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Body and Machine: Interactions between Medicine, Mechanics, and Philosophy in Early Alexandria

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At different historical moments of exceptional cultural efflorescence, science plays strikingly divergent roles. Theoretically inclined, original "research" scientists represent a more conspicuous strand in the intellectual texture of early Alexandria than, for example, of Periklean Athens or of Augustan Rome (despite the brilliant technological, architectural, and general cultural virtuosity of Athens and Rome). Scientists were, of course, active in many Greek cities throughout the Hellenistic epoch, including Syracuse, Athens, Rhodes, Kos, Pergamon, Smyrna, Ephesos, Laodicea-ad-Lycum, and Antioch,[1] but a thick texture of scientific activity is a particularly distinctive feature of Alexandrian culture in the third century B.C. How many other ancient Greek cities could, within a single century, count Euclid,[2] Aristarchos of Samos,[3] Archimedes of Syracuse,[4] Konon of Samos, Dositheos, Eratosthenes of Cyrene,[5] and Apollonios of Perge[6] among its resident (or closely associated) mathematical scientists? And how many cities could, simultaneously, claim brilliant mechanicians such as Ktesibios,[7] his pupil Philon of Byzantium,[8] and Dionysos of Alexandria[9] among its technological innovators, not to mention, among its physicians, both Herophilos (the first person to conduct systematic scientific dissections of human cadavers)[10] and the founders of the influential Empiricist "school"?[11]

Collectively, these and other figures make for an exceptional century of scientific activity within a single city. Not only is the number of innovative scientists in Alexandria noteworthy, however, but so are the interactions between different branches of science and the heterogeneity of rival points of view advocated by Greek scientists associated with the city. It is in these contexts, too, that one should locate two new, fundamentally divergent, rival scientific models of the human body developed in the third century B.C. by the Greek pioneers of systematic human dissection.

The exceptional constellation of factors that, for the first and last time in antiquity, permitted systematic scientific human dissection—and systematic vivisectory experimentation on condemned criminals[12]—in the early third century B.C. needs no renewed rehearsal here (see note

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10 above). But it should perhaps be underscored again that any monocausal explanatory hypothesis is likely to be inadequate. Instead, on our horizon of explanation we have to accommodate a variety of interactive factors, including the thick texture of scientific activity in Alexandria; the attested royal support of this activity; the cultural ambitions of early Hellenistic rulers; the relation of culture to political power; the Ptolemies' own violations of Greek taboos; an intellectual environment in which bold, erudite experimentation coexisted with conservative tradition; the impressive example of Aristotle's scientifically productive dissections and vivisections of animals (never of humans) in the previous century; the philosophical secularization of the corpse by Aristotle and the Stoics (the latter classified it among the *ἀδιάφορα*, that is, things that are morally "indifferent"); and the possibility of expropriating the age-old Egyptian practice of mummification as a "legitimating" precedent and as proof that a cadaver may be opened with impunity (although no respectable historian of science has confused *religious* mummification with *systematic scientific* dissection; the motivations, methods, contexts, aims, and results of these two kinds of activity were quite different). Out of the systematic human dissections made possible by these and perhaps by other interactive factors arose two rival models of the body articulated most clearly by Herophilos and Erasistratos. I turn first to Herophilos, then to Erasistratos.

Herophilos

To the vast new world opened up by the founder of their city, Alexandrians in various domains responded with extremes of cultural smallness and bigness, on the one hand exploring and creating the miniature, on the other hand embracing the gigantism that became a conspicuous feature of Hellenistic siege technology, of sculpture, of architecture, of shipbuilding, of ostentatious victory games, of religious processions, and so on. The Kallimachean poetics of smallness, the miniaturization of mechanical technology by Ktesibios and others, and miniaturization in the decorative arts all belong to the "culture of smallness." So does a noteworthy feature of Herophilos's model of the body—what one might call his "miniaturization of anatomy."

Herophilos was not satisfied with describing only larger bones, organs, vessels, and muscles; rather, he carefully differentiated among human parts barely distinguishable by the naked eye, and in the process he created a new nomenclature for the body—a detailed new language of the body that extensively deploys vivid metaphors drawn from Alexandrian artifactual culture, such as the Pharos.[13] Through his repeated, meticulous dissections Herophilos not only discovered the existence of nerves but also accurately described the paths of at least seven pairs of cranial nerves and recognized the difference between motor and sensory nerves. He distinguished between the ventricles of the brain, and he carefully differentiated between four membranes of the eye, bestowing upon subsequent nomenclature the terms *cornea* and *retina*.[14] He also discovered the heart valves, the systematic anatomical distinction between arteries and veins, and numerous other smaller features of the vascular system.

