

² P. M. Fraser, *Ptolemaic Alexandria*, 3 vols. (Oxford: the Clarendon Press, 1972), Vol. I, pp. 338-376, Vol. II, pp. 495-551.

above is, I think, that he provides an overall picture of the Alexandrian physician for the first time through a comprehensive and systematic analysis of all the elements which constitute the whole structure of his medical science, including anatomy, physiology, pathology, therapeutics, and so on. As a consequence of his extensive research in the structure of his medical science, Von Staden comes to a conclusion that Herophilus may well be characterized as a physician, who had both aspects of innovation and tradition in common as two closely intertwined elements.³ Herophilus has been celebrated on the one hand as a radically innovative scientist, who is connected with the discovery of nerves. Specifically, he is said to have discovered the system of sensory and motor nerves and its connection with the brain, which he identified as the control centre of the whole human body.⁴ There is no doubt that anatomical researches on the structures and functions of the human body and its parts and organs, which he is reported to have done through the practice of human dissection and vivisection, made these discoveries possible.⁵ It is obvious, then, that the Alexandrian physician may have claim to a place of honour as one of the most remarkable contributors to the innovations in the knowledge of the human body. In his pathology and therapeutics, on the other hand, Herophilus did not emancipate himself from the tradition of Hippocratic medicine.⁶ Von Staden's evaluation of the Alexandrian physician was followed, among others, by Mario Vegetti, who goes so far as to say that Herophilus is one of the typical cases of the tensions or even conflicts between innovation and tradition, which Vegetti claims to have prevented the 'revolution' of Hellenistic medicine from attaining perfection.⁷

It is doubtful whether these claims constitute a valid evaluation of the Alexandrian physician, because modern historians of medicine may indeed introduce a conceptual distinction between 'innovation' and 'tradition' from their own point of view, but we need to have serious reservations about the use of these terms, because it does not seem to be clear at all whether Herophilus himself regarded his own medical

³ Von Staden (1989), p.427.

⁴ For his anatomical identification of the two kinds of nerves having their origin in the brain as the central organ of the body, Rufus of Ephesus (?), *De anatomia partium hominis*, 71-5 [=T81 Von Staden]. See also F. Solmsen, 'Greek philosophy and the discovery of the nerves', *Museum Helveticum* 18 (1961), p.185.

⁵ There are several documents on human vivisection, of which the most famous is the passage of the treatise *De medicina*, which was written by Aulus Cornelius Celsus, a Roman encyclopedist dated from the first half of the first century AD, Book 1, prooem. 23-6 [=T63a Von Staden].

⁶ Galen, *De placitis Hippocratis et Platonis*, VIII 5, 24 [=T132 Von Staden]. Von Staden (1989), pp.246-7, claims, with an emphasis that Herophilus followed humoral pathology, that it is a striking instance of the persistence of tradition within an innovative scientific community. See Fraser (1972), p.354.

⁷ M.Vegetti, 'Between Knowledge and Practice: Hellenistic Medicine', in Mirko D. Grmek (ed.), *The Western Medical Thought from Antiquity to the Middle Ages*, coordinated by B. Fantini, translated by A. Shugaar (Cambridge, Massachusetts: Harvard University Press, 1998), pp.84-92.

researches on the human body as a purely innovative process in the development of medicine. This will be the most important aspect to bear in mind especially in our approach to his remarkable achievements on anatomy.

Human anatomy is obviously one of the most characteristic features of early Alexandrian medicine. There can be no doubt that Aristotle (384-322 BC) opened the way to this direction. With the method of anatomical investigation, which he introduced for his biological researches, Aristotle made a decisive impact on the development of medicine. The influence of Aristotelian biological model on contemporary medicine may be found most clearly in the medical physiology of the human body proposed by the physician Praxagoras. Following Aristotelian model, he introduced cardiocentrism in his medical school of Cos, where there had been a tradition of Hippocratic encephalocentrism, by insisting that the heart is the centre of all psychic functions.⁸ Herophilus was a disciple of Praxagoras, and he developed Aristotelian method of anatomical investigation, which he may have taken over from his teacher. However, Herophilus' anatomical physiology of the human being is fundamentally different from his teacher's. Through his anatomical researches based on human dissection and vivisection, the Alexandrian physician proved that the brain, not the heart, is responsible for all psychic functions, and claimed that the brain as the control centre of the human body interacts with all its parts through the system of sensory and motor nerves. The crucial point here is that Herophilus rejected his teacher's cardiocentric model of the human being, and returned to the tradition of Hippocratic encephalocentrism, as represented by the author of the Hippocratic treatise *On the Sacred Disease*. This would suggest that the Alexandrian physician might possibly have launched his anatomical researches on the structure and functions of the human brain with a view to confirm the legitimacy of the tradition of Hippocratic encephalocentrism in opposition to his teacher.

Another and the more significant point to which I want to draw specific attention in my discussion below is that Herophilus differentiated between the faculties of the soul ($\psi\upsilon\chi\eta$) and the ones attributed to the nature ($\phi\upsilon\sigma\iota\varsigma$).⁹ According to his anatomical physiology of the human being, faculties responsible for sense perceptions and for voluntary motions of the body were classified as the ones peculiar to the soul, while

⁸ Athenaios, *Deipnosophistai*, XV 687e [= F. Steckerl, *The Fragments of Praxagoras of Cos and His School* (Leiden: E. J. Brill, 1958), p.65, Fr.30].

⁹ There are two documents which report that Herophilus made this differentiation. 1) Ps.-Plutarch, *Placita philosophorum*, IV 22 [=T143b Von Staden], 2) Rufus of Ephesus (?), *Synopsis de pulsibus*, 2 [=T149 Von Staden]. See also Von Staden, 'Body, Soul and Nerves: Epicurus, Herophilus, Erasistratus, the Stoics and Galen', in J. P. Wright and P. Potter (edd.), *Psyche and Soma: Physicians and Metaphysicians on the Mind-Body Problem from Antiquity to Enlightenment* (Oxford University Press, 2000), pp.87-91.

those which produce involuntary movements of the body, such as the pulse and respiration, were classified as 'natural' faculties. Thus, Herophilus limited the faculties peculiar to the soul more narrowly than Aristotle, by defining the nature as responsible for some functions which Aristotle had assigned to the soul according to his biological theory.¹⁰ Von Staden points out perceptively that Herophilus' differentiation between these two kinds of faculties shows a strong affinity with the psychology proposed by one of the early Stoic philosophers, Chrysippus (c.280-206 BC).¹¹ It seems that Chrysippus made a conceptual distinction between nature and soul, and limited the function of the soul to cognition and voluntary motions of the animal, including human beings.¹² We cannot assume, however, that Herophilus' anatomical physiology of the human being was influenced by Stoic psychology, since Chrysippus is dated later than him.¹³ So there seems to be another background of thought, which led the Alexandrian physician to differentiate between these two kinds of faculties. I would suggest that he introduced this differentiation, following the Hippocratic conception of nature as specifically applied to the domain of the human body.

