

GALEN AND THE BEST OF ALL POSSIBLE WORLDS

Tous les événements sont enchaînés dans le meilleur des mondes possibles
(Voltaire, *Candide*)

Voltaire's Pangloss, the man who held among other things that noses were clearly created in order to support spectacles, is the very archetype of the lunatic teleologist; a caricature of sublimely confident faith in the general and undeniable goodness of the world's arrangement, a faith that managed astoundingly to survive the Lisbon earthquake and his own subsequent *auto da fé*. Voltaire, of course, is poking fun at such conceptions; and, no doubt, in their extreme sanguinity as well as in their apparent imperviousness to devastating empirical counter-evidence, they do seem to be eminently risible notions. In the face of them we might be tempted to abandon 'métaphysico-théologo-cosmolonigologie', and to agree with *Candide* that 'Cela est bien dit, mais il faut cultiver notre jardin'.

Voltaire's model, as is well known, was Leibniz; but at first sight it might almost as easily have been Galen. For Galen apparently embraced a teleology that was virtually as broad in its scope as that of *Candide*'s teacher. He explicitly takes his opponents to task for failing to appreciate the purposiveness in nature, and consequently for failing to see that genuine explanations of things (at least, of the structure and function of the parts of the human body) must be teleological in form. In this he is deliberately attacking not only mechanistic conceptions of the structure of the world, particularly those of the atomists, or of those (such as the physician Asclepiades) who were strongly influenced by them; he is also explicitly rejecting teleology of a more limited kind, such as that associated with Aristotle, and to an even greater extent with his immediate successor in the Lyceum, Theophrastus. For Galen, it is strictly and literally true that Nature does nothing in vain: and any refusal to accept the implications of that claim, and any attempts to dilute the teleology to make it more palatable, are admissions of weakmindedness, and blemishes on the body of natural science. In the course of this paper, I shall attempt first of all (in the first three sections) to sketch an outline of the scope and structure of Galen's teleology and of its relations with its theoretical predecessors. Secondly (in Section 4) I shall analyse some specific problems and difficulties that confront teleologies of a broad scope such as Galen's (but are by no means parochially confined to his version of it), and attempt to demonstrate how Galen's account can be largely immunised from them. And finally (in Section 5) I shall offer a defence of Galen's teleological conception of nature considered as a methodological, regulative principle for scientific inquiry.¹

I. THE NATURE OF TELEOLOGICAL EXPLANATION

The notion that properly constructed explanations of physical processes should make reference to the end-states of those processes is worked out in great detail by

¹ This paper is one of three related studies in Galen's teleology, and its relation to his views on anatomical practice; the latter considerations will take very much a back seat in this discussion. The others are 'Galen explains the elephant' (to appear in M. Matthen and B. Linsky [edd.], *Philosophy and Biology* [Edmonton, 1988]), and 'Galen's anatomical procedure' (forthcoming).

Aristotle; indeed, it forms the corner-stone of his entire developed philosophy of nature. But Aristotle did not invent such a style of explanation; it is at least adumbrated in Anaxagoras, in his concept of a directing force in the cosmos, a force which he calls Mind, or *nous*.² And Anaxagoras may not have been the first to posit cosmic forces of this sort; such hypotheses go back at least as far as Empedocles and his perpetually warring contraries of Love and Strife;³ but the postulation of cosmic forces does not in itself entail or even suggest teleology, and is obviously perfectly compatible with a strictly mechanist conception of the working of the world.

So it is to Anaxagoras that we should look first of all. According to Plato, Socrates was impressed with Anaxagoras' claim that Mind ruled the world: but was deeply disappointed with the work (or rather the lack of it) which he made the concept do:

Then I heard someone reading, as he said, from a book of Anaxagoras, that Mind was the disposer and the cause of all, and I was delighted at this notion, which appeared quite admirable, and I said to myself: if Mind is the disposer, Mind will dispose all for the best, and put each particular in its best place; and I argued that if anyone wanted to find out the cause of something's coming to be or being destroyed, or why it was the way it was, he needed to find out what manner of acting and being affected was best for that thing. And consequently someone had only to consider what was best and finest for himself and for others, and then he would also know the worse: for the same branch of knowledge (*epistēmē*) involves both. (*Phaedo* 97c-d)

Plato's Socrates goes on to say that he had high hopes of Anaxagoras explaining such things as the position of the earth at the centre of the cosmos, and its shape and the relative motions of the heavenly bodies, as being for the best (*ibid.* 97d-98b). However, these hopes were dashed: for he discovered that Anaxagoras made no genuine use of such a cosmic principle, but rather relied upon 'air, ether and water, and other absurdities' as his explanatory tools.

And Socrates continues by comparing him to

a person who began by maintaining that Socrates did everything he did because of Mind, but who then, when attempting to detail the causes of each of the things that I did, were to say that I was now sitting here because my body was put together out of bones and sinews, and that bones are solid and have joints between them, while sinews are such as to tauten and relax and cover the bones, along with the flesh and skin which covers them; and that as the bones are lifted up at their joints by the tautening or relaxation of the sinews, it is possible for me to flex my limbs, and for this reason, being flexed, I am sitting down. (*ibid.* 98c-d)

Socrates proceeds to castigate Anaxagoras for offering 'a myriad of such causes' while omitting the true one, namely that it has seemed better to the Athenians to have him stuck there, and to him to go along with it:

for by the dog, these bones and sinews would long since have been in Megara or Boeotia, impelled by a belief about what was for the best, if I had not thought it juster and more noble to submit to the penalty ordained by the city rather than escape and run away. (*ibid.* 98e-99a)⁴

² 59 B 1, 11, 12, 14 DK; Aristotle, *Met.* 1 3, 984b15-18; cf. Diogenes Laertius 2 6.

³ 31 B 16, 17, 21, 26, 35, 71, 73, 75, 86, 87, etc. DK; the relative chronology of Anaxagoras and Empedocles is however controversial: see D. O'Brien, 'The Relation of Anaxagoras and Empedocles', *JHS* 88 (1968), 93-114, and G. S. Kirk, J. E. Raven and M. Schofield (edd.) *The Presocratic Philosophers*² (Cambridge, 1983), pp. 280-1, 352-4. The crucial report from Aristotle's *Met.* 1 3, 984a11ff. (= 31 A 6 DK; cf. A 7 DK) is unfortunately ambiguous, although the most natural interpretation would have it that Anaxagoras, albeit older than Empedocles, embarked later than him on a philosophical career.

⁴ Cf. *Laws* 967b-c, an obvious allusion to Anaxagoras, and the inadequacy of his notion of the ordering Mind.

