CHAPTER 10
Hellenistic biological sciences

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The five centuries that separate Aristotle's death in 322 BC from Galen's ascendancy in Rome in the latter part of the second century AD were fertile ones for the biological sciences, in particular medicine. Nor is the period solely of interest to historians of science—for the methodological debates characteristic of the life sciences of the time shadow, and in some cases foreshadow, those which raged between the contemporary Sceptical and Dogmatic schools. If our knowledge of the medicine of the period is necessarily circumscribed by the fragmentary nature of almost all of our sources, and if the project of reconstructing the science is consequently all the more difficult, the enterprise is none the less a rich, fascinating, and exciting one.

EMPIRICISM AND AETIOLOGY

When Aristotle died, scientific theories, their nature and status, had already been the subject of intense debate for at least a century. The more theoretical of the Hippocratic doctors, such as the authors of *On Regimen* 1.2 (who analysed human physiology in terms of fire and water) and *Nature of Man* (who introduced the theory of the four humours: blood, phlegm, black and yellow bile), took issue with their empirically-minded colleagues, notably the writer of *On Ancient Medicine,* who eschewed such arcana, championing instead the cause of explanations grounded in experience. That debate revolved around the issue of what science properly investigates, and what sorts of explanation it should produce. Should it deal in grand theoretical structures, postulating hidden entities in terms of which the course of ordinary observable events is to be determined (and, for the practising physician, altered)? Or must it rather simply concentrate on establishing a secure body of data concerning which phenomena are observed to go along with which others? What, crucially, is the analysis and role of the notion of cause in science?

These questions were posed with unprecedented sharpness in Aristotle's theoretical works on science, most particularly in *Posterior Analytics* and *Parts of Animals* 1. Aristotle stressed that science must start from an empirical base (*Parts of Animals* 1.1, 639b3 ff., 640a14 ff.; although

precisely how it should do so is obscure: *Posterior Analytics* 2.19); but it must also aspire to final exhibition in the form of a complete and rigorous deductive structure, whose theorems can be seen to flow from its fundamental axioms and definitions. Science's explanatory force resides in that dependency: a fact is explained when it is shown to follow as a deductive consequence of some causally prior and more basic facts about the domain in question (*Posterior Analytics* 1.2; cf. 113, 2 16–17). Aristotelian science seeks to make patent the total structure of reality, and is thus strongly realist in conception. The axioms are not merely arbitrary postulates: they are the bedrock foundational facts upon which everything else depends. Yet such realisms are, of course, notoriously prone to epistemological attack; and Aristotelian realism was no exception. It is one thing to assert that science ought to have some such form; quite another to explain how we can know when we have actually arrived at it. Such difficulties form the core of the empiricist, and later the sceptical, onslaughts upon the scientific pretensions of those they called the Dogmatists.

DIOCLES OF CARYSTUS

Let us begin, however, with Diocles of Carystus:

> Those who think that one should state a cause in every case do not appear to understand first that it is not always necessary to do so from a practical point of view, and second that many things which exist are somehow by their nature akin to principles, so that they cannot be given a causal account. Furthermore, they sometimes err in assuming what is unknown, disputed, and implausible, thinking that they have adequately given the cause. You should disregard people who aetiologize in this manner, and who think that one should state causes for everything; you should rather rely upon things which have been excogitated over a long period on the basis of experience *[empeiria];* and you should seek a cause f or contingent things when that is likely to make what you say about them more understandable and more believable.
> (Diocles, in Galen, *On the Powers of Foodstuffs* VI, 455–6 Kühn [10.10])[1]

Diocles was a doctor. His dates are controversial, but he is very likely a younger contemporary of Aristotle: and that text has unmistakable Aristotelian echoes, so much so that Jaeger [10.55] was moved to make Diocles a more or less orthodox Aristotelian. However, this is clearly an exaggeration: although Diocles agrees with Aristotle that not everything requires causal explanation, his reasons are not Aristotle's.

Aristotle took genuine first principles to be indemonstrable—that is what it *is* to be a first principle (*Posterior Analytics* 1 2; *Metaphysics* 4 3). Diocles however says only that some things are akin to first principles—he does not say that they *are*. Moreover, anticipating a familiar Sceptical trope (the Fourth Mode of Agrippa: Sextus Empiricus, *Outlines of Pyrrhonism* (hereafter *PH*) 1 168, 173–4), he notes that theorists frequently merely assume, without argument or justification, some hypothetical starting-point for their systems in spite of its being a matter of controversy. The physician should offer explanatory accounts only where they are pedagogically helpful, basing his actual practice firmly on *empeiria*. Indeed, Diocles does not even insist that such accounts be true—they function simply as useful heuristic and persuasive tools.

Diocles was concerned to combat what he took to be an overly simplified view of the powers of particular foodstuffs:

> those who think that things which possess similar juices [? humours] or smells or degrees of heat or anything else of this sort have identical powers *[dunameis]* are mistaken, for one may point to many cases in which dissimilar things arise from things which are similar in these ways.
>
> (*ibid*., Fragment 112 Wellmann)

One rather needs to realize that 'their nature as a whole is the cause' of their particular powers. Diocles does not, then, reject theory or the offering of *aitiologiai,* causal accounts; and he is happy to recognize the existence of powers or faculties (quite what this involves will be of paramount importance in what follows). But he opposes what he takes to be the too naive and typological view adopted by some of his opponents (in this case probably Pleistarchus), a position which is at least compatible with the description of him (by Celsus: *On Medicine* Proem 8) as a Hippocratic.

HEROPHILUS

This tentative attitude towards causal explanation was shared by the great Alexandrian physician, anatomist, and physiological theorist Herophilus of Chalcedon (fl. *c.* 260 BC). Herophilus was perhaps the first Greek doctor to practise systematic anatomical researches upon human beings based upon dissection (the evidence is collected in von Staden [10.15—hereafter VS] ch. VI, T 60–129; see also 139–53), although he was not the first systematic dissector. That honour, like so many others, belongs to Aristotle: and Herophilus was perhaps indebted to Aristotle in other respects as well.

A methodological injunction of his is preserved, in slightly different forms, in two sources:

> let the *phainomena* be said [*legesthai*: perhaps 'be stated'] first [*prôta*: perhaps 'to be primary'], even if they are not first.
> (Herophilus T 50a VS; cf. T 50b VS: the bracketed words point to the interpretative problems).[2]

This text has been compared (VS p.118) to the methodological proem to *Parts of Animals* (1.1, 639b3–11), where Aristotle asks whether the natural scientist should ape the mathematical astronomers by first studying the *phainomena* and only then going on to state their causes. At 640a14–15 he answers his own question affirmatively; and our passage apparently echoes this (particularly if '*legesthai*' is translated as 'be stated'). If Herophilus really intends to recall Aristotle, then it is significant that his dictum makes no mention of causes or causal explanation (although as it stands it leaves room for such explanations). Rather (on what is, on balance, the most plausible interpretation) Herophilus urges us to treat the phenomena as being of primary importance, even if they may not (in the genuine metaphysical order of things) be really basic. Whatever else may be true, we need to start from the apparent facts, and only then (if at all) proceed to discover their underlying causes. This has an obvious Dioclean ring; and it appears too that Herophilus is offering a more circumspect version of Anaxagoras's celebrated dictum: 'the *phainomena* are a glimpse of the non-evident *(ta adêla)*' (Fragment 21a).

This is empiricism with a small 'e': science must start from the *phainomena:* these are what need, in the famous Greek slogan, to be saved (cf. Lloyd [10.57]), and which science, ideally, tries to explain.

Other texts attest to Herophilus's reliance on experience, *empeiria*:

> We find, however, that this Herophilus concedes no small importance to experience, nay indeed, to speak the truth, he makes experience all-important
>
> (T 52 VS)

and he is said (T 53 VS) to have given an account of pulse-rhythm based on observation and experience, rather than abstract rational theorizing.

On the other hand, he did not reject theory altogether; indeed in the immediately preceding passage (T 147 VS), Galen says that he 'surpassed the great majority of the ancients, not only in breadth of knowledge but in intellect', citing as an example his 'rational account' *(logos)* of the arterial pulse. In fact, the historian Polybius went so far as to stigmatize the 'Herophileans' (although not directly Herophilus himself) for relying purely on theory, and hence being about as much practical use as a pilot who navigated from a book (T 56 VS). And while that charge is clearly unjustified if levelled against Herophilus himself, none the less it is clear that he was perfectly prepared to countenance theoretical speculation of

the type that was to become anathema to the medical Empiricists (see below, p. 33), whose stance Polybius represents.

What, then, was the relation for Herophilus between theory and experience? This question is peculiarly difficult to answer, and not only because of the fragmentary nature of our evidence; for that evidence, although incomplete, appears to ascribe to Herophilus two quite distinct and on the face of it incompatible attitudes. Let us approach them, however, by way of a brief treatment of Herophilus's anatomical achievements.

Only three actual citations from his *On Anatomy* survive (60–2 VS); but a wealth of testimonia attests to his comprehensiveness and to his influence in the field of general human anatomy. He gave a far more complete account of the structure of the brain than any of his predecessors (T 75–9 VS; cf. [10.15] 155–9), distinguishing its main ventricles, discovering the 'calamus scriptorius', and bequeathing to his modern successors the name and description of the 'torcular Herophili'.[3] His dissections of the eye were of a calibre and detail quite unparalleled by any of his forebears (T 82–9 VS): he was the first to distinguish the four membranes of the eye, as well as isolating the optic nerve. Indeed he is usually (and justifiably) credited with the discovery of the functions of the nerves in general (Solmsen [10.69]; it *is* disputed whether he or Erasistratus was the first to distinguish between motor and sensory nerves: T 81 VS).