The miniaturization of anatomy was, of course, not Herophilos's only anatomical accomplishment. He also offered the first accurate description of the human liver, conducted the first investigation of the pancreas, and provided a descriptive and functional anatomy of the reproductive parts that was not improved upon for centuries.[15] Furthermore, he demystified the womb by discovering the ovaries and the Fallopian tubes, by establishing the anatomical impossibility of a wandering womb that causes hysterical suffocation, and by abandoning the traditional idea—later revived by the influential Galen—of a bicameral uterus (with a cold left chamber for the gestation of the female fetus and a hot right chamber for the gestation of the male).[16] But many of his greatest advances lay precisely in the exploration of minute parts unknown to—or poorly recognized by—the Hippocratics, Aristotle, Diokles, Praxagoras, and other precursors.

A second conspicuous feature of Herophilos's version of the body is that it is a "dynamic" model that deploys, inter alia, principles that display affinities with theories of magnetism. In the extant remains of his writings Herophilos did not make explicit the similarities between his theory of "faculties" or capacities (*δυνάμεις*) and magnetism, but Galen later did so,[17] possibly drawing on Stoic sources (this would not be surprising, since several of Herophilos's views have much in common with Stoic theories). In particular, Herophilos seems to have believed that the body is a material continuum that harbors no void, and that invisible, innate capacities or faculties control and regulate all bodily functions, often by attracting or pulling various forms of matter—liquids, solids, air—through ducts and other spaces in the body toward their appropriate destinations. These innate faculties are thoroughly secularized; no claim of divine design or divine force is made for them.

Thus an invisible, innate faculty ("vital *dynamis*"?), extending from the heart throughout the walls of the arteries, maintains pulsation in the form of simultaneous dilatation and contraction of the heart and of all arteries. This *dynamis* thereby pulls or "attracts" a mixture of blood and pneuma (the latter ultimately derived from respiration) from the heart through the entire body via the arterial system.[18] Blood (without pneuma) apparently is similarly moved through the veins, while pneuma—by means of which at least some sensory and voluntary motor activity is conducted—is moved through the nerve ducts.[19] Innate faculties likewise seem to govern the movements and proportional relations of the traditional humors. Other motive faculties apparently reside in the muscles, the lungs, the digestive organs, and so on. According to Herophilos, respiration, for example, is due to a special capacity or faculty that displays itself as the lungs' natural tendency to dilate and contract. All bodily matter, in fact, seems to be regulated by such faculties. Herophilos explicitly says, for example, that the uterus "is woven from the same things as the other parts and is regulated by the same faculties" (*ὑπὸ τῶν αὐτῶν δυνάμεων*) that govern the rest of bodily matter (*ὕλας*).[20] All the body's natural processes and motions, voluntary and involuntary, like all its materials, therefore are regulated or managed (*διοικεῖσθαι*) by nature-given capacities or faculties or powers (*δυνάμεις*) capable of moving matter through bodily ducts and spaces, especially by means of magnetlike attraction.

A third noteworthy feature of Herophilos's dynamic, magnetic model of the body is his tendency to quantify or to mathematicize aspects of both the exterior and the interior of the body, including its internal motions. The traditional view that Greek science, unlike modern science, was largely qualitative rather than quantitative in nature has been shown by Geoffrey Lloyd and others to be in need of significant qualification.[21] In certain important respects Herophilos's mathematicizing aspirations go beyond those of earlier Greeks. Unlike the Hippocratics, Herophilos tries to extend precise measurement beyond pharmacology, stages in the embryo, and the periodicities that appear in physical disorders such as fevers. And unlike Polykleitos's *Canon,* with its measurement of fixed proportionalities, its "nonnaturalistic" *μέσον*, its *συμμετρία*, and its *κατὰ τὸ παράδειγμα*,[22] Herophilos extends the process of measuring into small interior structures of the body and into individual internal physiological and pathological processes.

Although Herophilos uses quantification to define generalizable bodily laws, as had the Hippocratics and Polykleitos, he leaves ample room for individual variability among human bodies (in this respect, too, following some Hippocratics)—as does much of Hellenistic art. His version of the body is inspired neither by an aestheticizing mathematicism nor by a mathematicizing aestheticism, but by the aspiration to define precisely as many natural structures and processes in the body as possible, while recognizing that not all bodily features will submit to quantification or generalization.