In what follows, I will focus principally on these two points, along with some other significant features of Herophilus' medical science in order to elucidate his fundamental standpoint as regards the tradition of Hippocratic medicine. By Hippocratic medicine in my phraseology here, I mean a set of medical principles, theories and methodologies, which may well be discovered in a group of medical treatises and documents in the Hippocratic Corpus, which have been ascribed with some historical certainty to the authors who belonged to the Hippocratic medical school of Cos in the fifth and fourth centuries BC.¹⁴ The ones traditionally ascribed to the medical school of Cnidus will therefore be excluded. There is another group of treatises with a strong philosophical tendency towards Pre-Socratic thought, which will also be out of scope here. Beate Gundert includes these and some other treatises in

¹⁰ Aristotle insists that growth and reproduction are two faculties, which belong to the nutritive soul. He held that both plants and animals, including human beings, share them in common. See *De anima*, II 4, 415a22-416b30.

¹¹ Von Staden (2000), p.90.

¹² Galen, *Adversus Julianum*, 5 [= J. von Arnim (ed.), *Stoicorum Veterum Fragmenta*, 4 vols. (Leipzig, 1903-1924, reprint. Stuttgart, 1964), II 718]. According to Chrysippus, all animals are arranged both by nature and by soul, which is defined as only responsible for sense perception and self-movement. See also Clemens of Alexandra, *Stromateis*, 2 [=SVF, II 714].

¹³ Von Staden (2000), p.102, suggests, conversely, that Chrysippus' distinction between nature and soul in his psychology may have been prompted by Herophilus' differentiation between psychic and 'natural' faculties in his medical theory of the human being.

¹⁴ My grouping of the 'Hippocratic' treatises almost corresponds to what Jacques Jouanna classifies as the ones which form the original core of the Hippocratic Corpus and is due to the school of Hippocrates, known as the medical school of Cos. See J. Jouanna, *Hippocrates*, translated by M. B. DeBevoise (Baltimore: The Johns Hopkins Press, 1999), p.65.

the Hippocratic Corpus in her most recent discussion to develop more extensive arguments in an attempt to give an overall view of the conception of nature in the Hippocratic Corpus.¹⁵ However, I am sceptical about the legitimacy of her approach to this topic, because I am afraid that she does not seem to take into much account the fact that the Hippocratic Corpus is substantially an amalgam of a large number of medical treatises and documents written by authors of various intellectual backgrounds. My own approach, though it may indeed be regarded as remaining within a limited scope of discussion, will lead us to have a more historically exact understanding of Herophilus' medical science and its relationship to the tradition of Hippocratic medicine.

Herophilus on the Methodology of Medical Science

I begin with an analysis of one famous statement, which would illustrate Herophilus' methodology of medical science. The statement is found in the treatise of a medical author, including excerpts from the Aristotelian Meno's book on medical doctrines, preserved in a papyrus known as Anonymus Londinensis of the British Museum. The passage, which contains his statement, will be cited below.

Some parts of the body are simple, and others are compound. However, we understand 'simple' and 'compound' with reference to sense perception, just as Herophilus observes, saying this: 'Let the appearances be described as primary, even if they are not primary.' Erasistratus went even further than the medical principle. Indeed, he hypothesized that the primary bodies are what may be seen by reason, so that the vein perceived by senses is composed of bodies which may be seen by reason, i.e. of vein, artery and nerve.¹⁶

In this passage, the author compares the opinions of the two physicians as regards the simple and compound parts or constituents of the human body. Erasistratus (c.320-240

¹⁵ B. Gundert, 'Soma and Psyche in the Hippocratic Medicine', in J. P. Wright and P. Potter (2000), pp.13-35. She draws a conclusion that human body and soul are manifestations of the same principle, i.e. nature (*physis*), which embraces the totality of bodily structures, physiological processes, and *also* psychic events. There is much doubt, however, whether it is possible to have a comprehensive view of the conception of nature, with which all authors may share in common. I cannot therefore accept her conclusion.

¹⁶ H. Diels (ed.), *Anonymus Londinensis ex Aristotelis Iatricis Menoniis et aliis medicis eclogae*, 21. 18-32, *Supplementum Aristotelicum*, III.1 (Berlin, 1893), pp. 37-8 [=T50a Von Staden]. Galen refers to the same statement, though perhaps in a mutilated form, in his treatise *Methodus medendi*, II 5, 7 [=T50b Von Staden]. I follow the English translation by Von Staden, except for a few modifications, which I believe to be needed for some phrases and sentences.

BC), who was Herophilus' younger contemporary, and followed his medical career at the Seleucid court in Syrian Antioch and perhaps in Alexandria, defined primary parts of the body as entities intelligible by the reason, not immediately perceptible by the senses.¹⁷ Herophilus, on the other hand, may probably have held that primary parts of the body and also its compound parts can be perceived by the senses, since indeed he stated that the appearances (τὰ φαινόμενα) should be described as primary, even if they are not primary.

The statement, quoted by the author as Herophilus' own words, has been the focus of attention among many historians of medicine with different interpretations of its meaning. Von Fridolf Kudlien claims that the statement suggests that Herophilus' medical science had a close relationship to the sceptical trend of his contemporary philosophy, as represented by Pyrrhonism.¹⁸ Von Staden rightly rejects Kudlien's claim that Herophilus may be placed as a significant figure in the history of medical scepticism. Rather, Von Staden discerns that the statement is based partly on Aristotle's method of scientific inquiry, as formulated at the beginning of his biological treatise *On the Parts of Animals*, that science should start from what appears to the senses, and then proceed to their causes.¹⁹ On his interpretation, then, the statement may be translated as follows: 'Let the phenomena be described first, even if they are not primary.'

Von Staden understands the whole implication of the statement to be that the Alexandrian physician agrees with Aristotle on the first point ('the phenomena first'), while the second part of his statement would suggest that he is more cautious than Aristotle about attaining the knowledge of causes.²⁰ This interpretation, however, assumes that the same words 'primary' (πρῶτα) in the first and second parts of the statement have different meanings, which I think to be inconceivable within the context of a single sentence.²¹ Rather, an alternative translation of the statement, which Von Staden himself suggests in his brief commentary on it, taking these two words more consistently in the same meaning, though at last he decides to reject it on the

¹⁷ As regards the career of Erasistratus, there has been a controversy among modern historians of medicine. Fraser (1972), Vol.I, p.347, denies that he practiced in Alexandria. His view is countered by G. E. R. Lloyd, 'A Note on Erasistratus of Ceos', *Journal of Hellenic Studies* 95 (1975), pp.172-175.

¹⁸ F. Kudlien, 'Herophilus und der Beginn der medizinischen Skepsis', *Gesnerus* 21 (1964), pp.1-13, repr. H. Flashar (ed.), *Antike Medizin* (Darmstadt, 1971), pp.280-295.