I have quoted that famous passage at length, because it exemplifies precisely the type of criticism Galen was to level at his mechanistically-minded opponents; and because he himself was familiar with it.⁵ But before I turn to consider Galen's own teleology in detail, it will be worth while to dwell a little longer on Plato, and then to turn to Anaxagoras, and his relation with Aristotle.

In the *Timaeus*, which in many respects was to prove a model for Galen's own teleology, Plato attempts among other things to make good the deficiencies of Anaxagoras' treatment which he had diagnosed in the *Phaedo*. In particular, Plato's invocation of a divine organiser, the *dēmiourgos*, was an influence on Galen.⁶ Plato's distinction between the Demiurge and teleological explanation on the one hand and the 'co-operative causes' (*sunaitia*) on the other is highly relevant. Only the former are proper explanations, while the latter are merely the instruments with which the Demiurge carries through his purpose. At *Tim.* 45b–46d, Plato offers a detailed account of the physiology of vision; but he concludes his physiological explanations with the remark that

All these are co-operative causes (*sunaitia*) which God uses as ministers in bringing to completion the idea of the best as far as possible. They are thought by most people not to be co-operative causes, but genuine causes... but they are incapable of having any reason (*logos*) or intelligence (*nous*). The lover of *nous* and of understanding (*epistēmē*) should first of all pursue the causes of intelligent nature, and only afterwards those which are such as to move other things of necessity because they themselves are moved... both genera of causes should be enumerated, but those which are the creators (*dēmiourgoi*) with intellect (*nous*) of fine and good things should be separated from those which lack intelligence and produce chance, disorderly effects. (*Tim.* 46c–e)

And a little further on, Plato writes that 'the creation of the world is the joint product of mind (*nous*) and necessity' (*Tim.* 47e–48a; cf. *ibid.* 68e–69a), a contention which he stresses throughout the work. The world seemed to Plato, as it has done to many others, Galen included, to be evidently good, something which Plato emphasises both at the beginning of *Timaeus*' account (*Tim.* 28a–b, 29a, 29c–d, 30a–b) and at the very end of it (92c).

We have seen, at least in outline, Plato's attitude to teleological explanation; and it is apparent from the texts of the *Phaedo* and the *Timaeus* which we have examined that Plato subscribes to what I shall call a directed teleology. In general, a teleology is *directed* in this sense if the explanations which it countenances make reference, either directly or indirectly, to consciously entertained purposes. It is not enough, for a directed teleology, simply to invoke the final condition towards which a process tended as a part of the explanation of that process; you need also to talk, in non-metaphorical language, of the plan which is being effected, of the design that is being accomplished. Directed teleology, then, involves the positing of consciousnesses which consider how things ought to go, make plans in accordance with those considerations, and then act in accordance with those plans. As we shall see shortly, many of the ordinary cases which the proponents of teleological explanation rely

⁵ See *De Usu Partium* (*UP*) i.338 Helmreich: I discuss this whole passage in detail below. References to Galen are made in the standard way to the edition of C. G. Kühn (Leipzig, 1821–33, 20 vols. in 22), in spite of the manifold inadequacies of that text, giving an abbreviation of the title of the work, Kühn volume number in Roman, and page number in Arabic numerals. In the case of *UP*, I cite via the edition of Helmreich in the Teubner (Leipzig, 1907–9, 2 vols.); in case of texts which do not appear in Kühn, I cite them either by reference to a Teubner edition, or to the *Corpus Medicorum Graecorum* (*CMG*).

⁶ Galen wrote a commentary on the dialogue; only a fragment of it unfortunately survives, and on a less interesting section of the work at that.

upon to ground the plausibility of their account involve, in an entirely straightforward and everyday sense, something like rational planning. Plato's example of Socrates' sitting is a case in point: but so too are very many Peripatetic cases, and a number of illustrations which Galen himself employs (see below, Section 5).

However, that is by no means the only available model of teleological explanation; and it is not the one which, in spite of some of his examples, Aristotle adheres to. For Aristotle it is appropriate, indeed necessary, in the case of certain types of process to make explicit reference to its end-state or completion in order to explain, in some sense, how the process comes to be in the first place. And this is true whether or not it is the consciously directed result of rational agency. The processes of nature, for Aristotle, are not in that sense directed: but their regularity and repetitiousness, in conjunction with the basic more or less empirical intuition that acorns *grow into* oaks, or that infants *tend to become* adult human beings, renders the invocation of the end-state in some sense necessary for a proper characterisation of the process in the first place; in order even properly to identify the process in question, you need to know what it is tending towards (at least in the case of potentially completable processes). In this way, teleological explanation relates to the basic Aristotelian metaphysical doctrine of actuality and potentiality: just because the actual is in some sense prior to the potential (*Met.* 9 8, 1049b4ff.; 12 6, 1072a5ff.), the end-state of the process will figure in its explanation. It is no part of the purpose of this paper to analyse in detail these Aristotelian conceptions. Such analyses are problematic and controversial,⁷ particularly in so far as they attempt to reconcile teleological with mechanistic explanation; I shall discuss that problem in regard to Galen later on. But the central features of the doctrine should be clear enough; and it should be equally clear that, as it stands, such an account need make no reference at all to consciously-entertained purposes or designs – and for Aristotle, at least in the case of the products of nature, it will not do so.

Let us return to Anaxagoras. Aristotle famously criticises him for getting the direction of explanation wrong in the case of the human hand; Anaxagoras held that human beings are the most intelligent animals because they have hands. Aristotle holds, contrariwise, that they have hands because they are the most intelligent:

Nature, like an intelligent human being, always assigns each organ to something that is capable of using it... the most intelligent should be able to use efficiently the greatest number of tools: and the hand appears to be not so much a single tool, as a tool of tools, as it were. Thus Nature has given the tool which is most widely useful, namely the hand, to the creature which is capable of acquiring the greatest number of skills. (*PA* 4 10, 687a72–3)

So although Aristotle elsewhere commends Anaxagoras (albeit mildly) for having, along with Empedocles, introduced the notion of directive forces into the cosmos (he says that he seems like a sober man among drunks by comparison with the statements of his predecessors: *Met.* 1 3, 984b18),⁸ he agrees with Plato that his deployment of this concept is explanatorily inadequate:

⁷ For the influential recent accounts, see A. Gotthelf, 'Aristotle's conception of final causality', in A. Gotthelf and J. G. Lennox (edd.), *Philosophical Issues in Aristotle's Biology* (Cambridge, 1987), pp. 204–42 (reprinted with an additional postscript from an article originally published in *Review of Metaphysics* 30 (1976), 226–54); J. M. Cooper, 'Hypothetical necessity and natural teleology', in Gotthelf and Lennox (edd.), op. cit., pp. 243–74; D. M. Balme, 'Teleology and necessity', in Gotthelf and Lennox (edd.) op. cit., pp. 275–85; and the relevant chapters of R. R. K. Sorabji, *Necessity, Cause and Blame* (London, 1980).