Herophilus applied himself, then, to dissective anatomy with unprecedented vigour and attention to detail. However, he

> does not think that anatomical descriptions of the type which say that 'this part has its natural origin in that' can produce any general preconception relevant to theoretical knowledge…; for the faculties *[dunameis]* which control us are discovered from other *phainomena,* and not simply from inspection of the part itself.
>
> (T 57 VS)

It's no good basing your account of the functioning of the body simply on its apparent structure, presumably because (and this was to be a Galenic commonplace: see Furley and Wilkie [10.5] Introduction IV; Hankinson [10.45]) such structures, considered simply as inert constructions, tell you nothing about how they actually work. Thus we need to examine 'other *phainomena*', in this case presumably the observable effects of cutting or ligating the connections between them in a living animal (again as Galen was to do: see below, p. 349).

At this point we may introduce another controversy. Herophilus and his rough contemporary Erasistratus were both associated in an ancient tradition with the deliberate vivisection of live human beings. The most detailed (although by no means the only) evidence comes from Celsus:

> So it is necessary [sc. according to Rationalist doctors] to dissect the bodies of the dead in order to examine their viscera and intestines. And they say that Herophilus and Erasistratus did this in the best way by far, by cutting open criminals provided by kings from prison, and inspecting, while they were still alive, those parts which nature had previously hidden as to their position, colour, shape, size, arrangement, hardness, softness, smoothness, connection, and the projections and concavities of each, and whether anything is inserted into something else and whether anything receives into itself a part from some other.
>
> (T 63a VS: cf. T 63b–7)

This story has often been questioned, although not with good cause; and there is no reason not to accept it. Celsus does not say that Herophilus (and Erasistratus) vivisected in order more directly to investigate functions as such—but it is a highly plausible conjecture, since only by such experimentation on live creatures could the difference between motor and sensory nerves be discovered.

And equally obviously it is only in living creatures that faculties *(dunameis)* in this sense can be detected. T 57 VS cautions against too straightforward and unreflective a set of mechanical assumptions regarding the causal relations that hold between the parts of the body: merely observing that one is inserted into another is not enough to determine whether the two are causally related, and if so how and in what direction. Such inferences can only be made on the basis of the observation of the structures at work. Herophilus apparently posited four faculties of living creatures (131 VS), one of which was the vital faculty (T 164 VS)—but our evidence for these is exiguous in the extreme.

The 'vital faculty' may be that which is transmitted through the coats of the arteries (in Herophilus's view) to produce the pulse (which was of supreme importance in Herophilean diagnostics; he invented a water-clock for more accurate time-keeping: T 182 VS; cf. VS pp. 282–4); and if he did indeed distinguish motor and sensory nerves, that would provide a physiological basis for two more faculties (with thought as the fourth?)—but this is conjectural.

At all events, Herophilus seems to have started with a conceptual analysis of what it is that animals (perhaps particularly humans) standardly do—and then to have proceeded, on the basis of anatomical investigation, to try and isolate the media via which these faculties were transmitted. But as to precisely what the faculties consisted in, he perhaps maintained a prudent reserve.

This brings us to the issue of Herophilean scepticism. On the basis of the following reports in Galen's *On Antecedent Causes* (hereafter CP),[4] Kudlien [10.56] saw Herophilus as an important figure in the history of Greek scepticism:

> Some people say that nothing exists as a cause of anything, while others, like the Empiricists, dispute whether or not there is a cause, and still others, like Herophilus, accept it on a hypothetical basis, and others again—whose leader he [sc. Erasistratus][5] was—rejected, among the causes, the antecedent…causes as not very plausible.
>
> (T 58 VS)

> What, then, does Herophilus say? 'Whether or not there is a cause, is by nature undiscoverable; but in my opinion[6] I believe I am chilled, warmed, and filled with food and drink.'
>
> (Herophilus T 59a VS)

Presumably, to accept causes on a hypothetical basis[7] is to accord them a merely provisional status: we may make causal ascriptions on the basis of the phenomena, but the phenomena do entail them—and hence we can never know for certain that our causal hypotheses are correct (this is reminiscent of, but more sophisticated than, Diocles' position). Thus Herophilus anticipates the second mode of Aenesidemus against the aetiologists (Sextus, *PH* 1 180–1). This picture derives modest support from T 59a, provided that we understand ablatives of agency (for example 'by the wind', 'by the sun') with 'chilled' and 'heated' to square them with the repletion example. Herophilus then does not doubt that he is being (phenomenally speaking) chilled, heated, or filled up—but he cannot be certain that the sun (or whatever) is responsible for it (hence the cause is 'undiscoverable by nature': although it is worth noting that Celsus reports that he held that all diseases have their causes in the humours: *On Medicine* Proem 14). That coherent and moderately sophisticated attitude in regard to causal ascriptions represents, I think, an improvement on Aristotle's theory of science.

Thus the sceptical Herophilus seems to be a chimaera. Yet elsewhere in the same passage, Galen accuses Herophilus of lacking the courage of his convictions:

> Having expressed doubt about every cause with many strong arguments, he is himself subsequently detected using them, by saying 'it seems this way to everyone'.
>
> (T 59a VS)

This suggests that Herophilus offered an antithetical set of considerations, both for and against causes, in a manner reminiscent of the Pyrrhonists (cf. Sextus, *PH* 3 13–30), where the majority opinion that causes exist is weighed against contrary abstract argument. Indeed immediately afterwards Galen presents as Herophilean three general arguments against the very conceivability of causes which were later to find a natural home

in Pyrrhonism (they are rehearsed by Sextus: *Adversus Mathematicos (M) 9* 210–36). The arguments are similar in form, so one example will suffice:

> (1) If there are causes, then either (a) bodies cause bodies, or (b) incorporeals cause incorporeals, or (c) bodies cause incorporeals, or (d) incorporeals cause bodies;
> but
> (2) neither (a), nor (b), nor (c), nor (d);
> so
> (3) there are no causes.

That argument is sceptical both in form and content; and from it 'he drew the inference that nothing is the cause of anything'.

It is not clear what to make of these passages, but they are not obviously compatible with the earlier causal hypotheticalism—indeed, they seem clearly in conflict with it. It is one thing to have epistemological doubts about our access to the causal facts of the matter, quite another to impugn their very metaphysical coherence. I confess I can see no very satisfactory solution to this problem; but perhaps if we stress the fact that it is by nature (or perhaps 'in their nature') that causes are undiscoverable, we might attempt one along the following lines. The difficult, perhaps impossible, metaphysics of causation undermines any purely rationalistic attempt to create an aetiology: hence we can never give a satisfactory account of what causal powers and causal transmission really are. On the other hand, empirical experience and investigation provide us with clear examples of causal correlation—and we need no grand metaphysical theory in order to investigate and establish them. It is perhaps no accident that Herophilus talks neutrally of the 'powers' *(dunameis)* of the body: these are uncontroversial, empirically determined place-holders for whatever arcane, hidden facts in fact underlie them.

ERASISTRATUS

Herophilus's great contemporary (and accomplice in the charge of human vivisection), Erasistratus, probably also lived and worked for some at least of his life in Alexandria.[8] He too was an innovative theorist in anatomy (the differentiation between motor and sensory nerves is also attributed to him: Fragment 39 Garofalo [10.6]—hereafter G), and in physiology, where he introduced the theory of *triplokia,* the triple plaiting of three basic types of vessel (nerve, artery and vein), which he held to be the fundamental elements of all bodily tissue (Fragments 86–90 G. See further G, pp. 32–3).

Our main source for Erasistratus is Galen; and he is generally hostile to him (although he is much sharper with Erasistratus's latter-day followers), pouring scorn on his rejection of 'natural faculties' of attraction, repulsion,

and excretion (with which Galen chose to account for the functions of the bodily organs) in favour of the principle of *horror vacui* as the agent of internal movements of material in bodies (Fragments 93–6 G).[9] But behind Galen's polemic we may discern an Erasistratean attempt to reduce the physical mechanisms needed to explain metabolism and general physiological functioning to the bare minimum required to explain those processes—and if Galen is sometimes justified in his particular criticisms, we may none the less applaud Erasistratus's reductionist zeal. Indeed we may best proceed by following the outlines of Galen's rebuttal of the Erasistratean position.

Erasistratus is lambasted by Galen for his anti-teleological belief that some organs (including the spleen and the omentum) fulfilled no function at all (*On the Natural Faculties* II 33, 91, 132, 134; Fragment 81 G). Yet Erasistratus was not opposed to teleological explanation as such—in fact, he considered it to be the proper business of the philosopher (Fragment 114 G; Fragment 83 G; cf. Fragments 77–8 G; and G pp. 45–6); his attitude seems rather to be closer to that of Aristotle,[10] for whom some structures of the body are not susceptible of direct teleological explanation. But for all that, and in spite of the relative exiguousness (and partiality) of the sources, an Erasistratus committed as far as possible to the explanation of biological functioning on mechanistic principles emerges with reasonable clarity. Erasistratus further rejected the humoural theory of human constitution (Fragment 92 G), for which once more Galen takes him to task. But even Galen is not always hostile to him, admiring his diagnostic acumen;[11] and Erasistratus was held in the highest regard in antiquity.

From our point of view, Erasistratus's most significant doctrines concern causes. First of all (from a practical perspective) he held that all fevers are caused by inflammations, which are in turn caused by transfusion *(paremptôsis)* of blood from the veins (where it naturally belongs) to the arteries, where its presence is, for Erasistratus, pathological (Fragment 109 G).