¹⁹ Aristotle, *On the Parts of Animals*, I 1, 639b3-11, 640a13-16. On Aristotle's methodology, see also Ingemar Düring, 'Aristotle's Method in Biology', in S. Mansion (éd.), *Aristote et les problèmes de méthode*, Symposium Aristotelicum 1960 (Louvain, Paris, 1961), pp.213-221.

²⁰ Von Staden (1989), pp.117-119. See also T. Tieleman, *Galen and Chrysippus on the Soul* (Leiden: E.J. Brill, 1996), pp.22-23.

²¹ See R. J. Hankinson, 'Saving the Phenomena', *Phronesis* Vol. XXXV 2 (1990), pp.213-5, who quite rightly refers to this problem in his review of the book on Herophilus written by Von Staden.

ground that Herophilus does not identify phenomena with primary bodies, seems to be more plausible.²²

A further and more serious problem is that his interpretation does not seem to square with the main point of the arguments by the author in the passage cited above from the Anonymus Londinensis papyrus. The author reports that Erasistratus defined primary parts or constituents of the body as entities imperceptible by the senses but intelligible by the reason. He named these entities 'triple twists' (τριπλοκίαι) of invisible nerves, arteries and veins in his terminology, which he held to compose the walls of anatomically visible nerves, arteries and veins.²³ However, Erasistratus is criticized by the author, because he went even further than the 'medical principle' (ιατρικὸς κανὼν). The author is obviously of the same opinion on the methodology of medical science with Herophilus, who may probably have held primary parts of the body and also its compound parts to be perceptible by the senses. In this context, the author refers to the statement, which he ascribes to the Alexandrian physician, with a view to confirm his own methodological view.

Thus, we find it difficult to accept Von Staden's interpretation of the statement, since indeed the author of the medical treatise preserved in the Anonymus Londinensis papyrus understands it in a different way.²⁴ The second part of the statement, which is in the form of a concessive clause, does not necessarily suggest that Herophilus was more cautious than Aristotle about attaining the knowledge of causes, or that he was committed to the trend of his contemporary philosophical scepticism, as F. Kudlien put it. Rather, the whole statement seems to indicate that the Alexandrian physician intended to draw a clear line of demarcation between medical science and philosophical inquiry by insisting that physicians should define primary or real constituents of the body as being perceptible by the senses, although one may not necessarily define them as such from a philosophical point of view.

It should be noted above all that we find almost the same statement in the following passage at the beginning of the treatise *On the Nature of Man* in the Hippocratic Corpus, which has unanimously been ascribed in modern Hippocratic scholarship to a physician named Polybus (c.400 BC), who was reportedly Hippocrates' son-in-law and one of his principal disciples. We may almost legitimately regard the physician Polybus as one of the leading members of the Hippocratic medical school of Cos in the

²² Von Staden (1989), p.134.

²³ See Ivan Garofalo, *Erasistrati Fragmenta* (Pisa, 1988), Fr.86-89. For Erasistratus' own medical physiology of the human being, see Vegetti (1998), pp. 92-100, and also Von Staden (2000), pp. 92-96.

²⁴ Hankinson (1990), p.213, assumes that the account of the statement by the author himself may be misleading, though without giving any reason why it should be taken to be misleading.

fifth and fourth centuries BC.²⁵

Whoever has been accustomed to listening to speakers who discuss the nature of man beyond the scope, which pertains to medicine, is not suitable for listening to my present lecture. For I do not insist at all that a human being is air or fire or water or earth, or anything else that does not appear (sc. to the senses) to be existing in the human being.²⁶

In this passage, Polybus criticizes philosophical theories ascribed to those who hold that a single one of the four elements (i.e. fire, air, water and earth) is the essential constituent of the human being. According to the physician, their anthropology is obviously beyond the scope of medical discussion, because, he claims, each one of these elements is not confirmed by the senses to be existent in the human body. In fact, in the second chapter of the treatise in which he proceeds to criticize those who hold that a single kind of humour such as phlegm or bile is the essential constituent of the human being, he calls them 'physicians' (ἰητροί), because what they presuppose as the essential constituent of the human being can be perceived by the senses.²⁷

Thus, Herophilus' view on his methodology of medical science may well be regarded as corresponding with that proposed by Polybus, one of the leading members of the Hippocratic medical school of Cos. I think that it is not a mere coincidence at all, but rather suggests that the Alexandrian physician may have followed the medical principle formulated by him in the treatise *On the Nature of Man* by sharing the same opinion with the Hippocratic author as to the methodology of medical science.

Herophilus and the Tradition of Hippocratic Encephalocentrism

It has widely been acknowledged by modern historians of medicine that Herophilus was the first person who proved, on the basis of anatomical researches on the human body, that the brain is the centre of all psychic functions. He is also reported to have

²⁵ See Aristotle, *History of Animals*, III 3,512a12-513a8, where Aristotle cites under the authorship of Polybus a passage of *Nat. Hom.* ch.11 (a description of the vascular system) [VI 58, 1~60, 9. Littré]. With regard to his career as Hippocrates' son-in-law and one of his disciples, see Galen, the treatise *On the Difficulty of Breathing*, C.G. Kühn, *Claudii Galeni opera omnia* (Leipzig, 1821-33), VII, p.960, and his *Commentaries on Hippocrates' On the Nature of Man*, J. Mawaldt, G. Helmreich, J. Westenberger (edd.), *Corpus Medicorum Graecorum* V 9, 1 (Leipzig, Berlin, 1914), p.8.

²⁶ *Nat. Hom.* ch.1, É. Littré (éd.), *Œuvres complètes d' Hippocrate* (Paris, 1839-1861), VI 36, 1~5.

²⁷ See *Nat. Hom.* ch.2 [VI 34, 8~36, 16. Littré]. In ch.4-5 of the treatise, the physician Polybus, who defines the 'Hippocratic' four humours (i.e. phlegm, blood, yellow bile and black bile) as constituents of the nature of the human body, explains that their colours do not appear alike to the sight nor does their touch seem alike to the hand.

specified most precisely the location of the ruling part of the soul within it. According to his anatomical physiology of the human being, established through the practice of human dissection and vivisection, it is located in the ventricle of the cerebellum, which may be identified with the fourth ventricle of the brain.²⁸ The brain as the seat of the soul interacts with the entire body through the system of nerves. The nerves are divided into two kinds, i.e. sensory nerves and motor nerves, which he defined as being responsible for sense perceptions and for voluntary motions of the human body, as contrasted with its involuntary movements. Herophilus himself might possibly have called the latter nerves 'purposive' (προαιρετικά) in his terminology.²⁹