⁸ See also *Met.* 1 4, 985a11ff., 7, 988a18ff.

Anaxagoras uses Mind as a theatrical device (*méchanê*) for producing order, and whenever he is at a loss to explain something as being the result of necessary causes, he drags it in; but in all other cases, he holds anything other than Mind responsible for what occurs. (*Met.* 14, 985a18–22)

So the view that Anaxagoras makes inadequate and merely incidental use of what is a fundamental and essential explanatory category is common to Plato and Aristotle. Aristotle further takes Anaxagoras to task, in the passage from *PA*, for getting the *direction* of explanation the wrong way round: intelligence explains the possession of hands, and not *vice versa*.

This notion of the direction of explanation is crucial to the characterisation of a genuine, as opposed to a merely heuristic, teleology. Broadly speaking, a teleology is *genuine* in this sense if the end-states appealed to in the explanations are conceived of as forming a proper and irreducible part of the explanation of the process of generation; it is *heuristic* if it merely involves an appeal to the end-states as a way of characterising more perspicuously the sorts of process involved, without attributing to the end-states any such necessary explanatory role in the process. That is crude as it stands: but it will do for the time being. At this point it will suffice to point out that for a teleology to be genuine in this sense it need not involve actual *a tergo* causation. It need not be the case that the completed end state in some strong sense actually brings about the process that leads to it: intentional teleological explanations, of the sort used by Aristotle and Galen as examples, will count as types of genuine teleology. This is only one reason why it is wrong to think that all genuine teleological explanations need involve (or in Mackie's stronger formulation, be paradigm-cases of) backward causation.⁹

In general, the appearance of teleological notions in most modern biology (for example) is heuristic in character; and the most obvious characteristic of such heuristics is their metaphorical use of intentional verbs: the thermostat aims at keeping the temperature at 70 degrees; the steam-governor has the goal of keeping the engine running at a constant speed. In such cases, because the invocation of teleological notions is merely heuristic, there is no question of reversing the direction of explanation, or of ascribing genuine intentional states to artefacts like thermostats. Neither does the possible incompatibility of teleological with mechanistic explanations arise, a topic I shall return to in the next section.

The concept of explanatory direction is not an Aristotelian invention: it is perhaps first brought to philosophical consciousness by Plato in the *Euthyphro* (10a–11b), in the well-known passage in which he discusses the question of whether what is pious is pious because it is loved by the gods, or loved by the gods because it is pious. But Aristotle clearly makes use of it in the *PA* passage, and it is to become of crucial importance in Galen's own attacks on the mechanists.

It used to be fashionable to take the side of Anaxagoras (and indeed the other Presocratics) against Aristotle in this case: Anaxagoras, on this more or less traditional line, was a tough-minded scientific thinker with a genuine, if inchoate, insight into the workings of the world; and his views on the relations between the morphology of animals' bodies and their capacities excitingly anticipate modern evolutionary biology. Aristotle, by contrast, represents the triumph of an enormously influential and consequently hugely pernicious scientific view which, in its sterility and fruitlessness, effectively prevented the development of the biological sciences (not to

⁹ See J. L. Mackie, *The Cement of the Universe* (Oxford, 1974); and Sorabji, *op. cit.*, p. 156 n. 3, for a criticism of this view.

mention the physical ones) for two thousand years or more, until Galileo finally got science back onto the right progressive rails.¹⁰

More recently, that assessment has come under fire, for a variety of reasons and from a variety of quarters;¹¹ and some have even been tempted to discern an Aristotle only a few short steps away from a distinctly modern-looking account of the biological sciences.¹² I shall not discuss the strategies or the plausibility of such interpretations further. But it will be part of my project in this paper to show how, given certain plausible assumptions about the world as well as certain theoretical limitations, genuine teleology is an attractive, perhaps compelling, way of explaining the functioning of the world; and that Galen's own extreme brand of genuine teleology may, for all its apparent implausibility, actually be the best available candidate from the point of view of theoretical coherence.

II. THE LIMITS OF DIRECTION

So Plato and Aristotle both exalt explanation in terms of goals and ends; and the respective teleologies that they espouse are both, on the rough division I made above, genuine as opposed to heuristic. I want now to introduce a further distinction within the category of genuine teleological explanation, a distinction that I shall label as that between strong and weak genuine teleology. A genuine teleology is *strong* if the end-state is appealed to as fulfilling a properly causal role in the process; in this sense, strong genuine teleology might, although I think it need not, be a paradigm of backward causation on the Mackie model (see above, n. 9). I shall leave the precise specification of 'properly causal' here open, and trust (perhaps excessively optimistically) to its intuitive significance.¹³ By contrast, a genuine teleology is *weak* if it does not meet that criterion.

It might be thought that weak genuine teleology either is an empty notion, or that it collapses into heuristic teleology. That view is I think false: the reasons for its falsity are best brought out in Sorabji's subtle discussion of the varieties of teleological explanation open to, and appealed to, by Aristotle,¹⁴ and by Gotthelf in his 1976 paper.¹⁵ But it is worth mentioning because it is only on the assumption of such a vacuity or collapse that the argument for the incompatibility of genuine teleological explanation with mechanistic necessitation, which I mentioned earlier, begins to have any real plausibility. I now turn to that argument.

The argument is perhaps most clearly (if compactly) put by Jonathan Barnes in his commentary on Aristotle's *Posterior Analytics*;¹⁶ I paraphrase it as follows: it cannot

¹⁰ For a statement of these views, and a criticism of them, see J. Barnes, *The Presocratic Philosophers* (London, 1979), ii.112–16; cf. Fr. 59 A 16 DK, Plutarch's story of Anaxagoras' rationalist description of the formation of a ram with a single horn.

¹¹ Principal among the reasons being the increasing dissatisfaction in some quarters with the traditional models of scientific progress: the classic texts are T. S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, 1962), and (particularly for the case of Galileo) P. K. Feyerabend, *Against Method* (London, 1975).

¹² See D. M. Balme, art. cit., n. 7; and cf. Jonathan Barnes, 'An Aristotelian way with scepticism', in M. Matthen (ed.), *Aristotle Today* (Edmonton, 1987), 51–76.

¹³ Briefly, it may be worth saying crudely that for one event or state of affairs to be properly causal (in my sense) of another, the relation between the two of them must be such that the one brings about or maintains the other, where 'bringing about' and 'maintaining' are real and not merely epistemic relations, as those of explanation may sometimes be. But these issues are notoriously complex and controversial.

¹⁴ Sorabji, op. cit., pp. 143–74.

¹⁵ Gotthelf, art. cit., n. 7 above.