The most important Erasistratean claim, however, concerns the status of what came to be known as antecedent causes *(aitia prokatarktika)*,[12] the external factors responsible (in some medical theories, Galen's included) for triggering the already-existing disposition of the patient into illness. The bulk of Galen's *On Antecedent Causes* is devoted to refuting Erasistratus's causal 'sophisms', by which he seeks to remove *aitia prokatarktika* from the causal lists. Antecedent causes of disease include, standardly, such items as overheating, refrigeration, overwork, over-indulgence in food, drink, or sex, and the like. Such factors may not affect all equally—but none the less (so at least Galen thinks) they are pathogenically relevant. This is precisely what Erasistratus denies. His greatest mistake in pathology, according to Galen's view, was to deny the importance of external heating and chilling upon the human body, which are (Galen holds) of great pathogenic moment; yet Erasistratus holds them responsible

only for surface alterations in animals' conditions, having no effect on their internal dispositions (Fragment 75 G).

But Erasistratus's rejection of such antecedent causes is theoretically motivated. He contends that heat and cold cannot be the causes of illness, since they are not invariably followed by it, and do not persist at the time of the illness:[13]

> In this way sophists find reasons for their arguments that attempt to show that, even if on some occasion these things [i.e. antecedent heat, cold, etc.] harm weak bodies, not even then can they properly be called causes. For if indeed they do act because of their own internal nature, and this action derives from themselves, then they must be seen to have an effect at all times.
>
> (Galen, *CP* i 9–10)

Later, Galen quotes from Erasistratus directly:

> Most people, both now and in the past, have sought the causes of fevers, trying to ascertain and learn from the sick whether the illness has its origin in being chilled or exhausted or repletion, or some other cause of this kind; but this kind of inquiry into into the causes of diseases yields results neither true nor useful. For if cold were a cause of fever, then those who have been chilled the more should suffer the greater fever. But this is not what happens: rather there are some who have faced extreme danger from freezing, and who when rescued have remained unaffected by fever.... [And] many people who experience far worse exhaustion and repletion than that which coincides with fever in some others yet escape the illness.
>
> (Erasistratus, *CP* viii 102–3; cf. xi 141–4; xiii 166–8)

Similar arguments were, unsurprisingly, deployed by the Sceptics (Sextus, *M* 9 242–3). This argument has the effect of radically restricting the class of items allowable as causes: in effect, it stipulates that all causes must be *aitia sunektika,* containing causes. The notion of containing causes originated with the Stoic idea that every existent object required some internal tensile force to account for its persistence, that force being labelled its *aition sunektikon.* But the concept was soon redeployed by the doctors to cover not merely the persistence of objects, but the necessary and sufficient conditions of events and processes. Sextus defines *aitia sunektika* as 'those in the presence of which the effect is present, and with the removal of which it is removed, and with the lessening of which it is lessened' (Sextus, *PH* 315).

Thus, containing causes are strongly functionally-correlated with their effects (Sextus's example is of the relation between a noose and strangulation: the tighter the noose, the greater the strangulation).

In this way Erasistratus seeks to deny the status of cause to anything which does not meet these stringent requirements. It is however another matter whether he need be committed by this thesis concerning the proper application of the term 'cause' to the view that no item, unless constantly conjoined with some other, can have any causal relevance to it. Galen sometimes tries to pin this on Erasistratus—but it is by no means apparent that Erasistratus need accept this consequence. In fact Erasistratus allows that over-eating and exhaustion are implicated in the triggering of disease, although he apparently refused to grant them the title of causes.[14]

The crucial component in the Erasistratean pathology of fever was *plêthôra*. *Plêthôra* is vascular congestion caused by an influx of undigested food into the veins (Fragment 161 G). If the digestive system cannot cope with the excess of nutriment, and if evacuation does not take place by other means, the undigested food enters the veins, compressing the blood and forcing it through the valves *(anastomôseis)* between the veins and arteries (which normally contain only *pneuma*), causing inflammation and fever (Fragment 198 G). However, *plêthôra* can be treated before disease itself sets in; but once *paremptôsis* takes place, disease is unavoidable. Even so, these inflammations can be reduced by encouraging the blood to flow back through the *anastomôseis* into the veins.

Galen is concerned to emphasize the fact that external antecedent causes are causally relevant to that patient's subsequent condition. Erasistratus asks why, of a thousand people who attend the theatre on a hot afternoon (and hence who are exposed to the same external conditions) only four get overheated, and of these only one develops a full-blown fever: and infers that antecedent heating cannot be a cause of illness. Galen replies that it is not the *sole* cause (which fact accounts for the differential response to it; some people are more constitutionally susceptible than others). But even so, how can something no longer present be the cause of anything? The overheating occurs, *ex hypothesi*, several hours before the actual onset of the illness.

Erasistratus thus adopts two distinct theses:

(1) nothing can be a cause unless it is actually producing its effect; and

(2) nothing can be a cause unless it invariably produces its effect.

Effectively, Galen rejects both of them, rightly: but Erasistratus's position is not negligible, and it requires a certain sophistication in causal analysis to rebut it.

Erasistratus held that x was a genuine cause of y only if x at least initiated a sequence which was such that, other things being equal, y was bound to result. Thus he treats *paremptôsis* as being responsible for the fever, even though the disease can still be alleviated by the appropriate

interventions, since if left to run its own course, disease inevitably results. *Plêthôra*, on the other hand, cannot be a genuine (i.e. proximate) cause, although Erasistratus allows its causal relevance. However, he clearly rejects the notion that anything prior to the *plêthôra* can be a cause, on the basis of thesis (2).

THE EMPIRICISTS

Thus the theoretical contributions of the Alexandrians bring into centre-stage the preoccupation with the analysis and classification (as well as the epistemic justification) of the causal relation that was to characterize later Greek philosophy and science. Central to this debate were the doctors of the medical sect known as the Empiricists. Empiricism had a long history. The founding of the school is usually attributed to Philinus (fl. 250 BC) and Serapion (fl. 225 BC), although, following the ancient penchant for creating long and prestigious intellectual pedigrees, some Empiricists traced their ancestry back to the fifth-century Sicilian doctor Acro.

Serapion was connected with Herophilus; and it is plausible to see Empiricism proper as an outgrowth of the epistemological and explanatory caution which we have seen evinced by Herophilus. But the Empiricists go a good deal further. Their method simply consists in the observation and recording of phenomenal concurrences of events: therapies (both appropriate and inappropriate) are indicated by the past course of events. If I see that pomegranates are efficacious in one case of diarrhoea, I shall be moved to try them on another—and if that turns out well I shall be well on the way to forming what the Empiricists called an experience, an *empeiria*. Crucial to this is personal observation, *autopsia*, although the initial discoveries are held to be the result of luck:

> The Empiricists say that the art comes about as follows: one has observed many affections in people. Of these some are spontaneous, both in the sick and the healthy (for example nose-bleeds, sweating, or diarrhoea, or something similar which brings harm or benefit), even though one cannot see what it was that produced the effect. In other cases, the cause is obvious, although they too occur as a result of chance, not choice. Thus it just so happened that someone fell, or was hit or wounded in some other way, and that there followed a flow of blood, or that somebody who was sick satisfied his appetites by drinking cold water or wine, or whatever, each of which had either a harmful or beneficial effect. The first kind of beneficial or harmful effect they call 'natural', the second 'chance'. But in both cases they called the first observation of such an event an accident, choosing this name because one happens upon these things not by design. The accidental type of experience, then, is roughly like this. The extemporary kind, however, is characterized by the fact that we

> deliberately come to try something, led either by dreams or by something else to form an opinion as to what should be done. But there is further a third kind of experience, the imitative…where something which has proved to be beneficial…is tried out again for the same disease. This sort of experience has contributed the most to their art. For when they have imitated, not just two or three but very many times, what has turned out beneficial in the past, and when they discover that it has, for the most part, the same effect in the case of the same diseases, they call such a memory a theorem, and think it to be credible and to form part of the art. But when they had collected many such theorems, the whole collection formed the art of medicine. …Such collections came to be called *autopsia* by them… [which] consists in a certain kind of memory of what one has often perceived to happen in the same way. But they also called the same thing *empeiria*. History, however, they called the report of an *autopsia*.
>
> (Galen, *On Sects (SI)* 2, 2–3 Helmreich: trans. after Frede)[15]

That sketch of the Empirical method prompts several questions which will be taken up in the next section. But its general outline is clear enough. What the Empiricists are reacting against is the tendency of the theoretically-minded physicians (whom they compendiously lump together as the 'Dogmatists' or 'Rationalists') to explain both disease and therapy in terms of hidden internal conditions of the body which they must infer on the basis of the *phainomena*, the appearances. For the Empiricists all that there is are the appearances, and the theorems that are built up as a result of them.

Thus the debate between Rationalists (among whom are standardly enrolled Diocles, Herophilus, Erasistratus, and Asclepiades) and Empiricists turns, among other things, on the possibility of our having epistemic access to a purely theoretical domain; and in turn it forms part of the central Hellenistic debate among the philosophers about the nature and acceptability of certain types of sign-inference. Here is not the place to do more than sketch that debate (reproduced most fully in Sextus: *PH* 2 97–133; *M* 8 141–299); but crucial to it is the classification of different ways in which something may be non-evident *(adêlon)*:

> Of matters, then, according to the Dogmatists, some are (a) pre-evident, some (b) non-evident; and of the non-evident, some are (i) totally non-evident, some (ii) temporarily non-evident, and some (iii) naturally non-evident. Pre-evident are those which come to our knowledge from themselves, e.g. that it is day; totally non-evident are those which are not of a nature to fall under our knowledge, such as that the number of the stars is even; temporarily non-evident

> are those which, although they possess an evident nature, are now not evident to us because of certain external circumstances, as the city of Athens is to me now; while the naturally non-evident are those which do not possess a nature such as to be evident to us, such as the theoretical pores.
>
> (Sextus, *PH* 2 97–8)

Things in category (a) are unproblematic—likewise no one claims to be able to have any sort of access to the items under (b i). Moreover, all alike agree that the contents of (b ii) are accessible, by way of 'commemorative signs': I see smoke on the horizon, although I cannot now see any fire; but knowing that there's no smoke without fire, I infer that there must be a fire there, temporarily hidden from me. What distinguishes the Sceptic or the Empiricist from the Dogmatist is their attitudes towards category (b iii).