His attempts to measure bodily processes are perhaps also to be understood in the context of the renewed, more extensive preoccupation with scientific measurement in the third century B.C. Eratosthenes' *On the Measurement of the Earth* (see note 5), Aristarchos's *On the Sizes and Distances of the Sun and the Moon,* Archimedes' *On the Measurement of the Circle,* and Erasistratos's quantitative experiments are among the many manifestations of this interest. I cite only two brief examples of Herophilos's participation in this richly attested dimension of early Alexandrian science—pulse rhythms and the healing of wounds.[23]

Perhaps prompted in part by the native Egyptian concept, known from pharaonic medical papyri, of "counting" the body's vessels,[24] Herophilos became the first to develop an elaborate quantitative theory of the pulse. To measure differences among the pulses of people at different stages of life, he drew on precise musical units, including the πρῶτος χρόνος ("primary time unit") and the ἄλογος ("irrational unit"), possibly borrowed in part from Aristoxenos of Taras's *Elements of Rhythm*.[25] The primary differentiae of pulse types, he argues, are rhythm, speed, size, and vehemence or strength—all eminently quantifiable. Rhythm, which he defines as "a motion having a defined regulation in time," is central to his classification of normal, healthy pulses according to human stages of life. We all pass from a naturally pyrrhic pulse rhythm (⏑⏑) in infancy through a trochaic pulse (–⏑) in adolescence to a spondaic prime of life (––), and eventually on to an iambic pulse rhythm (⏑–) in old age.[26] Nature's music in our arteries hence displays mathematically formulable proportions of such absolute regularity that deviations, and hence illness, can be determined by exact measurement. This also holds true of the other pulse differentiae, notably of speed or frequency.

To measure the pulse Herophilos constructed a portable clepsydra that could be precisely calibrated to fit the age-group of each patient. The device was used to measure the deviation of the *frequency* of the patient's pulse rhythms from normal frequency and thus to measure, in particular, the patient's body temperature or fever, since Herophilos held pulse frequency to be a correlate of body temperature.[27] Herophilos's device was perhaps inspired in part by the rich native Egyptian tradition of time-measuring devices, such as a famous alabaster clepsydra of the second millennium B.C., and in part by the sophisticated refinement of water-clock technology by contemporary Alexandrian mechanicians such as Ktesibios.[28]

Among the mechanical devices invented by Ktesibios is an intricate automatic water clock, which, unlike the sundial, operated equally precisely by night and by day, in summer and in winter.[29] Particularly interesting in our context is the clock's mechanical seasonal adjustability. The principle of an adjustable timing device was hardly new; some of the pharaonic and Greek precursors of Ktesibios's device also could accommodate seasonable variations (see notes 28–30). But Ktesibios's mechanisms for ensuring a regular flow and for adjusting this flow seasonably were apparently sufficiently novel and striking to have drawn the attention of Vitruvius and his source(s). In particular, Ktesibios's clock could be adjusted easily by a series of wedges to accommodate shortening or lengthening of the days in different months of the changing seasons.[30] The same principle of easy adjustability to seasons centrally informs Herophilos's portable timing device—although here it is not the seasons of the year but the seasons of life, the ἡλικίαι of his patients, that call for quantifying adjustment. The similarities should not be pressed too far, but in both cases the mechanical adjustability of a timing device to accommodate regularly occurring, *quantifiable changes* within a larger order of *measurable regularity* is central to the efficacy of the measuring device.

A second example illustrates the diversity of contexts in which Herophilos mathematicized the body. Responding to the question why round wounds heal with more difficulty than others, Herophilos, according to Cassius, "accounts for the cause by giving a geometric demonstration" (γεωμετρικὴ ἀπόδειξις) of the surface area of circular shapes in relation to their diameter and circumference.[31] The question was well known to the Greeks, but Herophilos seems to have been the first to address it by means of mathematical proof. This effort, and others like it, of course should not be mistaken for a "geometric" conception of the body as a whole; Herophilos's version of the body is far too dynamic internally, too minutely detailed, too individually variable, and too provisional (see below) to accommodate overall paradigmatic notions such as Polykleitos's canon or the famous *quadratum*. Rather, his geometric proof here reflects his aspiration to deal with all bodily phenomena, large and small, normal and abnormal, with as much precision as possible, and to achieve such precision by mathematical or other quantitative means whenever possible.