¹⁶ J. Barnes, *Aristotle's Posterior Analytics* (Oxford, 1975), p. 222.

be the case that both mechanistic and teleological explanations can properly be applied to the same *explanandum*; for suppose that there is some *explanandum* *E*, and some set of conditions *C* which mechanistically explain *E*. In that case it is plausible to think that *C* necessitates (is a sufficient condition of) *E*. But then let us consider some putative final cause *F* which is supposed teleologically to explain *E*. How can it do so? At the very least, one would expect that, for *F* to be an explanation, or part of the explanation, of *E*, then *F* must be a necessary condition for *E*; that is to say, if it hadn't been the case that *F*, then *E* would not have occurred. But if *C* is sufficient for *E*, then *F* cannot be necessary for *E* unless it is also necessary for *C*; but it doesn't look as though final causes are plausibly to be thought necessary for the mechanistic conditions that obtain; so mechanistic and teleological forms of explanation cannot peacefully co-exist.

It is the penultimate claim that is suspect here: and as John Cooper has recently persuasively argued,¹⁷ Aristotle develops his concept of hypothetical necessity partly at least to evade just such objections. For one can coherently hold that, once the materials are assembled in the right way, then natural mechanisms will ineluctably see to the result; but it is the bringing together in the right way which is explained by the appeal to final causes. Suppose the obtaining of a state of affairs *S* consists in the satisfaction of a complex set of subsidiary conditions, *C*₁, *C*₂, *C*₃, ... *C*_{*n*}; then what the final cause explains in the case of *S* is how each of the *C*_{*i*}'s happens to be in the right place at the right time. That is fairly crude: but the crudities are of an inessential nature, and it is relatively easy to see how they can be removed.

That picture is, I submit, coherent no matter what teleological option you choose to adopt: but it is surely intuitively far more plausible on the assumption that the teleology is a directed one. The divine clockmaker winds up the mechanism and lets it go; but any explanation of the subsequent course of events that simply pays attention to the mechanism is going to be obviously and seriously deficient. Galen, as we shall see, will avail himself of just that sort of consideration. But even if one buys the incompatibility argument, which would effectively rule out the co-existence of mechanistic necessitation with strong genuine teleological explanation, one could still hold onto the weak construal of a genuine teleology, because on that construal there is no initial reason for holding that the relation between final cause and *explanandum* must involve the one's being a necessary condition for the other. Aristotle, then, has at least two options open to him in drawing the teeth of that argument.

(There are in fact others: I mention the following possibilities for the sake of completeness, not because I think that as a matter of fact they figure in any ancient account. As part of the project of reconciling teleology with mechanism, one might deny that mechanism entailed that (a) conditions *C* be *sufficient* for *E*; they might merely be (b) necessary for it, allowing only (c) the conjunction of *C* and *F* jointly to necessitate *E*; thus mechanism of this sort would be compatible even with strong genuine teleological explanation; this last might be, but need not be, a version of the first option sketched above. And it is worth noting that even (c) is not necessary: it seems to me at least that one could entertain a non-vacuous concept of mechanism, together with a rich idea of teleological explanation, and *still* maintain that the conjunction of them was insufficient for *E*; maintain, that is, either that there was some further factor or set of factors *G* which in conjunction with *C* and *F* necessitated *E*; or, even more radically, that although *C* and *F* were both necessary, and genuinely causal, the outcome of *E* was radically and irreducibly underdetermined. All this is

¹⁷ Art. cit., n. 7 above, and elsewhere.

an aside: but is important to stress just how rich is the stock of possible avenues open here.)

Galen, in spite of the relative strength of his teleological notions, could nevertheless consistently embrace either of the two alternatives outlined above from within his directed perspective. In other words, he might deny the implausibility of treating a final cause of some effect or state as being part of the necessary conditions of the mechanical necessitation of that state or effect; or equally he might hold that it was not the end-state *itself* that was causally responsible for the particular disposition of the material elements, and hence for the outcome, but rather the divine Demiurge's *conception* of that end-state. Nothing of any great importance hangs on which way he goes here, although I shall consider the issue a little further later on.

But whichever line Galen takes, it is at least clear that there are important distinctions between Aristotelian and Galenic teleology. First of all, however one construes Aristotle's teleology, it is pretty well generally agreed that it does not involve direction; Aristotle's God is far too intellectually self-centred, indeed necessarily so, to waste his time worrying about anything else;¹⁸ and that however one takes Aristotle's occasional claims to the effect that (for instance) the motion of the stars is caused by desire, it seems fairly clear that natural teleology for Aristotle is not except perhaps in a metaphorical sense intentional;¹⁹ and that distinguishes him from both Plato and Galen.

That last claim is controversial: some interpreters, notably R. E. Siegel,²⁰ have argued that Galen's teleology is in fact similar to that of Aristotle, and that all talk of the Demiurge is mere metaphor. Siegel cites Galen's reference to Hippocrates' conception of a constructive power in nature as something which 'clearly reflects Galen's impersonal teleological interpretation of nature' (op. cit., p. 17). The passage in question (*On the Doctrines of Plato and Hippocrates* (PHP) v.791 Kühn) immediately follows a section in which Galen has argued that, just as it would be absurd when one saw a house or a ship but did not see the artisan responsible for it to conclude that it had arisen spontaneously, so when one sees anything else that clearly evinces design it is rational to ascribe that design to an artisan even if you don't know who or what it is (PHP v.789–90 Kühn). This seems to me to render Siegel's position untenable, at least as regards the major expositions of the matter in Galen.²¹ It is true that in *On the Formation of the Foetus* (*Foet. Form.*), Galen is more circumspect about the source of the arranging power in animals' bodies (iv.687–8 Kühn), saying that the determination of this is a matter for philosophers, not physicians; but even here he treats personified Nature as a fit object for worship, in other words as a god.²² I have not the space here directly to discuss this issue further;

¹⁸ See e.g. *Met.* 12 7, 1072b14ff.

¹⁹ Although this last claim has been controverted: see J. M. Rist, 'Aristotelian Teleology', *TAPA* 96 (1965), 337–49; on the comparative infrequency with which Aristotle does use metaphors of striving and desiring, see Allan Gotthelf, art. cit. (n. 7), 227; for examples, see *de Generatione Animalium* 1 23, 731a24; 2 16, 744b15; and cf. *Phys.* 2 8.

²⁰ In *Galen on Psychology, Psychopathology, and Function and Diseases of the Nervous System* (Basel, 1973), pp. 13–18.

²¹ Cf. Galen's ascription of arrangement to mind, and not to chance: *UP* i.342 Helmreich, a passage discussed in more detail in Section 5; and cf. *PHP* v.783–6.