The Dogmatists hold that we can legitimately infer purely theoretical entities: in the paradigm case of such an inference (which will be of importance in the next section), the fact of sweating is an indicative sign (as they called them) of the existence of invisible pores in the skin. It is the latter type of reasoning (or *analogismos*, as they call it) that the Empiricists reject. The important difference between it and the smoke-fire case is that, in the latter, we may simply perceptually verify the inference; but in the case of (b iii), no direct perceptual confirmation can, by definition, be forthcoming. In a manner significantly reminiscent of the philosophical Sceptics, Empiricists chide Dogmatists for the rashness of their theorizing, for the way it outruns its evidential base. The only things they will allow are the Humean concatenations of evident events that make up the general theorems to be used in commemorative sign-inference—and even that is, in principle, defeasible.

The Dogmatists treat the indicative sign as being 'an antecedent proposition in a sound conditional, which is revelatory of the consequent' (Sextus, *PH* 2 101). The Empiricists, like the Sceptics, urge that there can be no such uniquely revelatory conditionals: there is in principle always more than one way to account for the evident facts (cf. The Eight Modes of Aenesidemus against the Aetiologists: Sextus, *PH* 1 180–5); and in in any case the Dogmatists are unable to agree among themselves as to what their 'signs' are signs of:

> In the case of fever patients, flushing and prominence of the vessels and a moist skin and increased temperature and quickening of the pulse and all the other signs…do not appear alike to all; but to Herophilus, for example, they seem to be definite signs of good blood, to Erasistratus of the transference of the blood from the veins to the arteries,[16] and to Asclepiades of the lodgement of theoretical particles in the theoretical interstices.
>
> (Sextus, *M* 8 219–20; cf. 189)

And, again in obvious tandem with Pyrrhonian scepticism, the Empiricists point to the endemic and irresoluble disputes among the Dogmatists as proof that their 'signs' are nothing of the sort (*SI* 5, 11–12 Helmreich).

Moreover, there is no need for such theorizing: everything necessary to medical science can be discovered on the basis of experience. Thus the Empiricist accumulates collections of instances in which certain things follow upon certain others. This collection is an *empeiria*; and if it is big enough, it will constitute a general theorem. It is worth noting that, for the Empiricists, the relations that hold between the items in such theorems do not have to be universal and affirmative. They outlined a five-fold typology of connection and disjunction according to whether things were seen to go together always, for the most part, half the time, rarely, or never: all of these are valuable in determining which therapies are, and which are not, appropriate.

None the less, some Empiricists did allow another way in which therapies could be obtained, their 'transition to the similar' *(hê tou homoiou metabasis)*. Transition is a form of analogical reasoning, to be used in cases of

> diseases which had not been encountered previously, or which were known, but for which there was no ready supply of medicines proven by experience. Hence they turned transition to the similar into a means for finding remedies. By its means they transfer the same remedy from one ailment to another and from one affected place to another, and they move from a previously discovered remedy to one similar to it.
>
> (Galen, *SI* 2, 3–4 Helmreich)

Similar ailments may yield to similar medicines; and what works on one part of the body may well work on another similar part. Transition, then,

> amounts to a method of discovery, but not yet to discovery itself, prior to testing. But as soon as you put what is expected to the test, it is already as credible (if the test is positive) as if it had been observed many times.
>
> (ibid. 4)

Thus transition does not itself generate theorems; but it suggests likely testable candidates for them—and the Empiricists have a high degree of confidence in successfully tested transitional solutions.

Even so, they are at pains to point out the distinctions between this limited acceptance of inference and the opposing position of the Dogmatists:

> Logical [i.e. Dogmatic] transition based on the nature of things lays hold of knowledge by means of indication *[endeixis]*.[17] But the Empirical variety relies on what is discovered by experience, not because it is persuasive or plausible that the similar should be productive of something similar, or require similar things, or undergo similar things; it is not on the basis of this, or anything else of this sort, that they think it justifiable to make the transition, but on the basis of the fact that they have discovered by experience that things behave this way.
>
> (Galen, *Subfiguratio Empirica* 9, 70 Deichgräber)

Thus transition for the Empiricists is not, supposedly, grounded in any conviction that its past successes render it objectively probable that the procedure will deliver useful results; rather the Empiricist simply acts directly on the basis of past experience. It is plausible to assimilate their position here (as elsewhere) to that of Hume—we can provide no rational basis for our reliance on the procedures involved: but we are simply constrained by nature to behave in such a way.

But even so, transition was a source of internal controversy within the Empiricist school itself. This probably arose in the course of the debates with the Rationalists, in response to the latters' accusations that the basic Empirical practice of *autopsia* supplemented by *historia*[18] is fatally circumscribed: it is simply not rich enough to discover the whole art of medicine on its own (Galen, for example, claims that the cupping-glass could never have been discovered by Empiricist extemporaneousness alone: *On the Affected Parts* VIII 154). Thus, as a result of the on-going debate between the medical schools on the nature of allowable inference (paralleled of course in the great philosophical debates), some Empiricists come to relax their original epistemological hard line:

> the question has been raised whether Serapion too believed that transition to the similar is a third constitutive part of medicine as a whole. Menodotus taught that it was not, but that the Empiricist only makes use of transition, it not being the same thing to make use of something and to treat it as a part. Cassius the Pyrrhonian even tries to show that the Empiricist does not even make use of transition of this sort.... Theodas did better in saying that transition constituted reasonable experience. Others still have held that transition is more like a tool.
>
> (*Subfiguratio Empirica* 4, 49–50 Deichgräber)

Galen's caution about Serapion shows that by his day little was known for sure about the early history of Empiricism. Menodotus was the leading Empiricist of the middle of the second century AD (and hence the author of

the Empiricism Galen is familiar with). The intriguing Cassius probably flourished in the middle of the first century BC; and just as Aenesidemus abandoned an Academy gone soft and Stoic in epistemology to refound Pyrrhonism, so too Cassius reacted against the increasingly watered-down nature of Empiricist epistemology in order to rediscover its pristine originality.

These debates, then, concern the acceptability of certain types of reasoning, and what attitude the Empiricist should take to them. Effectively, Menodotus refuses to enshrine transition as a proper part of the Empiricist method of discovery. He allows that Empiricists do, in the course of their practice, make use of such manoeuvres: but it is one thing to employ a procedure, quite another to endorse it.

However one interprets the complex and shadowy history of Empiricism, it is clear that the more the Empiricists are prepared to allow some form of reasoning (and perhaps hence of rational justification) into their practice, the harder it becomes to distinguish them from their Dogmatic opponents: and indeed Galen, true to his syncretist tendencies, discerned a convergence between the practices of the better Empiricists and the more reputable Dogmatists. None the less, there will remain for even the most relaxed Empiricism a sharp distinction between what entities (and hence what types of explanation) each school will allow. The Dogmatist will happily admit theoretical entities into his structures, and will use them in both physiological and therapeutic explanations: the *phainomena* are indications *(endeixeis)* of the hidden conditions of the body which are ultimately causally responsible for its funtioning well or ill. By contrast, the only indications the Empiricists allow are those afforded by commemorative sign-inference, or *epilogismos*, direct psychological suggestions of therapies that have proved appropriate in similar conditions in the past; and they will countenance no theory at all involving things by nature non-evident. A corollary of this is that all explanation for the Empiricists will be epistemic in form: an Empiricist physician can explain why he adopts a certain course of action, in the sense of saying what prompts him to do so—but he will have no views whatsoever on the metaphysical reasons (if any) why it should be effective.

Of a piece with this rejection of theory is the Empiricists' refusal to have anything to do with anatomy, which they consider to be, for the most part, entirely useless (see Galen, *On Anatomical Procedures* II 288–90). They attacked the Alexandrian practice of vivisection as being not only cruel but also pointless (Celsus, *On Medicine Pr.* 74–5; cf. 23–6, and Ts. 63b–c VS), since what if anything a physician needed to know was how the body functioned under normal circumstances—but there is nothing normal about a body undergoing vivisection.[19]

But if the Empiricists will have nothing to do with hidden causes and conditions, it appears that they are none the less prepared to admit antecedent causes, *aitia prokatarktika:* for these are indeed evident events,

and hence can be put into suitable Humean correlations with further evident outcomes. Thus when Galen seeks, in *SI*, to offer a brief, thumbnail characterization of the differences between the major schools, he allows that the Empiricists (unlike the Methodists, for instance: see below, pp. 340–2) will admit antecedent causes into their account of the general set of circumstances, surrounding the illness or *sundromê* (*SI* 8, 18–20 Helmreich). Yet on the other hand Galen also reports (*CP* xiii 162) that the Empiricists refuse either to affirm or deny the existence of antecedent causes. This apparent contradiction is, I think, easily resolved. What the Empiricists refuse to allow is any theory of causal interaction—hence they will have nothing to do with the Dogmatists' theoretical accounts of how antecedent causes of the sort embraced by Galen and rejected by Erasistratus can have the effects they apparently do. But that does not mean that they cannot treat them, in sound Empiricist fashion, as signs that produce expectations of future occurrences. Why then call them causes? Simply, the Empiricists (like the Pyrrhonists) do not bother themselves with terminological disputes. Thus there is no real inconsistency in the positions ascribed to them by Galen.[20]

ASCLEPIADES

The last section situated the development of Empiricism within the context of their long-running dispute with their Dogmatist opponents that paralleled the contemporary epistemological debates of the philosophical schools. A key figure in that debate is Asclepiades of Bithynia (fl. *c.* 125 BC). Galen's early text, *On Medical Experience*, rehearses a debate between a Dogmatist and an Empiricist: the debate is fictional, but the bulk of the Dogmatic polemic is ascribable to Asclepiades (Menodotus lies behind the Empiricist reply). Asclepiades made a great reputation for himself in Rome, not least because of the pleasantness of the treatments he prescribed (a fact which earned him the scorn of Pliny: *Natural History* 26 12–15). But he was not merely a panderer to public tastes: he elaborated a theory of disease in which the main pathogenic factor was the lodgement in and blockage of invisible pores in the body of invisible corpuscles (this feature has often led people to assume that Asclepiades was an atomist of sorts: as Vallance [10.70] demonstrates, that conclusion is unfounded and premature). Moreover, as far as we can tell (the evidence is fragmentary and very difficult to assess) he accounted for motions of fluids within the body (and perhaps outside it) on the principle of 'movement towards the rarefied' *(pros to leptomeres phora)*, a modification of Erasistratus's *horror vacui*.[21] Galen takes him to task both for this and for his abandonment of teleology (for example *On the Function of Parts* III 464–71), and considers him to be in the same case as Epicurus (*On the Natural Faculties* II 30–57).