Thus, Herophilus' anatomical physiology of the human being may be regarded as one of the most remarkable contributions to the innovations in the medical knowledge of the human being. However, it still remains unclear what it was that indeed led the Alexandrian physician to make so much of his focus on the brain that he finally defined it as the control centre of the whole human body. Of course, there had been some encephalocentric models of the human being provided by his predecessors dated from the classical period, more primitive as they might have been than his own. Its oldest version has been ascribed to Alcmaeon of Croton, a Pythagorean physician, who was followed by Diogenes of Apollonia (c.423 BC), Democritus (c.420 BC) and some others.³⁰ In medical tradition, the author of the treatise *On the Sacred Disease*, who, though not definitely identified with Hippocrates, was probably one of the members of his medical school of Cos, provides the most systematic encephalocentric model of the human being.³¹ Von Staden holds that the author of this treatise was Herophilus' most significant predecessor, though he does not seem to want to say explicitly that his encephalocentric model was followed by the Alexandrian physician.³² But, given the fact that Herophilus himself was a disciple of Praxagoras, who belonged to the medical school of Cos, it is probable that the encephalocentric model provided by the author of this treatise was the most accessible to him. And further, though Von Staden does not mention it, there is evidence that Herophilus' anatomical physiology of the human

²⁸ Galen, *De usu partium corporis humani*, VIII 11 [=T138 Von Staden].

²⁹ Rufus of Ephesus (?), *De anatomia partium hominis*, 71-5 [=T81 Von Staden]. See Von Staden (1989), p. 251.

³⁰ Alcmaeon is reported to have held that all senses are connected with the brain and that they will be impaired, if it is moved and changes its place. (Theophrastus, *De Sensu*, 25-6 [=H. Diels - W. Kranz, *Die Fragmente der Vorsokratiker*, 6. Auflage, 3 Bde (Berlin, 1951-1952), 24A5]). Diogenes of Apollonia is reported to have claimed that the air within or around the brain is responsible for sense perceptions such as hearing and smelling (Theophrastus, *De Sensu*, 39-45[=DK.64A19]). Democritus held that the commanding part of the soul is seated in the brain (Aetuis, *Placita*, V 1 [=DK. 68A105]).

³¹ This treatise, like the other Hippocratic treatise *On Airs, Waters, Places*, with which it is closely connected, has traditionally been ascribed to the medical school of Cos. Jouanna (1999), pp.411-412.

³² Von Staden (1989), pp. 248-249.

being may have been modeled on Hippocratic encephalocentrism.

I will give my own answer to the question mentioned above, with a specific focus on Herophilus' opposition to his teacher Praxagoras as regards their pathological accounts of some particular affections of the human body, which, I think, may have urged the Alexandrian physician to return to the tradition of Hippocratic encephalocentrism. His opposition to Praxagoras will be confirmed by some documents, including the following passage of Galen's treatise *On the Differences of Pulses*, Book IV.

There was no small argument about these affections (sc. spasm, tremor, palpitation) made by Herophilus against his teacher Praxagoras, who had stated incorrectly that palpitation, tremor and spasm are an affection of the arteries, differing not in kind but in size from the pulsating motion in them. For the pulse, Praxagoras said, occurs when the arteries are in a natural state, without any difficult circumstance. But when their motion is increased to an unnatural extent, spasm is caused in the first place, and secondly, following upon it, tremor, and thirdly palpitation is caused. All these affections differ from each other in size.³³

In the passage cited above, Galen reports that there was a serious disagreement of opinion between Praxagoras and his disciple Herophilus about the cause of palpitation, tremor and spasm, which sometimes affect the human body. According to Galen's report, the crucial point which we may assume that Herophilus made against his teacher is that Praxagoras did not qualitatively differentiate between pulsating motion and these affections of the body (i.e. spasm, tremor and palpitation) by connecting all of them with the arteries. In fact, Galen insists, Praxagoras explained that they are caused when the motion of the arteries is increased to an unnatural extent, deviating from their normal condition, which he held to constitute pulsation.

Unfortunately, Galen's report does not give any more explicit information as to what was Herophilus' own account of the cause of these affections. But we have another relevant passage from a treatise entitled *A Synopsis of Pulses*, which has been ascribed with disputed authenticity to Rufus of Ephesus, dated from the second half of the first century AD.

Praxagoras, then, assumed that these things (sc. pulse, palpitation, tremor,

³³ Galen, *De pulsuum differentiis*, IV 3 [=T150 Von Staden]. See Steckerl (1958), pp.61-62, Fr. 27.

and spasm) differ from each other in quantity but not in quality at all. The pulse turns into palpitation as its motion grows faster, and from the palpitation the tremor develops. And this is what Praxagoras said, who was not an inconsequential figure either in his medical theories or in his life. Herophilus, who had a more accurate knowledge of this topic, found their differences to lie in quality instead. For, he says, pulse occurs only in the arteries and the heart, while palpitation and spasm and tremor occur in muscles as well as in nerves. And the pulse, he says, is born with an animal and dies with it, while these other motions do not. Also, the pulse, he says, occurs both when the arteries are filled and when they are emptied, while these others do not. And the pulse always attends us involuntarily, since it exists naturally, while the others are also within our power to choose, by pressing out and depressing the parts frequently.³⁴

In this passage, we may see how the two physicians disagreed most fundamentally with each other as concerns the cause of the affections mentioned above. Herophilus enumerates some of the features specific to the pulse in order to differentiate it from the three affections of the body (i.e. palpitation, spasm and tremor), because, he insists, the pulse is to be assigned to the arteries and the heart, while these three affections are found to occur in muscles as well as in nerves. His teacher Praxagoras, on the other hand, did not qualitatively distinguish between all of them. In fact, Praxagoras is reported to have held that the nerves are endings of the arteries, which originate from the heart and change into the nerves at the extremities of the body.³⁵ That is exactly the reason why he explained that the three affections are caused when the motion of the arteries is increased to an unnatural extent, deviating from their normal condition, which he supposed to constitute the pulse.

We find that Praxagoras' cardiocentric model of the human being involves a serious problem, because his model cannot give an account of clinical cases in which some of these affections *do* occur in some particular parts of the body, while the heart and the arteries are observed on the normality of the pulse to be functioning well. In other words, with a view to give a persuasive account of these cases, it is theoretically

³⁴ Rufus of Ephesus (?), *Synopsis de pulsibus*, 2 [=T149 Von Staden]. See also Steckerl (1958), p.62, Fr.27. There seems to be some inconsistency between these two reports on Praxagoras' explanation of the pulsation and the bodily affections. In Galen's report, Praxagoras claimed that palpitation is the most abnormal type of affection, deviated from the normal motion, i.e. the pulsation. Rufus of Ephesus (?) reports, however, that Praxagoras explained that the pulse turns first into palpitation, as its motion grows faster. I am inclined to think that Rufus of Ephesus (?) gives a more correct report than Galen.