²² See M. T. May, *Galen on the Usefulness of the Parts of the Body* (Ithaca, 1967), pp. 9–12. In this context it is worth recording Hume's reading of Galen's teleology in *Dialogues Concerning Natural Religion*, Pt. 12: Hume clearly takes the Galenic account of the anatomical complexity of the human body in *Foet. Form.* to show that the animal kingdom is directly created and providentially ordered (I am indebted to my colleague David Norton for drawing my attention to this passage).

but some of the strengths of (and hence justifications for) my reading of Galen as a directed teleologist should emerge in the course of the argument.²³

There is, furthermore, another distinction between Aristotle and Galen which should now be brought out, because, as we shall see, it turns out to be related to the one I have just discussed. Aristotle's teleology is limited: not everything has a final cause, even in nature. I am not here concerned with the failure of the final cause in the case of certain types of event, namely those labelled by Aristotle as chance or coincidental (*Phys.* 2 4–6, 195b30–198a13), such as happening upon someone who owes you money (*Phys.* 2 5, 196b34–197a6), or the discovery of buried treasure while digging one's garden in the manner approved by Candide;²⁴ nor yet those that produce monstrosities in nature (*Phys.* 2 6, 197b33ff.). The failures in question are *systematic* failures, general species-wide traits which cannot be explained directly in teleological terms, not rare unfortunate deviations from the norm.

Consider the following passage:

It is likely that the gall-bladder is a residue (*perittôma*) and not for the sake of anything.... For although nature sometimes makes use even of residues, it is not right because of this to look for purpose in everything. Some things have purposes; many others come to be as a result of these things by necessity. (*PA* 4 2, 677a12–19)

So, although Aristotle will often invoke the slogan 'Nature does nothing in vain' (e.g. at *Cael.* 1 4, 271a33; *PA* 2 13, 658a9, etc.), he does not literally believe it. There are some parts of animals' bodies which do nothing at all; they are in a sense explicable in terms of final causes; for they are the unavoidable outcomes of further processes which are themselves explicable teleologically.²⁵ And Theophrastus, as J. G. Lennox has recently argued, went further still.²⁶

Galen will have nothing to do with concessions of that kind. In the opening pages of *de Usu Partium*, his great attempt to justify a strong, genuine, directed teleology, Galen writes that he felt compelled to write on such matters, because, admirable though they generally were, neither Plato nor Aristotle really understood the extent and completeness of Nature's design (*UP* i.11–13 Helmreich). Galen actually follows Aristotle's general pattern of treatment in *PA*; a recent study by Paul Moraux has emphasised how carefully and penetratively Galen read his Aristotle.²⁷ But his constant purpose is to discern purpose where Aristotle and others saw none, and he carries this project through with a remarkable degree of resolve and commitment.

Thus, when he comes to discuss the gall-bladder, at *UP* i.272–6 Helmreich, he expands fulsomely and enthusiastically on both its function and the nature of its design. Nature not only does nothing in vain for Galen, but it also arranges things in the best possible way. Thus we can distinguish two levels of appeal to teleological factors in explanation. There will be a final cause for the existence of the organ itself; but there will also be a reason, in terms of improved efficiency of its functioning or

²³ See further, n. 30 below.

²⁴ See Alexander of Aphrodisias, *de Fato* 8, 172.17ff., Bruns; the passage appears in R. W. Sharples, *Alexander of Aphrodisias on Fate* (London, 1983), pp. 184–5.

²⁵ For a detailed analysis of this aspect of Aristotle's teleology, see W. Kullman, *Wissenschaft und Methode* (Darmstadt, 1974); and also Sorabji, op. cit., pp. 155–6.

²⁶ J. G. Lennox, 'Theophrastus and the limits of teleology', in W. W. Fortenbaugh *et al.* (edd.), *Theophrastus of Eresus* (New Brunswick, 1985), pp. 143–64.

²⁷ P. Moraux, 'Galen and Aristotle's *De partibus animalium*', in A. Gotthelf (ed.), *Aristotle on Nature and Living Things* (Pittsburgh, 1985), pp. 327–44. The extent and nature of Galen's reliance on his predecessors is the subject of my article 'Galen's philosophical eclecticism', forthcoming in W. Haase (ed.), *Aufstieg und Niedergang der Römische Welt*, ii.36.4.

of some other goal-related specification (I shall return to this at the end of the paper), as to why the organ in question is in the place it is and disposed in the manner in which it is.

It is instructive at this juncture to compare Aristotle's and Galen's accounts of the causes of facial hair. Aristotle commences his treatment (*UP* 2 14, 658a12ff.) by remarking that animals which have body hair also have eyelids, and *vice versa*: hence birds and scaly creatures don't have eyelashes, with the exception of the taxonomists' nightmare, the Libyan ostrich (ὁ στρουθὸς ὁ Λιβυκός).²⁸ After a brief and rather unsatisfactory account of why humans are the only animals genuinely to have hair on both eye-lids, Aristotle turns to the head in general, declaring that man is the hairiest headed of the animals (*PA* 2 14, 658b3), and that there are two distinct reasons for this. First of all, human hirsuteness is the result of necessity (the brain is large, hot, and wet, a combination which physically necessitates a luxuriant growth); but secondly it comes about for a reason: the human brain needs insulative protective, also on account of its particular features (*PA* 2 14, 658b4ff.). In this passage, indeed, Aristotle owes something to Plato's account in the *Timaeus* (76c–e), which makes use both of 'necessary causes' and of the Creator's intelligence in the manner which we have already observed (above, p. 208).

Returning to the eyebrows and eyelashes, Aristotle holds that the former are to protect the eyes from sweat dripping into them, while the latter function like a palisade, preventing things from getting in (*PA* 2 15, 658b14ff.). None the less, in spite of and in addition to this teleological reason, the hair is formed of necessity, as a result of the accumulation of internal moisture, as it has to be 'unless some function (*ergon*) of Nature diverts it to another use' (*PA* 2 15, 658b23f.). So we can readily discern the two types of explanation co-existing more or less peacefully here. There is no apparent tension, for Aristotle, in giving both mechanistic and final-cause explanations of one and the same phenomenon.

Nevertheless, the ghost of the argument for incompatibility-I outlined above does surface again here: just what is the explanatory power involved in saying that, in addition to being the products of necessity, such features are teleologically explicable? At the very least the following is true: even if the two contrasting types of explanation for Aristotle can be coherently combined, the teleological component does a good deal less real work than one might at first sight imagine. And that is one good reason why, if you are to buy into the notion of teleology at all, there is something to be said for preferring the strong variety to the weak one; and equally why one might privilege the directed over the undirected species. Hence there are reasons for Galen to adopt what I shall henceforward refer to as the Directed Teleology Hypothesis, or DTH.