But most important from our point of view is his attack on Empiricism. Pliny takes him to task for being a medical parvenu, insufficiently versed in

autopsia and *empeiria* (*Natural History* 26 12); but it is clear from Galen's *On Medical Experience* that he was an implacable foe of Empiricism. First of all, he attacks the Empiricists' right simply to help themselves to a pre-theoretical notion of similarity, a notion he takes it that they require in order to ground their theorems. Diseases are infinitely variable: we require theory in order to determine what counts as relevant similarity between one condition and another, and what does not—but that is precisely what the Empiricists eschew (*On Medical Experience* 3–4, 88–90 Walzer):

> What is more manifold than disease? How does one discover that a disease is the same as another in all its characteristics? Is it by the number of the symptoms, or by their strength and power?
>
> (*On Medical Experience* 4, 89 Walzer)

And mere hearsay of the sort afforded by Empiricist *historia* cannot confirm that it is precisely the same condition that is being experienced (ibid.).

Moreover, even if this is allowed, how can the Empiricists pretheoretically narrow down sufficiently the indefinitely many distinct events and factors that surround each individual case in order to make them empirically tractable? Why, in default of theory, should one be concerned about what patients ate, whether they overworked, were overheated, drank too much or had too much sex, rather than where they lived, what they had been reading and what types of clothes they wore (ibid. 6, 91–2)? The Empiricists thus require theory to sort out the relevant from the irrelevant, otherwise their syndromes will be too large to be contained even in a library (ibid. 7, 94).

Finally, even if all these difficulties can be resolved, what is it that makes the Empiricists' 'experience' 'technical', i.e. constitutive of the art of medicine? For a single instance of observed connection is not enough:

> They themselves also say that what has been observed but once does not amount to anything technical; so what is observed very many times is composed of many things each of which is non-technical. The argument could also be presented as follows…: what has been observed once is non-technical; hence the same is true of what has been observed very many times.
>
> (ibid. 7, 94 Walzer)

Finally Asclepiades asks: 'how many times is many?' Does the Empiricist have an account of how frequently some conjunction needs to be observed before it becomes theorematic, some account 'grounded in the nature of things' (ibid. 95–6)? If so, then he is a theorist of natures *malgré lui*. But if not, the Empirical 'art' is irremediably vague and without foundation. Moreover, it is vulnerable to a soritical objection: how can the addition of

one single instance (which the Empiricists allow is, on its own, evidentially inadequate) make the difference between having and lacking theorematic status (ibid. 96–7)?

The Empiricists' reply, in essence, is that the Dogmatists' demands here are misplaced. They, from their own avowedly theoretical standpoint, may think it necessary to provide an account of how many instances validate a particular theorem; but the Empiricist is under no such obligation. He allows that different cases provide for different degrees of (subjective) confirmation, but that is a fact about his own psychology, having nothing necessarily to do with the way things really are. All the Empiricist does is describe a practice, in strictly psychological, associationist terms. Like Hume, he may be able to point to the mechanisms which operate in particular cases to generate certain degrees of confidence or expectation: but equally like him he will not produce any metaphysical justification of those attitudes. Thus as regards the sorites (ibid. 16–18, 114–20), the Empiricist will not say how many times makes many. The answer to the question will vary from individual to individual and case to case, since it is, at bottom, a matter of individual psychology rather than logic. Building up an experience is not a matter of inference—rather, after observing a certain number of particular cases, the Empiricist simply sees that they exhibit a general pattern. Now, that pattern may ultimately prove to be misleading and chimerical (then it will be abandoned or modified in the light of further experience): but past experience gives us (once more subjective) grounds for hoping that it will not do so. Experience, then, does not license belief—it merely causes it. That position is, I think, coherent. It may not, for a variety of reasons, be satisfying, especially to an Asclepiadean Dogmatist—but mere dissatisfaction with it cannot show it to be untenable.

ATHENAEUS OF ATTALEIA AND THE PRECEDING CAUSE

We noted above the crucial distinction insisted upon by Galen and others between antecedent and containing causes. That distinction is a venerable one (traces of it are to be found in the Hippocratics); but the terminology of antecedent and containing is usually ascribed to the Stoics. In a famous image, Chrysippus compared the relation of external stimulus and internal disposition in the case of human action to the rolling of a cylinder: it requires a shove to get it going, but thereafter contains to roll '*suapte vi et natura*' (Cicero, *On Fate* 49). The antecedent shove is necessary (although not sufficient) for the initial movement—however, the movement continues after the shove has stopped, under its own steam, as it were: for that, the nature of the cylinder is a sufficient, containing cause. Chrysippus's interests were in showing how human beings could be part of a fully deterministic causal nexus, in which their actions are conditioned by an

ineluctable fate (defined as the interrelations of antecedent causes), and yet still be fit objects for moral appraisal: we can be praised and blamed for what we do because, after the initial stimulus, it is our dispositional structures (and our assent to the various presented impressions) that account for our actions.

It is often assumed that a third type of cause, the preceding *(proêgoumenon)* cause is also to be attributed to the Stoics, although this is far from clear (no text unequivocally so ascribes it). The distinction between antecedent and preceding causes is to be found in Galen, although he does not invariably avail himself of it. Roughly speaking, however, the preceding cause is an internal dispositional state which is roused into actuality by the impact of the antecedent cause, thus setting in train what is now the containing cause of the condition in question. An antecedent *(prokatarktikon)* cause is evident, open to inspection, while a preceding *(proêgoumenon)* cause is not: it is an internal state of affairs. Frede ([10.26] 242) remarks that such a distinction would have been at home in Chrysippean psychology; but the rolling drum passage does not apparently advert to it,[22] and it is not found elsewhere in surviving Stoic discussions of psychology and action. In fact, the distinction may well be medical in origin, and due to Athenaeus of Attaleia.[23]

Athenaeus (fl. ?*c.* 100 BC) founded the Pneumatist school of medicine, which accounted for proper and improper physiological functioning in terms of the states of the various internal types *of pneuma*, or dynamic gaseous fluid, in the body. What matters for us, however, is not the structure of his general physiology, but rather the causal taxonomy Galen attributes to him in *On Containing Causes* 2 (=*CMG* Supp. Or. II, 134.3–19). Galen explicitly says that Athenaeus was responsible for the tripartite division into antecedent, preceding and containing causes, where preceding causes are the internally conditioned effects of external antecedent causes, but are not yet themselves containing causes of the illness. This account is supported by Pseudo-Galen, *Medical Definitions* XIX 392; and one may readily see how such a distinction might commend itself to medical theorists. If this is right, then, an important refinement in Hellenistic causal theory is owed not to the philosophers but to the doctors—and this is by no means the only such instance of philosophically important innovations being made in the medical schools.

THE METHODISTS

The origins of the Methodist school of medicine, which arose early in the first century AD, are obscure, but it seems to have been developed out of Asclepiadean corpuscularian physiology, first by Themison of Laodicea at the end of the first century BC (who is generally thought not himself to have been a Methodist), and completed by his pupil Thessalus, a contemporary of Nero.

They held that there were two fundamental ways in which the parts of the body could become out of balance: they could either be too loose (and hence promote too free a flow of the bodily fluids) or too costive (with the opposite effect). In line with this magnificently simple pathology, they rejected the patient's causal history as being therapeutically irrelevant,

> claiming that the indication *[endeixis]* as to what is beneficial, derived directly from the affections themselves, is enough for them, and not even these taken as specific particulars, but taking them to be common and universal. Thus they also call these affections which pervade all particulars 'communalities'…which they call restriction and relaxation, and they say that each disease is either constricted, relaxed, or a mixture of the two.
>
> (Galen, *SI* 6, 12–13 Helmreich)

The physician's only task is to recognize the existence of these pathological states, which, on the Methodists' own account, he should be able to manage without difficulty after a little practice (medicine could be learned in six months, so they claimed), since these 'communalities' are not inferred, theoretical entities, but are in fact perfectly evident. Thus the Methodists reject antecedent causes, even in the sense in which the Empiricists accept them. In an instructive passage (ibid. 8, 18–19) Galen compares the attitudes of Empiricists and Methodists to the case of a man bitten by a rabid dog. For the former, the dog's condition will be relevant (mad dogs' bites having been observed to be far more serious than others); for the Methodists, however, all that matters is the wound itself—and that of course has nothing to do with the condition of the dog (Dogmatists will of course go further than the Empiricists, trying to specify how the dog's condition can have had the devastating effect on someone's internal constitution).