³⁵ Galen, *De placitis Hippocratis et Platonis*, I 6, 18 [= Steckerl (1958), pp.49-53, Fr.11].

necessary to regard the system of muscles and nerves as essentially different from that of arteries, which have their origin in the heart. This would seem to explain why the Alexandrian physician placed a great emphasis on the brain as the control centre of the whole human body, which he held to interact with it and its part through the sensory and motor nerves as responsible for sense perceptions and for voluntary motions respectively. As is clear from the passage cited above from the treatise ascribed with disputed authenticity to Rufus of Ephesus, Herophilus regarded these affections as occurring in the human body when functions specific to the nerves and muscles are seriously impeded.

As we have already seen, Herophilus had some predecessors from the classical period, who had already supposed that the brain is the centre of all psychic functions, though the most systematic model was undoubtedly provided by the author of the Hippocratic treatise *On the Sacred Disease*. The Hippocratic author was probably followed by the Alexandrian physician, I think, especially because the author regards the brain as the control centre of the human being, which is responsible not only for sense perception and cognition in general, but also for all voluntary motions of the human body and its parts, while other predecessors seem to have been concerned most principally with its connection with our cognitive activities.

Now, I will cite below the most important passage from the Hippocratic treatise. After he has explained how the brain is responsible for all kinds of psychic phenomena, such as emotions, intelligence, sense perception, thinking, including moral and aesthetic judgments, and their disturbed conditions, the author summarizes his arguments.

For these reasons, I hold that the brain has the most power in a human being. For when it is healthy, it is the interpreter to us of the phenomena originating from the air, while the air provides intelligence. Eyes, ears, tongue, hands and feet act in accordance with the judgment of the brain. In fact, intelligence occurs in the whole body, according as it participates in air, while the brain is the messenger for the comprehension.³⁶

In this passage, the author gives an account of two fundamental functions to be assigned to the brain as the control centre of the human being. First, he defines its role as the 'interpreter' (ἐρμηνεύς) to us of the phenomena originating from the air. It is

³⁶ *Morb. Sacr.* ch.16 (19) [VI 390, 10~16. Littré]. In Littré's edition, chapters of the treatise are divided in a different manner from those of Jones' edition, which will be indicated in round brackets.

almost probable in this definition of the brain that he assumes a psychophysical model, which will be described as follows. When particular sense organs receive ‘sensory impressions’ which will be formed there when these sense organs are stimulated by external objects, these impressions are transmitted by the flow of breath (πνεῦμα) through the vessels to the brain, whereby they will be transformed into our experiences of perceiving some particular objects. Secondly and more interestingly, the author insists that sense organs and other parts of the body do their service to the judgment of the brain, which he proceeds to define in the sentence that immediately follows as the ‘messenger’ (διαγγέλλων) for the comprehension (σύνεσις).³⁷ This would suggest that the author holds that the brain is the control centre of all voluntary motions of the body, which will occur, when instructions from the comprehension are transmitted through the brain as its messenger by the flow of breath in the vessels to each part of the body. When, on the other hand, the flow of breath is blocked by the phlegm, which runs down into the vessels from the brain flooded with this humour, there occur bodily abnormalities, such as paralyses and spasm in feet and hands, which will seriously impede voluntary motions of the human being.³⁸

This Hippocratic model seems to have urged Herophilus to develop a more sophisticated encephalocentric model of the human being on the basis of his anatomical knowledge of the human body. Indeed, the Hippocratic author did not even distinguish between the veins and arteries in the vascular system of the human body, let alone between sensory and motor nerves.³⁹ There is no doubt, however, that the author’s encephalocentric model, in which he holds that the brain is the control centre of the human being, claiming that it is responsible not only for our cognitive activities but for our voluntary motions, is the most systematic of all the encephalocentric views attributed to his contemporary philosophers and physicians. And, as I mentioned above, it is probable that the author’s encephalocentric model was the most accessible to the Alexandrian physician, since his teacher Praxagoras belonged to the Hippocratic medical school of Cos, though he himself rejected Hippocratic encephalocentrism. His disciple, however, returned to the tradition of Hippocratic encephalocentrism through his disagreement of opinion with his teacher

³⁷ Strangely enough, Von Staden (1989), p.248-249, does not refer to the second function, which the author assigns to the brain in the passage cited above, text to note 36.

³⁸ *Morb.Sacr.* ch.7 (10) [VI 372, 4~374, 20. Littré].

³⁹ For the detailed account of the vascular system given by the Hippocratic author, see *Morb.Sacr.* ch.3 (6) [VI 366, 7~25. Littré]. In his encephalocentric model, the brain has its connection with the heart within the same system. But its priority to the heart is obvious from the fact that he insists that the flow of breath, which we draw in, goes first into the brain, and then into the other parts of the body, leaving there its purest part, which he holds to provide us with intelligence. See *Morb.Sacr.* ch.16 (19) [VI 390,15~ 392, 3. Littré].

on the physiology of the pulse and some particular affections of the body.

Herophilus and the Hippocratic Conception of Nature

It is one of the most characteristic features of Herophilus' anatomical physiology of the human being that he differentiated between the faculties of the soul and the ones attributed to the nature (*φύσις*), though it has not been made clear enough in modern scholarship what urged the Alexandrian physician to introduce the differentiation between these two faculties into his physiology. Indeed, his differentiation would seem to be original at first glance, because we do not find a similar conceptualization of nature as distinct with the soul in his contemporary theories and doctrines.⁴⁰ When we turn to his predecessors in the fifth and fourth centuries BC, on the other hand, we find that the Hippocratic doctors appear to be the most promising for us to elucidate the intellectual background of his conceptualization of nature, because they provide some significant examples of the term of nature, conceptualized as clearly distinct from the soul, as indeed is in his anatomical physiology of the human being.

First, I will cite the passages from relevant documents, which I think to report how Herophilus conceptualized 'natural' faculties as distinct from the ones assigned to the soul, which he regarded as being responsible for voluntary motions of the human body. And then, I will refer to the examples of the term of nature in some of the Hippocratic treatises, which, as I mentioned before, have been ascribed to the authors who belonged to the Hippocratic medical school of Cos.⁴¹ I suppose that these examples will be of the most interest to us for illustrating a new aspect of his anatomical physiology in terms of the tradition of Hippocratic medicine.

In the latter part of the passage cited above from the treatise, which has been ascribed to Rufus of Ephesus, though with disputed authenticity, Herophilus enumerated some of the features specific to the pulse with a view to differentiate it from the affections of the body, such as palpitation, tremor and spasm. I suppose that the last point which he made is the most important for understanding his own conception of nature. The whole sentence will be cited below.

And the pulse always attends us involuntarily, since it exists naturally, while the others are also within our power to choose, by pressing out and

⁴⁰ Of course, it has an affinity with the conceptual distinction between the soul and nature in the Stoic psychology ascribed to Chrysippus, who is dated later than Herophilus. See text to notes 9-13 above.