What that is in its main lines should by now be reasonably apparent; the finer details will occupy much of the rest of this paper. But it might simply be worth remarking that, while any version of DTH looks as though it will have to be a genuine teleology in the sense I distinguished earlier, it seems to be an open question whether it should be strong or weak. That question depends, I think, on the analysis of the relationship between the goal as it is conceived in the mind of the artisan, and the goal as achieved, which is beyond the scope of this paper: in particular, at least for Galen, it is a matter of the relation between the *telos* and the *skopos* of an activity; but

²⁸ The Libyan ostrich is a particularly extreme example of animals that, in Aristotle's language, 'equivocate' (*epamphoterizein*) between one genus and another; he deals with it at the very end of *PA* (4 13, 697b14ff.). On the notion of equivocation in general, see G. E. R. Lloyd, *Science, Folklore and Ideology* (Cambridge, 1983), pp. 44–52.

nothing in my subsequent analysis depends in any way on that, and so the question can be left open.²⁹

Let us now turn to Galen's account of the same features. At *UP* ii.153–65 Helmreich, Galen holds that facial hair is produced by the expulsion of the 'thicker residues'; thus he too offers a mechanistic explanation, and makes use (although not an Aristotelian use) of the notion of residues that we encountered in connection with the gall-bladder. And he echoes Aristotle (and indeed Plato) in claiming that facial hair is to be given a final-cause explanation in terms of its protective value to the individual. But he goes a great deal further. For he claims (as he does throughout *UP*) that not only are things the way they are because it's better that way, but that they were consciously arranged like that by an intelligent, benevolent Creator, whom Galen calls in obvious and conscious reminiscence of Plato's *Timaeus* the Demiurge.³⁰

Furthermore, he holds that the fact that a particular arrangement is *beautiful* can figure in a proper teleological explanation. Aristotle does on one occasion invoke the notion of *to kalon* in connection with the explanation of nature (*PA* I 5, 645a23ff.); and *to kalon* is sometimes rendered as 'beauty'.³¹ But that is, in this case, an infelicitous translation. Aristotle does not have aesthetic considerations in mind, for as he goes on to explain, it is the simple fact that organisms have purposes that makes them (and the study of them) fall within the ambit of the *kalon*, or fine and noble.

Galen, however, frequently makes use of the concept of adornment as part of his explanations; and it is easy to see that such appeals are far more intuitively plausible in the case of a directed teleology than in that of an undirected one. One might, I suppose, hold that as a matter of fact the products of nature turned out to be beautiful, turned out that is to have aesthetic value. But in default of hypothesising an intelligent, sensitive Creator who deliberately brings things about that way, one might well be inclined to think that claims to the effect that Nature made things beautiful told you more about the nature of beauty, or of our concepts of it, than about the nature of Nature; or in a slightly different language, that the fact that nature made things beautiful was a formal and not an efficient explanation for things; or again, to recall the language of the *Euthyphro* passage I referred to earlier, that the natural was beautiful because it was natural, and not natural because it was beautiful. Let us consider some of Galen's account more closely:

The hair of the beard not only protects the cheeks, but also serves as an ornament to them; for a man seems more stately, especially as he grows older, if he has everywhere a good covering of hair. This is also the reason why Nature has left the so-called cheekbones and the nose smooth and free of hair; for [if they were hairy] the whole countenance would become savage and bestial,

²⁹ On the function of the terms *telos* and *skopos* in later Greek philosophy and science, see Gisela Striker's illuminating article 'Antipater, or the art of living', in M. Nussbaum and M. Schofield (edd.), *The Norms of Nature* (Cambridge, 1985), pp. 185–204. Galen does not invariably distinguish between *telé* and *skopoi*: see *de Causis Procatacteticis* (*Caus. Proc.*) vi.57, = *CMG* Supp. ii.15.3–8, and cf. my remarks *ad loc.* in my forthcoming edition, translation, and commentary of this text, *Galen on Antecedent Causes*. Where he does, he adopts a version of the distinction close to the Stoic account discussed by Striker (and cf. *SVF* iii.3): 'The aim (*skopos*) of medical science is health; its goal (*telos*) is the achievement of it' (*On Sects for Beginners* i.64 Kühn).

³⁰ References to the Demiurge are too ubiquitous in *UP* to be worthy of individual note; and I take them to show unequivocally that, at least at the time he wrote that work (it was begun at the end of Galen's first Roman period in about A.D. 165, and completed after his return to Rome between 169 and 175: see May, *op. cit.*, n. 22 above, pp. 3–4; J. Ilberg, 'Über die Schriftstellerei des Klaudios Galenos', *Rheinisches Museum* 44 (1889), 210–19) he subscribed to a directed teleology.

³¹ E.g. by A. L. Peck in his Loeb Classical Library version of *PA*, p. 101.

and by no means suitable for a civilised, social animal.... On the other hand, for women the rest of whose bodies are soft and hairless like those of children, the bareness of the face would not be inappropriate, and besides this animal does not have an august character like the male, and so does not need an august form. For I have already shown many times... that Nature makes for the body a form appropriate to the character of the soul. And the female sex does not need any special covering as protection against the cold, since for most part women stay indoors, yet they do need long hair on their heads both for protection and ornament.... Really, however, there is another reason that makes it necessary for us to have hair on our chins and heads. For since the exhalation from the humours rises to the head, Nature makes use of its thicker residues in particular to nourish the hair, and since men have as much more of these residues as they are warmer than women, she has devised two ways for men to evacuate them. (*UP* ii.154–5 Helmreich; trans. May,³² pp. 530–1, with adaptations)

This is clearly to go a lot further than Aristotle, not merely in the types of feature that the explanation will involve, but also in the differentiation between male and female. There are two principal novelties here: the use of ornamentation (to which I shall return in a later section), and the deployment of the notion of suitability, or appropriateness, of the body to the soul, which I shall now deal with.

At *UP* i.54, 194 Helmreich, Galen remarks that apes have ridiculous bodies to go with their absurd souls. However, elsewhere he contends that apes' bodies are particularly well-suited to the function they have to fulfil, namely that of scampering rapidly up and down trees (*UP* i.153–4 Helmreich). May thinks that these two claims are incompatible, and suggests (*op. cit.*, p. 174 n. 33) that in the latter passage Galen has abandoned the first view in favour of the second. However it is not necessary to assume this, and indeed it is crucial to our whole project not to do so, since properly understood, the two passages are not in conflict.

It is quite consistent to hold that, relative to their functions and capacities, apes are well-designed; but that from an absolute standpoint, their souls (and hence their bodies) are absurd; just as it is consistent to hold that somebody is an extremely good buffoon, without being thereby committed to the idea that they are in some general sense extremely good. (As it stands that defence is inadequate, for reasons that will become clear later: but it is at least the first stage in making the two ideas compatible.)