Indeed Sextus commends the Methodists for being closer to the Pyrrhonians than the Empiricists are, since

> the Methodist speaks of 'communality' and 'pervade' and the like in a non-committal way. Thus also he uses the term 'indication' undogmatically to denote the guidance derived from the apparent affections or symptoms, both natural and unnatural, for the discovery of the apparently appropriate remedies.
>
> (Sextus, *PH* 1 240)

And the Methodist, like the Sceptic, is driven by the 'compulsion of the affections' to apply countervailing remedies.

Moreover, it seems from Sextus's account that Methodism, unlike Empiricism, does not even rely on the memory. One does not, apparently, need to develop an understanding of the communalities on the basis of long

experience; rather one simply sees them. And while the Methodists admit indication of sorts (cf. Galen, *SI* 6, 14 Helmreich), it involves no inferences of hidden conditions. In fact, the fifth-century AD medical writer Caelius Aurelianus[24] preserves a Methodist argument against sign-inference:

> Thessalus and his sect…argue thus: if there were sure and inevitable signs of future events, such as the onset of phrenitis, all who manifested them would necessarily develop phrenitis. But some of those who show these symptoms do not develop phrenitis.
>
> (Caelius Aurelianus, *On Acute Diseases* 1 22)

Moreover, Caelius continues:

> every sign is understood in relation to what is signified, since signs belong in the category of relations. But can anything be called a sign if the thing signified is not only not present now, but in some cases never will be?
>
> (ibid. 1 29)

This parallels Erasistratus's claims about causes; and it is vulnerable to the same objections. But even so, there is surely something to the anti-Dogmatic doctors' claims that the endemic dispute among the Dogmatists about the relative significance of pathological signs at the very least compromises their claims to expertise.

GALEN

Thus, by the beginning of the Imperial period, there were three major competing groups of doctors in the Greco-Roman world, of which one class, the Dogmatists, includes a wide variety of different theoretical standpoints united only by a common belief in the importance of inference to the hidden, internal conditions of the body, and of producing theoretical aetiologies for diseases. Moroever, as we have seen, Empiricism was not a monolithic orthodoxy—it came in different strengths, and evolved over time. Equally even Methodism, whose hard-line early position was sketched above, came to soften some of its rough edges over time. Soranus of Ephesus (fl. early second century AD), whose *Gynaecology* survives, allowed himself a good deal of doctrinal leeway. He was prepared to talk, against the original Thessalian orthodoxy, of causes and aetiology, and would sometimes speculate on patients' internal conditions.

This is the world upon which Galen was to make such a deep and lasting impression. Born into a well-to-do family in Pergamon in AD 129, Galen was first broadly educated in philosophy (at the feet of some of the major figures of the day), and then equally well schooled in Dogmatist medicine and anatomy. For all that, Galen never underestimated the value of

empiricism: indeed his main contribution to medical theory and methodology was his largely successful attempt to supersede and render redundant the dispute between the schools by showing just what each of them had to offer to a synthetic medical method.

But, for all his eclecticism, Galen was no mere indiscriminate plunderer of the various previous traditions. Rather his aim is, in line with the general tendency of the emerging Middle Platonist orthodoxy of the time, syncretic: he seeks to show how the best elements of the various schools can not only be combined to form a coherent whole—they are, in a deep sense, equivalent. And we can trace this drive both in medicine and philosophy. Galen sought both to show how successful Empiricist and Dogmatist practice could converge into a theoretically unified whole, and to demonstrate the fundamental agreement between at least the reputable philosophical schools on all important issues of metaphysics and epistemology. But it should be stressed that this is no anodyne compendiousness—Galen is implacably hostile to Methodism (at least in its original Thessalian form), and he frequently lambasts representatives of various Dogmatic schools, including Herophilus, Erasistratus, and Asclepiades for their perceived theoretical shortcomings (we have already briefly noted some of these broadsides). Equally, he regularly attacks Chrysippus and other Stoics for what he sees as their lack of logical acumen, and insufficiency of rigour in argument. Sceptics in particular receive short shrift from him (although, significantly, he reveals that as a young man he was seduced by Scepticism's siren song, rejecting it only after discovering the a priori certainties of geometrical demonstration: *On His Own Books* XIX 49).

And Galen is consistent in his expressed view that the pinnacle of all wisdom is to be sought in Plato in philosophy and Hippocrates in medicine. Indeed, his monumental *On the Doctrines of Hippocrates and Plato* (*PHP*: V 181–805) is devoted to demonstrating the substantial agreement on all major points between his two great authorities (this is the clearest measure of Galen's syncretism). Thus both of them (he contends) support a divided soul, whose rational faculty is located, contra Aristotle and the Stoics, in the brain, while emotion and desire find their seats in heart and liver respectively. Even so, Galen will not follow Plato slavishly—he refuses to commit himself one way or the other on questions such as the eternity of the world or the soul's immortality, holding that such 'philosophical' questions are beyond the reach of human knowledge; and in general he will not treat any of his predecessors' work, no matter how exalted, as holy writ.

In fact, he considers his principal debt to the great ancients to be one of method rather than substance: they pointed the way both to the discovery and justification of true science, and it is the duty of all who follow in their footsteps to carry that programme to completion. Of course their task has been rendered immeasurably harder by the proliferation of sophists and

charlatans whose only concern is with a quick and easy reputation at the ultimate expense of their duped clientele, a fact which Galen harps upon throughout his works. A passage of *On the Natural Faculties* is worth quoting at length:

> Although the statements of the ancients on these matters were accurate, they did not support their case with logical demonstration; of course they did not suspect that there could be sophists so shameless as to contradict plain facts. Of the moderns, some have been taken in by their sophisms, while others who have tried to argue against them lack, for the most part, the ability of the ancients. For these reasons I have tried to construct my arguments on the lines the ancients would have adopted if they were around to take issue with those who seek to overturn the finest achievements of the science. That I will achieve but little success, however, I realise. For I find that very many things which were conclusively demonstrated by the ancients are unintelligible to most people because of their ignorance, or perhaps because of their unwillingness to come to understanding, which is due to idleness. And even if they have arrived at any knowledge, they have not properly examined the issue. It is essential that anyone who wants to understand anything better than the ordinary run of humanity must far outshine them, both in natural endowment, and in the quality of their early training. As a lad he must develop an almost erotic passion for the truth, so that day and night, like someone possessed, he will not let up in his desire to learn what was propounded by the most illustrious of the ancients. And when he has learnt these things, he must spend a great deal of time testing and justifying them, seeing what accords with the observable facts and what does not; and on the basis of this he will accept some doctrines and reject others.
>
> (Galen, *On the Natural Faculties* II 178–80)

That passage encapsulates many of Galen's obsessions: with the necessity for rigorous and lengthy training allied to innate ability (a combination he clearly felt himself to have been blessed with); the importance of logic in general and demonstration in particular to the construction of medical science; the need empirically to test and confirm the results of any theory before accepting it (time and again Galen castigates his theoretical opponents for failing either to see or to admit that their theories clash with the evidence); and the moral degeneracy and inadequacy of the vast majority of his contemporary opponents. These themes are ubiquitous in Galen—and they are of course highly rhetorically coloured. But that fact alone should not cause us to dismiss his claims out of hand. Let us finally, then, see what they amounted to in a variety of different areas.

First of all training and logic. These things go together, Galen thinks—it is because of people's lamentable logical shortcomings that they are unable to see through the fallacies of the medical charlatans (Galen's principal, although by no means exclusive, targets here are Methodists and Erasistrateans) that surround them. Only by understanding logical consequence, and being able to expose equivocation and other similar sources of fallacy (*PHP* V 795–7), will the young hopeful be able to expose the sophistries of the medical degenerates (among which Galen classes, for example, Erasistratus's arguments against antecedent causation).

Indeed the tiro doctor should acquaint himself with both Aristotelian categorical and Stoic hypothetical syllogistic (in his syncretic manner, Galen thinks them to be but two sides of the same basic coin) in order to be able to recognize and to construct valid arguments, and to expose the invalid. Indeed, Galen wrote voluminously on logic (his fifteen-book *On Demonstration* is lost), of which only a short handbook, the *Introduction to Logic*,[25] survives. The *Introduction* briefly outlines the Aristotelian and Stoic systems, before pointing out that neither is equipped to handle the sort of relational inference to be found in mathematics and elsewhere, for which he proposes the development of a third type of argument, the relational syllogism, arguments which have their validity 'in virtue of an axiom' (*Introduction* 16–18). Galen's actual treatment of the logic of relations is limited and naive: but he deserves the credit for having seen clearly (and uniquely among the ancients) the syntactic inadequacies of the traditional logics.

But logic was not merely useful as a destructive weapon for rooting out bad argument. The proper model for science, Galen thinks, is Aristotelian, along the lines laid out in *Posterior Analytics* (upon which Galen wrote commentaries, now lost). Galen insists that all science, medicine included, is axiomatic in structure, proceeding from basic, indubitable axioms via secure principles of inference to the theorematic derived truths. The axioms will include logical laws (such as that of the excluded middle); but also comprehended are principles of mathematics ('equals subtracted from equals leave equals'), and various metaphysical principles such as 'nothing occurs causelessly', 'nothing comes to be from nothing', and 'nothing is completely annihilated'. These axioms are described as being 'evident to the understanding', and anyone who rejects them is simply not worthy of further consideration.

But in addition to the class of things evident to the understanding, there is a set of items which are equally evident to perception. Galen has no truck with scepticism, accusing sceptics of bad faith and of subverting human life (*On Distinguishing Pulses* VIII 782–6; *On the Best Method of Teaching* I 40–52). In fact, Galen thinks, it turns out upon analysis that even the Academics agreed with the undeniability of things perceptually evident, an agreement they obscured by their insistence upon talking about the 'persuasive' (*pithanon*) as opposed to the true (*PHP* V 777–8). Galen no

doubt minimizes the genuine differences that existed between the Stoic and Academic epistemologies (he considers the Stoic criterion of the cataleptic impression to amount to no more than the common-sense view that what is evident to perception is true); but equally it is worth pointing out that, by the end of the two-centuries-long debate between the schools, some others (notably Antiochus and Aenesidemus, from their different perspectives) could see little difference either. Galen is surely right to stress the fact of pragmatic convergence between them.