⁴¹ See text to notes 14-15 above.

depressing the parts frequently.⁴²

In this passage, the pulsating motion is explained characteristically as one of the involuntary movements of the body. The Alexandrian physician believed that the affections of the body, which he holds to usually take place involuntarily, may also occur as 'voluntary' motions, as for example when we press our hands strongly against the wall, or when we try to lift up a heavy box with our hands.⁴³ However, the pulse must be essentially differentiated from these affections, because, he claims, it always attends us involuntarily (ἀπροαιρέτως), since it exists naturally (φυσικῶς). His emphasis here on nature (φύσις) in this context is closely related to the other features of the pulse, which he mentioned in the same passage. The pulse occurs only in the arteries and the heart, and it also attends an animal all the time, as long as it lives. In fact, there is evidence that as regards the faculty, which he held to be responsible for the arteries to dilate and to contract continuously, Herophilus defined it as 'vital' power, which makes life possible.⁴⁴ This would suggest that he identified nature with the life principle inherent in the body of a living animal.

There is another passage in the treatise *On the Doctrines of Philosophers*, ascribed to Ps.-Plutarch, which provides the other significant example of the term of nature. The passage as a whole concerns Herophilus' account of the movements of the lungs and the mechanism of respiration.

Herophilus admits the faculties for moving the bodies in the nerves, arteries, and muscles. Accordingly, he thinks that the lung by itself has a desire to dilate and contract in a natural way. The drawing in of breath from outside, he says, is accordingly the activity of the lung, and it draws it in through the repletion which occurs from without.⁴⁵

In this passage, Herophilus claims that the lungs have a desire or tendency of their

⁴² Rufus of Ephesus (?), *Synopsis de pulsibus*, 2 [=T149 Von Staden]. Von Staden translates the former part of the sentence, somewhat ambiguously, as 'the pulse attends us involuntarily and exists naturally (italics mine).

⁴³ The point here seems to be that these affections *per se* take place involuntarily, but we can *also* cause them to happen intentionally, either by lifting up a heavy box, or by pressing our hands against the wall. But the pulsating motion is essentially an involuntary movement, because we cannot bring it about, or even get control of it in whatever way.

⁴⁴ Galen, *De pulsuum differentiis*, III 2 [=T164 Von Staden]. See also Von Staden (2000), p.89.

⁴⁵ Ps.-Plutarch, *Placita philosophorum*, IV 22 [=T143b Von Staden]. The same theory is reported, though possibly with some mutilations, in the treatise written by Ps. - Galen, *De historia philosopha*, 103 (H. Diels, *Doxographi Graeci*, Berlin, 1879, p.639) [= T143c Von Staden].

own to dilate and to contract in a natural way (φυσικῶς). The voluntary motions of the body, on the other hand, are derived from the nerves and muscles, and the arteries are responsible for the pulsation, which may also be classified into the category of an involuntary movement. Von Staden emphasizes the original aspect of Herophilus' account of the mechanism of respiration, which he ascribed to the autonomous function of the lungs to dilate and contract, while his predecessors and contemporary physicians explained it in terms of the movement and heat of the heart, as represented by Aristotle's theory of respiration.⁴⁶ The crucial point here, I think, is rather the fact that the Alexandrian physician took nature (φύσις) as the principle which controls the autonomous function of the lungs to dilate and contract.

It is obvious from these passages cited above that the conception of nature is very significant for Herophilus' anatomical physiology of the human being. We find that the Alexandrian physician presupposed a different principle, which he defined as nature to explain the mechanism of involuntary movements of the body, such as the pulse and respiration, apart from the soul, the ruling part of which is located in the fourth ventricle of the brain. The brain, which he defined as the seat of the soul, interacts with the whole body and its parts through the system of sensory and motor nerves as being responsible for sense perceptions and for voluntary motions of the body respectively. In his anatomical physiology of the human being, accordingly, the faculties of the soul are differentiated from those attributed to the nature.

So much enough is for the conception of nature, which may well be regarded as one of the most characteristic aspects of Herophilus' anatomical physiology of the human being. Now, I will turn to the conception of nature, which I think to be made clear from the examples of the term in the following passages of the Hippocratic treatises, which have been ascribed to the medical school of Cos.⁴⁷ I would suggest that the Alexandrian physician might possibly have had in mind this Hippocratic conception of nature most principally, when he established his own physiology on the differentiation between the faculties of the soul and the 'natural' faculties.

The most important feature of the Hippocratic conception of nature, which will be illustrated by the examples of the Hippocratic treatises cited below, is that it is applied specifically to the domain of the human body as distinct from psychic states and activities, which are usually assigned to the soul. This is especially the case with the

⁴⁶ Von Staden (1989), pp. 259-262. For Aristotle's theory of respiration, see *On Respiration*, ch.20 -1, 479b17-480b30. See also Plato, *Timaeus*, 70c-d and 79a-d.

⁴⁷ For the most recent discussion of the same topic, see the article by B. Gundert (2000), which I have already mentioned in note 15 above, though I want to emphasize that my understanding of the 'Hippocratic' conception of nature is fundamentally different from hers.

famous Hippocratic treatise *On Airs, Waters, Places*, which, though it might still remain unclear whether it was written by Hippocrates, has traditionally been ascribed to his medical school of Cos from antiquity, and is now placed by so many people in modern Hippocratic scholarship under the same authorship with the other treatise *On the Sacred Disease*.⁴⁸ I will cite below the passage, which includes the last sentence of chapter 15 and part of the opening paragraph of chapter 16 of the treatise.

So much is my discussion of the differences in nature and in shape among the people living in Asia. As regards the lack of spirit and the lack of courage, on the other hand, the chief reason why Asians are less warlike and milder in character than Europeans is the uniformity of the seasons, which produce violent changes neither towards heat nor towards cold, but are equable.⁴⁹

In this passage, the Hippocratic author, who has completed his discussion about the differences in nature (φύσις) and in shape among the inhabitants of Asia, mentions that they also differ in their character (ἦθος) from the inhabitants of Europe. He goes on to give his account of the formation of human character, which he holds to be brought about by different environmental factors. The term of nature, collocated by the author in the passage cited above with shape, and further with some other physical aspects, such as stature and form, which his discussion in chapters 23 and 24 of the treatise would suggest, is used to denote the physical constitution of the people.⁵⁰ These aspects depend mostly on the natural environments, such as climate and the change of seasons, which function as their formative causes. The author holds that the same account may be applied to the formation of human character as well. In the paragraph that follows, however, he insists that social environments like political institutions (νόμοι) are also the effective factors, which may function independently as its formative causes. These arguments will lead to a conceptual distinction between body and soul, which the author introduces in his discussion of chapter 23, where he gives a final answer to the question why Europeans are more courageous than Asian people.