These examples of Herophilos's interactions with geometry, with the mathematical features of Aristoxenos's musical theory, and with a flexible Egyptian-Alexandrian technology of precise measurement illustrate the extent to which his new, dynamic-magnetic version of the body, minutely detailed anatomically, regulated by incessantly active innate powers that continually also pull—rather than merely push—matter through it with meticulous regularity and precision,[32] is also projected as mathematically and technologically verifiable.

A fourth noteworthy feature of Herophilos's version of the body should not be overlooked: his insistence on its provisionality. For all his precise formulations of regularities in quantitative terms, he argues that all causal theory—and hence all explanations of bodily functions or dysfunctions—must have a merely hypothetical status; cause cannot be known or articulated with certainty but only ex hypothesi.[33] Experience (ἐμπειρία) is important to Herophilos, and he believes that we have no choice but to begin with the surface world of phenomena: "Let the appearances (φαινόμενα) be stated first even if they are not first."[34] But the good scientist, trying to understand *how* the body works, will also have to investigate *why* things work the way they do. This will make it necessary to engage in inferences from the visible to the invisible and hence in the construction of theories, notably of causal theories (for example, about invisible faculties that regulate the body). It is in this causal domain, in particular, that Herophilos insists on the hypothetical nature of his version of the body. It is important not to mistake this epistemological stance for that of Hellenistic skepticism. Herophilos's hypotheticalism does not entail suspension of all judgment. His minute anatomical investigations, his theory of faculties, and his efforts at quantification illustrate that his aim is not skeptical *epochē*, and that he is not reluctant to construct theories. Rather, he welds his impressively detailed observations to a bold insight into the provisionality of their explanation, no matter how precisely mathematicized these explanations might be.[35]

Erasistratos

Whether Erasistratos, the author of the major rival Greek version of the human body in the early Hellenistic period, ever practiced in Alexandria, is controversial. Geoffrey Lloyd and most modern scholars believe that he did, at least for a substantial period of time, whereas Peter Fraser has revived the view that only Seleucid connections are attested for Erasistratos.[36] It is a pity that many, though not all, scholars have felt obliged to choose between Alexandria and Antioch. There is in fact evidence that not only Erasistratos but also several of his relatives, pupils, and associates were active as physicians both in Seleucid Antioch and in Ptolemaic Alexandria.[37] One neglected, albeit problematic, ancient source, Saint Augustine's acquaintance Vindician, claims that Erasistratos, like Herophilos, conducted pathological examinations "*in Alexandria*" by means of dissecting human cadavers; and another, Caelius Aurelianus, refers to a remedy that Erasistratos sent or promised to send to one of the Ptolemies (*Ptolemaeo regi promittens*).[38] The mobility of the Hellenistic scientific community is well attested, and ancient sources allude to Erasistratos's presence not only in Antioch and Alexandria but also in Keos, Athens, Knidos, Kos, and other localities.[39] More pertinent for present purposes is that, wherever he conducted his investigations, Erasistratos's theories show close interaction with Alexandrian science. Four related features of Erasistratos's model of the body are noteworthy in this context.

First, Erasistratos refines and extends Herophilos's anatomical and physiological discoveries, for example, by making an even clearer distinction between motor nerves and sensory nerves, by specifying more precisely the origin of the nerves in the brain as well as the nervous connections between the brain and the spine, and by demonstrating the function of the heart valves.[40] In addition, he seems to have been the first to extend the systematic use of human dissection to pathology and to deploy experimentation regularly in order to verify his physiological theories.[41]

Second, epistemologically less reticent than Herophilos, Erasistratos distinguishes between the conjectural, or stochastic, branches of medicine (therapeutics, semiotics) and its scientific branches (etiology, physiology).[42] For the latter Erasistratos claims certainty, and in this context he tries to develop a more comprehensive systematic model of all major bodily functions as interdependent, interactive processes. Respiration, appetite, digestion, maintenance of body temperature, sensation, muscular activity, the nervous system, pulsation, and the distribution of blood and pneuma by the vascular system all are depicted as interdependent parts of a unitary system.[43] Abandoning the Herophilean model of material processes regulated by invisible innate faculties (*δυνάμεις*), and likewise jettisoning the theory of the four humors, Erasistratos instead uses his "miniature" anatomical knowledge to develop a more mechanistic version of the body.