And just as he stresses the convergence of practice between the good Empiricist and the competent Dogmatist (above, p. 336) in the realm of prescription and therapy, so here in epistemology his bent towards syncretism manifests itself. At the end of the day, when all the dust has settled, everyone who is not hopelessly ensnared in sophistry and illusion will agree that the senses, in good condition and uncorrupted by disease, are criteria of truth: for we have nothing else to go on; and in any case, nature could not have provided us with such 'natural criteria' if they were not, for the most part at least, reliable (*PHP* V 725–6). That, admittedly brief, attempt to justify his epistemological optimism serves as a convenient bridge into what is in many ways the most important feature of Galen's natural philosophy: his teleology.

Galen attributes his teleology, as so much else, to the example of Plato (of the *Timaeus*) and Hippocrates:

> even if you are one of those who through ignorance of Nature's works accuse her of lack of skill, I think you will repent with shame and change your view for the better, agreeing with Hippocrates who is continually singing the praises of Nature's righteousness and the foresight she displays in the creation of animals.
>
> (*On the Usefulness of the Parts (UP)* III 235)

A page or so later, he invites the reader to choose between two choruses: that surrounding Plato and Hippocrates, which exalts the purposiveness and foresight of Nature in arranging things in animals' bodies for the best; and the other, which denies Nature's skill and claims that many things are created by her to no purpose.

The invocation of Hippocrates is a trifle strained; and while Plato in the *Timaeus* clearly outlines a natural teleology, and one which does indeed in important respects anticipate Galen's own, it is clear that, insofar as the detailed working-out of his teleological conception of nature is concerned, it is the Aristotle of *Parts of Animals* to whom he is most indebted. But if the detail is Aristotelian (although Galen claims to expand upon and advance Aristotle's position), the form of the teleology is indeed Platonic: for Galen, unlike Aristotle, attributes the teleological structure of nature to a divine artificer, whose praises he sings contantly throughout *UP,* and whom he calls, in conscious recollection of the *Timaeus*, the Demiurge.

Thus there is no doubt on which side of the great ancient debate between teleology and mechanism Galen will find himself: he is particularly harsh on those who (such as Epicurus and Asclepiades) wilfully refuse, as he sees it, to recognize the providential form of Nature. His reason for ascribing nature's purposive structure to a Demiurge is a simple and familiar one (it is to be found also in the Stoics, and appealed to the young Aristotle: Cicero, *Nature of the Gods* 2 95): if one compares the construction of the natural world with the work of any human artisan, one will immediately recognize a basic similarity in design, although the former by far outshines the latter in beauty, functionality, economy, and goodness (*UP* III 238–9; IV 346–66). Thus if it is absurd to suppose that any human artefact might have come about by chance and undesigned, how much more so in the case of the natural world. That version of the Argument from Design is currently out of favour; but it is so only because we possess far more sophisticated conceptual resources (in the form of cybernetics, and Darwinian notions of natural selection) with which to explain how unplanned, mechanically produced structures can none the less mimic design. The ancient mechanists, lacking such resources, were woefully inadequately equipped to offer any such account.[26]

It is from this perspective that he takes Asclepiades to task in an instructive passage from *UP* (III 464–71), in which he endorses the Aristotelian system of Four Causes (although he assimilates the Formal Cause to the Platonic paradigm, and elsewhere in his works makes no reference to it), with the Middle Platonist addition of the Instrumental Cause, that with which something is brought about (cf. *CP* vi 54–67). Asclepiades held that the 'venous arteries' (i.e. the pulmonary veins) became thin (unlike other arteries) because of their hard work; Galen holds, conversely, that they were made that way in order to be able to work hard. Thus Asclepiades gets the primary direction of explanation the wrong way round, because he fails to allow for purposiveness in nature; and he fails to see 'that the arteries of the lung are venous and the veins arterial because it is better so' (*UP* III 469). They are made thin by the Artificer in order that they may perform the function they are supposed to; their thinness is a mere instrumental cause, 'the most insignificant of all, and which I believe anyone versed in the philosophical method would not call a proper cause at all, but one that is contingent or consequential, like a counterfeit drachma' (ibid. 466; moreover the whole debate is vitiated by the fact that the ancients, lacking a circulatory account of the vascular system, mistook the pulmonary artery for a vein and vice versa).

Elsewhere (*CP* vi 67), Galen says that the final and efficient causes are the most important, followed by the instrumental and material; but Galen does not underestimate the importance of the latter—it is precisely by appealing to material factors that he can circumvent Erasistratus's 'sophism' against antecedent causes. Thus he appropriates three at least of Aristotle's canonical tetrad; the efficient and material causes are readily further

assimilable to the Stoics' active and passive principles (cf. Sextus, *PH* 3 1–2), and the Stoics too invoked purpose and design, the final cause. Moreover, Galen takes advantage of the conceptual distinctions made by the Stoics in philosophy and people such as Athenaeus in the medical tradition (see above, p. 340) in order to refine the notion of an efficient cause. The resulting structure gives him an explanatory model of great power and flexibility.

It remains to consider Galen's attitude towards the relations between theory and practice, reason and experience. We have already seen Galen's own report of how the dispute between the Dogmatists and the Empiricists played itself out in terms of an increasing convergence between the practices of at least the more reputable representatives of each tendency. Galen himself, in his own voice, underlines the need to appeal both to reason and to experience in order to arrive at a coherent and empirically adequate medical theory. On the one hand, he denies that the pure Empiricism of Cassius could ever have arrived either at complex remedies or at the discovery of such useful tools as the cupping-glass. On the other hand, theory without experience is blind: only by repeated testing of expected theoretical outcomes at the tribunal of experience *(peira)* can a theory be validated.

This is, of course, of a piece with his view that some things are evident to sense-perception; but unlike the Empiricists, Galen does not think that *peira* can be relied upon to deliver the candidates for theorematic status that are to be the subject of empirical testing—that is the role of theory, or *logos*. That is, *peira* is necessary for testing the results of logical deductions, but is on its own insufficient to discover the whole truth of science—in modern parlance, it functions in the context of justification, not that of discovery (cf. Galen, *On Hippocrates' 'Nature of Man'* XV 152–3). At MM X 29, he puts it slightly differently: *logos* serves to demonstrate the soundness of causal explanations, *while peira* assesses the results; moreover, *logos and peira* should be kept strictly separated and not confused, although any not thoroughly versed in the demonstrative method should restrict themselves *to peira* (ibid. 30–2). But even though the Empiricist may discover some therapies by his own method, his practice is fatally restricted—he lacks the means to progress logically from one item to another (ibid. 486; cf. 608, 628, 901).[27]

Furthermore, Galen is implacably opposed to the Empiricist line that anatomy is pointless: on the contrary, it is a vital tool in the discovery of the facts of connection and disconnection among the parts of the body that enable the competent theorist to deduce the functional relations that hold within it from facts of its structure.[28] In his treatise, *On Anatomical Procedures (AA)* he writes:

> anatomical study has one application for the scientist who loves knowledge for its own sake, another for him who values it only to

> demonstrate that Nature does nothing in vain, a third for one who provides himself from anatomy with data for investigating a physical or mental function, and a fourth for the practitioner who has to remove splinters and missiles efficiently, to excise parts properly, or to treat wounds, fistulae and abscesses.
>
> (*AA* II 286)

Thus anatomy has a variety of uses, theoretical and practical—but Galen is adamant that the sort of knowledge gained by the 'adventitious anatomy' that the Empiricists allow is insufficient for the purpose (*AA* II 288–9; cf. 224) 'Adventitious anatomy' is the chance observation of corpses on a battlefield, or of skeletons exposed by flooding in a graveyard, as by Galen himself (ibid. 221); and this underscores the fact that, by Galen's time, practising anatomists were in a much worse case than their Alexandrian predecessors. It had, in fact, become socially impossible even to investigate corpses on purpose; and the bulk of Galen's research was carried out on monkeys, pigs, goats and other animals (ibid. 222–4). In order for this to be productive, he had to rely on a theory of animal homology which occasionally led him astray—but for the most part, the fruits of this research were impressive and original.

One of his most remarkable results was the demonstration of the function of the recurrent laryngeal nerve in voice-production (*AA* II 675–81) upon experimental animals, in the course of a precise and brilliant sequence of experiments on neural sections in the spinal column, in which Galen showed how a ligature at a variety of different points variously affected the animal's abilities to move and to produce sounds. These experiments are important not least for the fact that they *are* experiments. It is often alleged that the ancients were innocent of anything that might be called 'the experimental method' in science and there is something to that claim. Although ancient science abounds with reports of observations from the Hippocratics onwards, there is at least in the classical period scant evidence of anything we might recognize as experimental design: the deliberate manipulation of selected variables in artificial conditions in order to determine their various relations.