⁴⁸ The same authorship of these two treatises is almost generally accepted by modern scholars. See J. Jouanna (éd.), *Hippocrate, tome II, 2^e Partie, Airs, Eaux, Lieux*, Les Belles Lettres (Paris, 1996), pp. 71-73. I still remain sceptical about the same authorship, though I am convinced that *Aer.* was written later than *Morb.Sacr.*, the arguments of which are obviously more developed by the author of *Aer.*

⁴⁹ *Aer.* ch. 15-16 [II 62, 11~16. Littré]. I follow the Greek text edited by Jouanna (1996).

⁵⁰ *Aer.* ch.23 [II 82, 6~84, 8. Littré] and ch.24 [II 86, 7~13. Littré]. In these paragraphs, the author refers to stature (μέγεθος) and form (εἶδος) of people living in Europe along with their shape (μορφή) as their most principal physical aspects.

For men's souls have been enslaved, and are not willing to run the risks readily and recklessly for the power of someone else. Autonomous people, however, who take risks on their own behalf and not on behalf of others, are eager to go into danger. For they enjoy the prize of victory themselves.⁵¹

The first sentence of this passage deserves special attention. The author explains as regards Asian people subject to Persian Kings how men's souls ($\psi\upsilon\chi\alpha\iota$) have been enslaved, and are not willing ($\text{o}\dot{\upsilon}$ βούλονται) to run the risks for the power of their masters. I would insist that this passage provides us with one of the earliest examples of the term of soul in Greek literature, which may well be identified with the self of the human being, because the author uses it to denote explicitly the subject of choice and voluntary motions, which is indeed described here as being responsible specifically for our moral judgments and moral actions.

We have another interesting passage, which covers the arguments of chapters 8 and 9 of the Hippocratic treatise *On Humours*, because we find there a similar example of the term of nature, which is conceptualized as closely related to the human body as distinct from the states and activities of the soul.

As to the body, one should know to what disease nature most inclines. As, for example, a swollen spleen produces a certain effect, nature also produces something of that kind. This is almost the case with an evil complexion, the body which drains dry, and so on. Be expert in these things through exercise. What belongs to the soul is incontinence in drink and food, in sleep and wakefulness, endurance of toil, either for the sake of certain passions, as for example of dice, or for the sake of one's craft, or through necessity. One should know as to what kind of things endurance is regular or irregular, and from what kind of states to what kind the changes of the soul occur.⁵²

In the former part of this passage, the Hippocratic author seems to refer to some particular symptoms of the diseases, of which nature ($\phi\acute{\upsilon}\sigma\iota\varsigma$) also works as a generating factor. It is obvious that the term of nature is used to denote the physical constitution of the individual person, who has a 'natural' inclination towards some

⁵¹ *Aer.* ch.23 [II 84, 20~86, 4. Littré].

⁵² *Hum.* ch.8-9 [V 488, 11~18. Littré]. The Greek text remains unstable in some parts of the passage cited above, but the general point of the arguments is clear enough.

particular kinds of diseases.⁵³ In the latter part of the passage, on the other hand, the author discusses the states, which he claims to belong specifically to the human soul (ψυχή), including men's mental characteristics such as incontinence, endurance, and so on.

Interestingly enough, in his arguments following the passage mentioned above, the author will proceed to refer to some cases of its interactions with the body, by insisting that the appropriate member of the body responds by its action to each of the psychic states, such as fear, shame, pleasure and pain, and so on.⁵⁴ This seems to suggest that the author understood the soul to be like a distinct constituent of the human being from the body and its parts, which he holds to react appropriately to each one of the states attributed to the soul.

Finally and most significantly, I want to draw special attention to an example of the term of nature in the first section of chapter 5 of the *Epidemics*, Book VI.

Natures are physicians of diseases. Nature finds the way for itself, not from thought. For example, blinking, and the tongue offers its assistance, and all the like. Well trained, readily and without instruction, nature does what is needed. Tears, moistures of the nostrils, sneezing, wax from the ear, production of saliva in the mouth, inhalation and exhalation of breath, yawning, coughing, hiccough, which do not always occur in the same way. The excretion of urine and wind of both kinds, from food and from breath, and in women, the things characteristic of them, and in the rest of the body, sweat, itching, stretching, and so on.⁵⁵

It is most striking in this famous passage that the Hippocratic author describes nature (φύσις) almost personified as an exemplary physician of diseases, who knows and does everything that is needed for curing them. There is no doubt that nature, which the Hippocratic author mentions here, denotes the autonomous power inherent in all human bodies, functioning for preserving as well as restoring health, since he insists that nature does what is needed, readily (έκούσα) and without instruction (οὐ μαθοῦσα). This power, he claims, works to keep the human body in its normal

⁵³ This example obviously illustrates the Hippocratic conception of nature, which corresponds with the physical constitution of the individual, as contrasted with the universal nature of the human body, which is common to all people, as formulated in the *Epidemics*, Book I, ch.10 (23) [II 668, 14~670, 2. Littré]. The author explicitly refers to 'the common nature (ή κοινή φύσις) of all people, and also the particular nature (ή ιδίη φύσις) of the individual'.

⁵⁴ *Hum.* ch.9 [V 490, 2~8. Littré].

⁵⁵ *Epidemics.* Book VI, ch.5, 1 [V 314, 5~8. Littré].

condition, and functions to restore its normal condition, if there is anything that does harm to it.

In the passage that immediately follows, the author enumerates a series of physiological phenomena, such as the flow of tears, saliva in the mouth, coughing, sweating and the excretion of urine, including, among others, inhalation and exhalation of breath by the movements of the lungs, which constitute respiration. It is particularly significant that the author defines nature as being responsible for these phenomena, which he might possibly distinguish from psychic states and activities, though there is no explicit reference to the soul, to which these states and activities are assigned by the authors of the other two Hippocratic treatises mentioned above.

These examples of the term of nature in the Hippocratic treatises will lead us to think that the conception of nature introduced by Herophilus in his medical physiology of the human being is very closely connected with the Hippocratic conception of nature. As stated before, Herophilus introduced his conception of nature in order to explain the mechanism of involuntary movements of the human body, such as the pulse and respiration. He differentiated these movements from the voluntary motions of the body, for which he thought the soul to be responsible. As regards the Hippocratic conception of nature, we find that it is conceptualized as specifically applied to the domain of the human body, as distinct from the states and activities of the soul. The Hippocratic authors are seen to use the term of nature in their treatises cited above to denote the physical constitution of the individual or that of people living in some particular regions, as distinct from psychic states and activities, which they attribute specifically to the soul. And most significantly, I think, the term is used by the Hippocratic author of the *Epidemics*, Book VI to denote the autonomous power inherent in all human bodies, which functions for maintaining the life of the human being. This example of the term of nature, provided by the author of the *Epidemics*, Book VI, is the most important for us to illuminate the fact that the Alexandrian physician had in mind most principally the Hippocratic conception of nature, when he established his own medical physiology of the human being on the differentiation between the faculties of the soul and the ones attributed to the nature.