Much the same goes for women: viewed on an absolute scale (Galen thinks), they are not as good as men; but that is quite compatible with their being absolutely excellent *qua* women. And however disgraceful that view might seem to us, it is certainly not incoherent; it is not, I think, an exaggeration to say that the power and consistency of Galen's whole conceptualisation of the structure of nature turns on the mutual compatibility of these claims. Some member of a natural kind *K* can be a good *K*, and yet need not be good in any other sense; but it is equally important to stress that this is not simply a trivial consequence of the attributive nature of 'good'; for it can still be, and for Galen certainly is, the case that even if no *K* is good (in the unrestricted or general sense), it is nevertheless good that there are *K*'s (and indeed, but not necessarily exclusively, that there are good *K*'s). That feature of the account

³² May, *op. cit.*, n. 22 above. May's translation is invaluable, although I think it is a pity she chose the word 'usefulness' to translate Galen's *chreia*, a word which may be rendered variously as 'function', 'purpose', 'end', 'need', 'use', and even 'reason' (perhaps 'function' is the least misleading general translation in Galenic contexts: see Siegel, *op. cit.*, n. 20, p. 30). Galen frequently uses the term to refer to final causes: see in particular *Caus. Proc.* vii.68–90, = *CMG* Supp. ii.17.28–22.11; see also my remarks *ad loc.* in my *Galen on Antecedent Causes*, *op. cit.*, n. 29 above. For a general account of *chreia* in Galen, see the essay "'Use'" and "'activity'", in D. J. Furley and J. S. Wilkie, *Galen on Respiration and the Arteries* (Princeton, 1984), pp. 58–69.

shows how it does not involve simply treating 'good' as attributive: for there are cases of attributive 'goods' which do not meet the last criterion. It may be true that Bluebeard is a good murderer, while others are bad, in the sense of incompetent, murderers; and it may be true that none of them are good; but it is *not* (or at least not obviously) true that it is good that there are murderers. I shall take up these points in final section of this paper.

III. GOD, CREATION AND POSSIBILITY

What kind of creature is Galen's Demiurge? Firstly, and most importantly, while he has the qualities of the Christian God (goodness, intelligence and above all skill), his practical abilities are constrained by physical necessities. Galen's Demiurge, like Plato's, has to make use of the material available (this is one more point of contact with the *Timaeus*); there is no room in Galen's cosmology for creation *ex nihilo* – indeed such a thing is *a priori* impossible. That nothing comes to be from nothing, and that nothing is utterly annihilated, commend themselves to Galen with the force of axioms.³³ For Galen, God is subject to more than merely the dictates of logical possibility; causal possibility as well restrains him from acting entirely at will.

In a most instructive passage, very shortly after the one just quoted, Galen is discussing the reasons why the eyelashes grow in such a way as to be able to fulfil their function of protecting like a palisade (Galen's language recalls that of Aristotle here) without thereby impeding other necessary functions, such as that of the eye. The function of the eyelashes is, for Galen, derivative: it rests on the prior functional necessity of the eyes. Lashes protect the eyes, and there would be no point in doing that if there were nothing to protect them for. The possibility of the hierarchisation of functional explanations that this introduces will assume some importance later on. If they were too thin, they would not keep foreign bodies out; but if they were too thick, they would impede vision. How come they get to be exactly the right length?

Has, then, our Creator commanded only these hairs to preserve always the same length, and do the hairs preserve it as they have been ordered either because they fear the injunction of their Lord, or reverence the God who commands it, or themselves believe it better to do so? Is this the way that Moses reasons about Nature (and it is a better way than Epicurus')? (*UP* ii.158 Helmreich; trans. May, op. cit., pp. 532–3)

The point is an important one: if you buy into the idea of an intelligent Demiurge, who disposes the world for the best, what are the mechanisms by which he goes about realising that goal? Must you, crucially, attribute intelligence and intentionality to the actual materials themselves, if you are to avoid a universe of pure chance and random agglomeration like that of the Epicureans?

The challenge matters: if that is the only disjunction available to you, then it could seem that, however good the Directed Teleology Hypothesis (DTH) might appear to be on other grounds, its explanatory superiority would be quite undermined by the grotesque implausibility of the animism or pan-psychism that it entailed. But Galen continues:

Yet it is best for us to adopt neither, but, continuing to derive the principle of generation from the Creator in all things generable, as Moses does, but to add to this the material principle... And since he has decided that it was necessary to make them [*sc.* the eyelashes and eyebrows] so, he spread under some of them a hard body like cartilage, and under the others a hard skin united to cartilage by means of the brows. Now it was not enough merely to will that they were

³³ See e.g. *On the Therapeutic Method* x.36–7 Kühn.

so: for if he wished to make a rock into a man all of a sudden, it would be impossible. And this is the point at which my teaching and that of Plato...differs from that of Moses.... Moses believed everything to be possible to God, even if he should wish to make a horse out of beef and ashes. We, however, do not feel this to be true, saying rather that some things are naturally impossible and that God does not attempt these at all but chooses from among the possible what is best to be done. (*UP* ii.158–9 Helmreich; trans. May, p. 533, with slight adaptations)³⁴

The theoretical advantages of such a limitation on the creative powers of the Demiurge are considerable. Principal among them is that it makes the compatibility between the way the world actually is and the supposed attributes of its divine organiser a good deal easier to establish. For, I take it, Galen's reasons for adopting DTH are simply that, given the obvious level of organisation in the world, particularly in the case of living things, it is highly implausible to think that it can all be accounted for as a result of random agglomerations on the lines suggested by the atomists. The problems that the Epicureans had in accounting for the initial appearance of worlds, and for the subsequent persistence of and regularities within them, are too well known to require rehearsal here. But Galen's *via media* gives him an account of divine power which is strong enough to do the explanatory work required of it, yet not so strong as to fall foul of the more obvious arguments of the Problem of Evil type.