But Erasistratus at least performed a recognizable experiment, by placing a bird in a sealed container, and weighing it before and after feeding, along with its droppings, in order to show that some of its body-weight had been lost by invisible emanations; and Galen in several places reports experiments he claims to have carried out. They are not, it must be admitted, uniformly well designed and performed. In *On the Use of Breathing* IV 504–5, he says that a boy was able to survive an entire day with an ox-bladder over his nose and mouth to prevent him from breathing; while in two places (IV 73 and II 645–8) he describes an experiment involving severing an artery and inserting a thin tube linking the severed parts. Galen claims, *contra* Erasistratus (whom he accuses of

not having observed the phenomena), that the portion of the artery distal to the incision will exhibit no pulse, thereby proving that the faculty of pulsation is carried in the arterial walls, and does not result from the pumping of the blood itself. But as Harvey, who repeated the experiment, observed, it is extremely difficult to effect such a severance and junction neatly, and in any case, the relative absence of pulsation distal to the cut can be explained on other grounds consistent with the pulse's being caused by the blood-flow.[29] But whatever the particular shortcomings of conception and execution, it is clear that by Galen's time appeal to artificially created experimental circumstances in order to support or disconfirm a theory was an established part of scientific procedure. There is a theoretical motivation for this: this is part of the *peira* which tests and confirms the discoveries of *logos*.

This methodology can be seen at work in *On the Doctrines of Hippocrates and Plato* in Galen's rebuttal of the Stoic (and Aristotelian) doctrine that reason was located in the heart rather than in the brain. He begins by distinguishing, in Aristotelian fashion, between properly scientific premisses, which are 'found in the very essence of the matter under consideration…we should first state the essence and definition of the thing under consideration, and then use it as a standard' (*PHP* V 219), and those which are 'superfluous and irrelevant; and this is how a premiss that is scientific differs from one that is either rhetorical or sophistical' (V 220).

We begin, then, with conceptual analysis:

> The governing part of the soul, as even [the Stoics] allow, is the source of sensation and drive. Therefore the demonstration that the heart is the location of the governing part must not start from any other premisses than that it initiates every voluntary motion in the other parts of the animal's body, and every sensation is referred to it.
>
> (*PHP* V 219–20)

But to determine that the heart really is the centre of voluntary control demands empirical data:

> What can this be shown from…apart from anatomy? For if it supplies the power of sensation and movement to all parts of the body, then it is necessary that there be some vessel growing out of it to perform this service.
>
> (*PHP* V 220)

This vessel can be isolated on the basis of anatomical experiment: hence the importance of the neural sections, which determine both what mediates the psychic power (here as elsewhere Galen speaks in studiedly neutral terms), and its direction of flow. By tracing the neural canals backwards to their source we can establish that they originate from the brain, and hence that

it is the brain and not the heart from which voluntary motion arises and to which sensation is referred. The argument is not innocent of certain controvertible causal assumptions, but it is typical of Galen's willingness to marry abstract argument to empirical investigation.[30]

Finally, a word about the notion of a power or faculty *(dunamis)*. We have already noted Herophilus's deployment of the concept (see above, p. 325). Galen frequently speaks of powers: and where he does so it is precisely in order to avoid too rash a set of claims regarding the actual physical status of things. Thus he disavows knowledge of the substance of the soul (cf. *On the Formation of Foetuses* IV 700–2); but he thinks its powers can perfectly well be investigated.

In *On the Natural Faculties* he is concerned with enumerating and specifying the function of various faculties that he discerns at work in the human body: thus, for instance, the kidneys possess (so he supposes) the faculty of attracting urine (II 57–64, 74, etc.). Quite how they do so is another matter; but that they do so is, Galen thinks, clear simply from the inadequacy of purely mechanical theories such as those of Erasistratus and Asclepiades to explain how the various bodily fluids get separated out and conveyed to their various proper places.

And whatever the empirical and theoretical shortcomings of this concept, at least in these cases there is something attractive both about the caution with which Galen essays his theorizing here, and, congruently, with the weight he seeks to place upon the empirical facts. Theories, for him, must be empirically driven and answerable to the tribunal of experience. Galen thus represents the culmination of the development we have discerned throughout the period of this study.

ABBREVIATIONS

AA	Galen, *Anatomical Procedures*
CP	Galen, *On Antecedent Causes*
DL	Diogenes Laertius, *Lives of the Philosophers*
G	Garofalo [10.6], *Erasistratus*
MM	Galen, *De methodo medendi*
PH	Sextus Empiricus, *Outlines of Pyrrhonism*
PHP	Galen, *On the Doctrines of Hippocrates and Plato*
SI	Galen, *On Sects*
UP	Galen, *On the Usefulness of the Parts*

NOTES

1 Even where later and better texts of Galen's work are available (as they are in this case: Corpus Medicorum Graecorum V. 4.2), I generally refer to the edition of Kühn [10.10], since the later texts are (for the most part) keyed to it. Exceptions are noted where they occur.

2 The sense of this lapidary fragment is disputed: see von Staden [10.15] and Hankinson, review of this in *Phronesis* 35 (1990). VS (125) translates 'let the appearances be described first even if they are not primary': but that reading requires us to take the two occurrences of the word *'prôta'* in completely distinct senses, even thought there is no indication to that effect.

3 This structure, the confluence of the four major cranial sinuses, is more common and more visible in animals than in humans, a fact which, along with his erroneous but influential ascription of a *rete mirabile* to humans (T 121 VS), has encouraged some to doubt whether Herophilus ever did in fact dissect humans; but on the whole the evidence suggests that he did: see p. 325.

4 See Hankinson [10.49] for an edition, translation and commentary of this text; it survives in a mediaeval Latin translation made by the Italian scholar Niccolò da Reggio.

5 Galen clearly refers here to Erasistratus, who was mentioned by name in the previous sentence (and who is the principal target of *CP*), and not to Herophilus, as von Staden suggests: [10.15] 136. See Hankinson [10.49] ad loc.

6 Niccolò's Latin reads: 'quid igitur ait? "causa vero, utrum sit vel non, natura quidem non est invenibile, existimatione autem puto infrigidari, estuari, cibo et potibus repleri".'

Von Staden renders *'existimatione'* as though it stands for *'ex hupotheseôs';* but Niccolò's *'ex suppositione'* of T 58 VS clearly translates *'ex hupotheseôs':* and he was careful to render technical terms unambiguously. Thus *'doxêi'* or the like seems more probable (so Bardong in his 'Rückübersetzung': CMG Supp. II, p. 53), yielding my translation. Von Staden's sense is undeniably attractive, and perhaps the text should be emended; but as the text stands it recalls the Pyrrhonist Timon of Phlius' remark that 'I do not claim honey is sweet; but I agree it seems so' (Diogenes Laertius *Lives of the Philosophers* 9 105 (hereafter DL)); which perhaps argues against emendation.

7 Von Staden misleadingly compares the Aristotelian doctrine of hypothetical necessity (*Physics* 2:9; *Parts of Animals* 1:1) with Herophilus' causal hypotheticalism—but there are no significant similarities between them; see Hankinson in *Phronesis* 1990, 209, n. 30.

8 This is a matter of dispute: see Fraser [10.25] and Lloyd [10.58] for opposing views.

9 On the Erasistratean principle of *horror vacui,* see Garofalo [10.6] 33–5; and Vallance [10.70] especially ch. 2.

10 This may not be accidental: Erasistratus is said to have studied with Theophrastus in the Lyceum (DL 5.57; cf. Fragment 7 G).

11 In particular his celebrated diagnosis of love-sickness by a method Galen himself repeated: he took the woman's pulse, and reeled off an apparently random list of names. When the woman's pulse suddenly quickened, Galen inferred that she was enamoured of the man he had just mentioned: *On Prognosis* XIV 630–5; cf. Nutton [10.66] 195–6.
12 For the history of the development of the concept, see Frede [10.26]; Hankinson [10.37], [10.38] and [10.49]
13 See *CP* ii 9–10; vi 46; viii 96–114; Hankinson [10.49].
14 Garofalo ([10.6] 30) thinks that Erasistratus called them 'origins *(archai)*' of disease: Fragment 162 G; 223 G; but it seems rather that Erasistratus reserved the term *archê* for the condition of *plêthôra* consequent upon them: see further below. On these issues in general, see [10.6] 29–31.
15 I here depart from my usual practice, and refer to *SI* by way of Helmreich, 1893, since Frede's English [10.4] is keyed only to that text.
16 This is the famous *paremptôsis* of Erasistratean pathology (although Sextus uses the term '*metaptôsis*'): for Erasistratus, all fever was consequent upon inflammation caused by blood being forced through the *anastomôseis* between the veins (in which in normal circumstances the blood resides) to the arteries, where it has no business being.
17 'Indication' here is equivalent to indicative sign-inference.
18 *Historia* did not, for the Empiricists, involve an uncritical acceptance of all received testimony: on the contrary, they elaborated a complex and sophisticated system of assessment of the relative value of different testimony (according to how far it cohered with other parts of the art already discovered, and on the basis of the past reliability of the source in question).
19 On the Empiricist attitude to anatomy, see Hankinson [10.50].
20 For more on this, see Hankinson [10.38]; and on the nature of antecedent causes in general, Hankinson [10.37].
21 See Vallance [10.70] ch. 2, for a careful analysis of the (principally Galenic) evidence, and a reconstruction of the theory.
22 However, this turns on tricky issues in the interpretation of Cicero's Latin rendering of technical Greek terminology: see Sedley [10.68] and Hankinson, forthcoming [10.52].
23 See Hankinson [10.37].
24 Caelius's two treatises, *On Acute Diseases* and *On Chronic Diseases,* are Latin adaptations of lost original works of the second-century Methodist Soranus of Ephesus.
25 Not discovered until 1841, and hence not edited by Kühn; see Kalbfleisch [10.9].
26 I discuss this in Hankinson [10.41], and [10.43].
27 On all these issues, see further Barnes [10.19].
28 On the relation of structure and function in Galen, see Furley and Wilkie [10.5] and Hankinson [10.42].
29 See Furley and Wilkie [10.5] 51–3.
30 See also Galen's criticism of the Stoic argument against the view that the mind is located in the brain from the fact that voice passes through the windpipe (*PHP* V 241).

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[CMG=Corpus medicorum graecorum]

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