According to Erasistratos, the body consists of particulate or corpuscular matter, which always acts in accordance with the principle that matter will rush into any space that is being emptied (*ἡ πρὸς τὸ κενούμενον ἀκολουθία*).[44] Erasistratos, in other words, denies the possibility of any continuous or massed void. But he acknowledges the distinction between massed void and disseminate or dispersed void.[45] The latter is not the continuous void postulated by Epicurus and other atomists but the interstitial void perhaps accepted by Erasistratos under the influence of his older contemporary, the Peripatetic Strato of Lampsakos (d. 269/268 B.C.), a tutor of Ptolemy II Philadelphos. In Strato's view void exists, but only in the three-dimensional interstices between imperfectly fitting particles of matter—particles of which all objects, animate and inanimate, are composed—since matter would immediately rush in to fill any larger, more continuous, massed void.[46] Wherever Strato might belong in Erasistratos's intellectual genealogy, it seems clear that Erasistratos shares these general principles and that, characteristically, he performs a simple experiment to illustrate them. It is striking that a similar experiment is found both in early Alexandrian mechanics and in Peripatetic writers.[47]

Third, on this material basis, Erasistratos consistently applies principles that also appear in Alexandrian mechanics, notably in pneumatics, hydraulics, and hydrostatics. Herophilos had confidently brought mechanical means—a measuring device—to the body surface to measure nature's music in the body, but Erasistratos now places natural "machines" *inside* the body. Indeed, the body *is* a machine according to the Erasistratean version: a perpetual nature-given automaton. There is no need for hidden invisible faculties (*δυνάμεις*), he believes; all physiological processes are explicable in terms of the material properties and structures of the parts of a mechanistically operating body. Yet, as will be shown below, Erasistratos preserves a teleological perspective by depicting most of these parts as being purposive, that is, as serving or effecting an identifiable function or end. He depicts the body, in effect, as an autonomous machine within which many interrelated, smaller machines with mostly purposive parts are continuously operative. A natural automaton in perpetual motion for the duration of human life, the human body keeps mechanically distributing blood from the heart and liver through the veins, vital pneuma from the heart through the arteries, and psychic pneuma from the brain through the nerves, all in accordance with *πρὸς τὸ κενούμενον ἀκολουθία* (matter "following toward that which is being emptied"),[48] and all without prompting by any external agency or by invisible internal faculties. A closer look at one of these purposive parts within the "body machine" might offer a useful illustration of Erasistratos's reasoning.

A major "submachine" within the larger body machine is the heart, which Erasistratos depicts as an automatic, double-action, suction-and-force pump or, to use his own metaphor, bellows. This cardiac bellows-pump is equipped with superbly functional valves that ensure the irreversibility of the flow both of what rushes into its two chambers and of what it pumps out.[49] The parallels between Erasistratos's model of the heart and central features of the new Alexandrian mechanical technology are striking. I offer only one example: the water pump invented by Ktesibios during Erasistratos's lifetime.[50]

1. Like Erasistratos's version of the heart, Ktesibios's water pump has two chambers.

2. Both the cardiac pump and the water pump are equipped with valves to ensure the irreversibility of the flow. As Vitruvius says of Ktesibios's pump, "in this chamber there are circular valves [*asses*] placed in the upper orifices ["nostrils"] of the tubes with an accurate fitting. And these valves, by closing up the apertures of the orifices ["nostrils"], do not permit that which has been pressed into the chamber by means of air to return."[51]

3. As in Erasistratos's model of the heart, so in Ktesibios's pump there are four sets of valves, two controlling intake and two regulating outflow from the two chambers.

4. Furthermore, Ktesibios uses valves to ensure the irreversibility of the flow of either liquid or air (both here and in several of his other machines). Erasistratos likewise describes the heart valves as ensuring the unidirectional flow of either air (*πνεῦμα*, breath) or liquid (blood): two sets of cardiac valves, he says, control the flow of pneuma (respectively *into* the left

chamber of the heart from the lungs and *out* of this left chamber into the aorta), while two other valve sets ensure unidirectional flow of blood into and from the right cardiac chamber.

5. Ktesibios's water pump has forked pipes (*fistulae furcillae*), and Erasistratos's vascular system is similarly dependent on forking vessels.