Conclusion

Through a conceptual analysis of Herophilus' methodology and his anatomical physiology of the human being, which, I think, has illuminated his intellectual background, I hope to have made it clear enough that his medical science has intrinsic

continuity of thought in some essential aspects with Hippocratic medicine.

First, I focused on his methodological statement to the effect that primary parts of the human body should be perceptible by the senses, and I argued that his methodology of medical science follows the medical principle formulated in the Hippocratic treatise *On the Nature of Man*. The author Polybus, who was Hippocrates' son-in-law and one of his principal disciples, insists that whoever intends to have a medical discussion should define the essential constituents of the human being as perceptible by the senses.

As a second point, I drew attention to the fact that Herophilus was in a serious disagreement of opinion with his teacher Praxagoras about the physiology of the pulse and some particular affections of the body. Their disagreement, I argued, led the Alexandrian physician to return to the tradition of Hippocratic encephalocentric model of the human being, as represented by the author of the Hippocratic treatise *On the Sacred Disease*. The author was probably Herophilus' most significant predecessor, because he holds that the brain is responsible not only for our cognitive activities but also for our voluntary motions. This explains why Herophilus placed a great emphasis on the brain, which interacts with the body and its parts through the sensory and motor nerves as responsible for sense perceptions and voluntary motions respectively.

And as a third point, I gave special attention to the fact that Herophilus differentiated between the faculties of the soul and the ones attributed to the nature. He made this differentiation in order to explain the mechanism of involuntary movements of the human body, as distinct from its voluntary motions. I argued that, when the Alexandrian physician established his anatomical physiology on this differentiation, he probably had in mind the Hippocratic conception of nature as applied by the authors of some Hippocratic treatises specifically to the domain of the human body, as distinct from the states and activities of the soul, which is illuminated most significantly by the example of the term of nature provided by the author of the *Epidemics*, Book VI.

Thus, it has turned out to be obvious that Herophilus regarded Hippocratic medicine as one of the most fundamental theoretical sources of his medical science. This will be confirmed by the fact that he wrote literary works on some of the Hippocratic texts, including the Hippocratic *Prognosticum* and *Epidemics*, Book VI, though they might have been sometimes critical.⁵⁶ In fact, his literary enthusiasm for

⁵⁶ Caelius Aurelianus, *Tardarum Passionum*, IV, 113 (CML VI 1, Pars II, p. 838) [=T31, T261 Von Staden], and Galen, *In Hippocratis Epidemiarum Librum VI Commentaria*, I 5 (CMG V 10. 2.2, pp. 20-21) [=T267a Von Staden]. See Von Staden (1989), pp.74-7, pp.428-431. Von Staden strongly suggests that the 'book' written by Herophilus against the Hippocratic *Prognosticum*, as is reported by Caelius Aurelianus, was a critical

Hippocratic texts was to initiate the Alexandrian tradition of Hippocratic exegesis. Among those who engaged most productively in Hippocratic exegesis was a physician Bacchius of Tanagra (c.275-c.200 BC). Bacchius was an adherent disciple of Herophilus and an editor of his famous lexicographic work of Hippocratic vocabulary in three books.⁵⁷ It is probable from the evidence of Hippocratic vocabulary preserved by Erotianus, a grammarian of the Neronian period that Bacchius' lexicon included words taken from the Hippocratic treatise *On the Sacred Disease*.⁵⁸ This strongly suggests that the treatise had long been playing an important role among Herophilus and his disciples as one of the most principal texts on Hippocratic medicine.

Now, we come to a conclusion that Herophilus was a more faithful successor than his teacher Praxagoras to the tradition of Hippocratic medicine, given the fact that his methodology and his anatomical physiology of the human being shows intrinsic continuity of thought with Hippocratic medicine. In fact, his teacher Praxagoras parted company with Hippocrates on the most fundamental point with his cardiocentric model of the human being, which he introduced into the medical school of Cos, where there had been a tradition of Hippocratic encephalocentrism. His disciple might possibly have been frustrated with this situation. Herophilus was not born in Cos as a member of the Asclepiadai, who claimed to be descended from Asclepius, and traditionally engaged in medical practice, but in Chalcedon on the Asiatic side of the Bosphorus, far remote from the city famous to all candidates for medical profession as the birthplace of Hippocrates.⁵⁹ Accordingly, it seems to have been much to his disappointment that his teacher rejected the tradition of Hippocratic encephalocentrism, which he should have followed, all the more because he belonged to the Asclepiadai, and further, he was one of the leading members of the medical school of Cos.⁶⁰

Herophilus probably reacted against his teacher's anti-traditionalist stance. This reaction, I suppose, eventually led him to commit to the tradition of Hippocratic medicine to such an extent that he might possibly have dared to identify himself as the most faithful follower of the Hippocratic tradition. His anatomical researches on the

commentary, though R. Flemming is doubtful of his suggestion (R. J. Hankinson (ed.), *The Cambridge Companion to Galen* (Cambridge UP, 2008), ch.13, p. 331, n. 40). It is probable, on the other hand, that a comment on the term 'infant' (νήπιος), which, according to Galen in his commentary, Zeuxis the Empiricist ascribes to Herophilus, constituted a part of his exegesis of the *Epidemics*, Book VI, because the comment exactly corresponds to the relevant passage there (*Epid. VI*, 1. 5).

⁵⁷ For the career of Bacchius as a member of the school of Herophilus and his contributions to the Hippocratic scholarship in Alexandria, see Von Staden (1989), pp.484-495.

⁵⁸ E. Nachmanson, Erotianus, *Vocum Hippocraticarum collectio cum Fragmentis* (Gothenburg, 1918), α 47 [=TBa.16 Von Staden].

⁵⁹ For a detailed description of Herophilus' life, see Von Staden (1989), pp.35-50.

⁶⁰ Galen, *Methodus medendi*, I 3 [=T10 Von Staden]. See also Steckerl (1958), p.70, Fr.45. Galen reports explicitly that Praxagoras was a 'descendant of Asclepius'.

structure and functions of the brain and his discovery of the nervous system may well be understood as an attempt to prove and ensure the legitimacy of Hippocratic encephalocentric model of the human being, although his contributions to anatomical physiology were innovative in the knowledge of the human body and in the development of medicine in general.

[Postscript]

This article is originally based on the paper entitled 'The Hippocratic Tradition in Early Hellenistic Medicine', which I gave to the Research Seminar held on 4 December 2008 at the Department of Classics and Ancient History, School of Humanities and Social Sciences, University of Exeter, UK, when I stayed there in late autumn for two weeks from 23 November to 6 December 2008 to do my overseas research focusing on ancient Greek and Roman medicine and its contemporary philosophy. I would very much appreciate Prof. Christopher Gill, Prof. John Wilkins, Prof. Barbara Borg, Prof. Daniel Ogden, and other members of the Department, who very kindly offered me an opportunity to give my paper to their Research Seminar, asked me valuable questions, and made lots of encouraging comments.

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