6. Both Erasistratos's version of the heart and Ktesibios's pump centrally depend on the principle of an intermediate valved chamber (*medius catinus*, see note 50). The Erasistratean heart serves as a double intermediate chamber, on the one hand, for blood between the vena cava (coming from the liver) and the pulmonary vessels that carry blood to the lungs, and, on the other hand, for pneuma between the lungs and the aorta.[52]

7. Just as Ktesibios's water pump is constructed with twin cylinders (*modioli gemelli*) sitting in a round space, so Erasistratos's heart is a two-chambered machine that sits in a larger roundish space, the thorax.[53]

8. As compression and expansion alternate in each chamber of Ktesibios's water pump, so contraction continuously alternates with dilatation in Erasistratos's cardiac bellows-pump.

9. More fundamentally, the mechanical principles are similar in the two cases: propulsion of matter into a contiguous space by compression or contraction and drawing in of contiguous matter by expansion or dilatation, based on the recognition that continuous—as opposed to disseminate—void does not exist naturally. (It should not be overlooked, however, that Erasistratos in his extant remains explicitly applies the theory of interstitial void only to the movement of liquids through the body, not to the compressibility of air.)

As always, similarity should not be mistaken for identity, nor does affinity necessarily entail influence. But the parallels between Erasistratos's model of the heart and Ktesibios's water pump are numerous, nontrivial, and nonmarginal. Whether Erasistratos borrowed from Ktesibios or Ktesibios from Erasistratos, or neither from either, is unclear, but it is evident that Erasistratos's version of the body has much in common with early Alexandrian technology. Furthermore, for whatever reasons, both Erasistratos and some early Alexandrian mechanicians, such as Ktesibios and Philon of Byzantium, developed versions of "machines"—Erasistratos to explain natural physiological processes, the others to explore new technological possibilities—that had at least some elements in common with Strato's theory of void and of particulate matter.[54] It also is striking that later Alexandrian writers on mechanics, such as Heron, probably drawing on early Hellenistic sources, invoke medical instruments and medical practices in support of their views on interstitial void and on pneumatics.[55] Heron's elaborate description of the design of medical devices that deploy his pneumatic principles, such as a cupping tool (ὀικύα) that does not require heating and a syringe for drawing off pus (πυουλκός, "pus puller"),[56] further illustrates the interaction between Hellenistic medicine and mechanical technology.

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Fourth, ever since antiquity the conspicuously mechanistic features of many of Erasistratos's physiological and pathological explanations have tended to obscure another major feature of his version of the body: teleology. In some of his extensive anti-Erasistratean polemics, Galen suggests that Erasistratos's teleological statements were merely rhetorical, hypocritical, Peripatetic window dressing, and that they were blatantly contradicted by Erasistratos himself, for example, when the latter fails to specify a function for the spleen, the omentum, the renal arteries, and yellow bile.[57] But the ancient evidence offers no compelling reason to accept Galen's judgment. Indeed, Galen's own reports leave little doubt that Erasistratos unequivocally articulated a teleological approach to the body: "Erasistratos himself supposed that nature (φύσις) is capable of forethought (προνοητική) for the living being and capable of *technē* (τεχνική)," and "Erasistratos seems to have sound sense, since he thinks that all parts of the body are both well placed (καλῆς τεθῆναι) and well shaped (διαπλαόθῆναι) by nature, . . . and he calls nature 'capable of *technē*' (τεχνική)."[58] Similarly, Galen reports, "nature does nothing without reason (ἀλόγως), for he [Erasistratos] himself says this";[59] "up to the point where he [Erasistratos] sings a hymn to nature as being capable of *technē*, I [Galen], too, recognize the opinions of the Peripatos" (and, adds Galen, Erasistratos's followers also claim that he associated with the Peripatos);[60] "only one [opinion about nature] will be found to be the same for Erasistratos and for those authors [*sc.* the Peripatetics], namely that nature makes all things for the sake of something and nothing in vain."[61] Plutarch (or pseudo-Plutarch) seems to allude to this fundamental feature of Erasistratos's conception of natural beings: "For, everywhere nature (φύσις) is exact (ἀκριβής), fond of *technē* (φιλότεχνος), without deficiency (ἀνελλιπής), and without superfluity (ἀπέριττος), having, as Erasistratos says, nothing tawdry (ῥωπικόν)."[62]

It is significant that Erasistratos emphasizes not only nature's purposiveness, providentiality, and aesthetically (καλῶς) directed accomplishments but also its craftsmanship (φύσις τεχνική, φιλότεχνος). *Technē* has a rich philosophical history as a paradigm of purposive or goal-directed activity, and hence Greek philosophers often use *technē*