Galen writes, in the course of his 'Hymn to Nature', that the Creator has willed that everything be for the best, thus demonstrating his perfect wisdom, power, and goodness (*UP* i.174 Helmreich). He commands this thesis (and hence DTH) to us by way of a series of considerations. But the important feature of them, whether they concern the configuration of the heavens, or the architecture of the human body, is that the Creator's power and perfection are restricted by the causal limitations imposed by the materials he uses:

Consider the matter from which each part is made, and do not imagine that from catamenia and semen³⁵ an immortal object could be produced...as bright and fair as the sun. (*UP* I, p. 176 Helmreich)

and a little further on:

Are you willing to have the sun formed from the substance of blood, so prone to putrefy and so filthy?... I will not, indeed, show you the sun in the body of an animal, but I will show you the eye, a very brilliant instrument, resembling the sun as closely as is possible in the body of an animal. (*UP* i.177 Helmreich)³⁶

The opponents of DTH go wrong, on Galen's view, in that they demand what is effectively a causal impossibility of the Demiurge. Once one sees that his activities are restricted in this way, it becomes easier to see how, given those constraints, his work is the best it could possibly be. In a related passage, Galen takes these opponents of teleology to task for an inability to perceive that true excellence is excellence of form, not of material: just as a sculptor exhibits as much technical or artistic skill in the execution of a clay *maquette* as in the production of fine marble or bronze, so the Demiurge's skill is apparent to the trained eye even while working with such inferior materials (*UP* i.174–6 Helmreich). I shall return to this aesthetic strand in Galen's teleology in a moment. However, this limitation on the demands for teleological excellence is clearly a theoretical strength of Galen's position as against that of the Christian or Jewish traditions.

³⁴ For discussion of the implications of this and other passages for Galen's theology, see R. Walzer, *Galen on Jews and Christians* (Oxford, 1949), pp. 18–37.

³⁵ These are the supposed constituents of the foetus for Galen as well as for Aristotle: *On the Natural Faculties* (*Nat. Fac.*) ii.85 Kühn.

³⁶ For the comparison of the sun with the eye, cf. Plato, *Rep.* 508a–b.

IV. THE SHORTCOMINGS OF DIRECTED TELEOLOGY

But is it not still true that, for all that, Galen's teleology suffers from a serious, perhaps fatal, weakness? One might think that Galen's account commits what I characterise as the *Error of Insufficient Relativisation*, or EIR, which is an error that occurs in the assessment of the supposed natural excellences of things: as such, it is entirely general, and it can, I believe, be detected in a wide variety of quite separate contexts. Consider what he says, for example, about the relative positions of the heavenly bodies. If we need to be convinced of the goodness of the arrangements made by the Demiurge, Galen urges, we should consider the celestial arrangements; but we should not let awe at their perfection deflect us from the realisation that, albeit on a necessarily more restricted scale, the arrangements of animals' bodies are, in their own way, perfect as well. We should ask what the best position in the universe for the sun might be: but we should also consider the excellence of the disposition of the human foot, which is a particularly lowly part of creation (*UP* i.176–7 Helmreich).

The sun could not be in a better position than it is: for if it were any further away, the earth would be too cold to be habitable; whereas if it were any closer, it would be too hot. At this point Galen draws an odd conclusion, but it is one whose oddity constitutes the best available evidence for convicting Galen of committing EIR: for he infers from these considerations that the position of the sun *relative to the other heavenly bodies* is the best possible: it could not have been better placed outside the orbit of Mars, for example, or lower than the orbit of the moon (*UP* i.176 Helmreich; Galen's universe is, of course, geocentric). But even if we allow Galen his conclusion that the *distance* of the sun is the best possible, that is perfectly compatible with different celestial *arrangements*: everything, the moon included, could have been stuck outside the present orbit of the sun, provided that that was held constant.

That may seem trivial: but it is symptomatic of the error of EIR. In general, EIR is committed when, in discussing the functional excellence of some *component* of a system, it is assumed that the state of all the *other* components to which it is to be compared is necessarily fixed. The outcome of EIR is generally a grossly inflated estimate of the excellence of the component; and as, *mutatis mutandis*, EIR can be applied to every other part of the system, a grossly inflated estimate of the excellence of the whole.

Perhaps an example is in order. Suppose I am a member of a soccer team. I am a large, burly centre-forward in the old British mould, with the ability to head the ball powerfully and accurately; I am however rather slow, almost completely devoid of ball-skills, and unable to kick very hard either. It so happens, however, that no-one in my team is able to pass the ball along the ground in any case, so that every time the ball is crossed from the wing, it arrives at head-height. Now, it could be argued that I am a functionally excellent part of the team, and there is a sense in which that is true, provided that one takes that as being a claim about the team *as it is now constituted*. But it would be to commit EIR if we were to infer from this that I am the best possible centre-forward. The proper course of action for any sensible team-manager would be to put not only me but the rest of my team-mates as well on the transfer-list.³⁷

³⁷ As I characterise it, EIR bears a strong formal resemblance to Lindsay Judson's concept of the Insulated Realisation Manoeuvre, which he considers vitiates Aristotle's treatment of the modalities: but I don't have the space to detail that resemblance here. See L. Judson, 'Eternity and necessity in Aristotle's *de Caelo*', in *Oxford Studies in Ancient Philosophy*, i (1983), 217–55.

Another way of viewing EIR might be as a failure to distinguish between absolute and hypothetical necessity. The Aristotelian notion of hypothetical necessity has been much discussed recently;³⁸ but I take it that at least this much is uncontroversial: it is a dyadic relation that functions at least partly as follows:

x is hypothetically necessary for *y* if and only if if *y* is to exist, *x* must exist (see Aristotle, *Phys.* 2 9, 199b33ff.)

That the sun be where it now is in relation to the other orbits is only hypothetically necessary relative to the fixity of those orbits. But why imagine that they need to be fixed at all in the first place?

Thus armed, one might imagine that Galen's conclusions concerning the excellence of the sun's distance from the Earth involve at least one more instance of EIR. For it is only for animals *constituted like us* that the sun's distance is ideal, if indeed it is at all; and for all we know there may be much better forms of life, for any interpretation of 'better', compatible with a much hotter or a much cooler sun. Or alternatively the sun could be further away, but larger, or nearer and cooler: and so on.

However, while it seems to me clearly the case that many arguments for the plausibility of some teleologies (notably perhaps Pangloss's) do commit EIR, Galen can be acquitted of that charge, or at least of any damaging version of it. Perhaps he does make the mistake of thinking that there is too straightforward an argument for the perfection of the heavenly arrangements; but at least in the biological cases, he can fall back on the hypothesis of the physical restraints: given the materials available to the Demiurge out of which it was even possible to fashion intelligent life-forms, it was as a matter of fact causally impossible to make them in such a way that they could survive in an environment either much hotter, or much cooler; or even if it were causally possible, there are reasons why things are better the way they are, even if perhaps we can't know what they are.

Now, that might seem to be a pretty weak response: an unargued, feeble appeal to the unknown in order to shore up what is basically an untenable paradigm; the last refuge, in fact, of the degenerating scientific programme.³⁹ If Galen's position is properly understood, however, it seems to me that this is not the case: I shall try and make that claim good in the final section. But it is worth stressing that, even if EIR can be avoided, Galen has more work to do than he seems to be aware of here. He needs to show how it is necessary that matter should be distributed in the way it is, given some belief in the interchangeability of the elements;⁴⁰ and also why, even given that, it was incumbent upon the Demiurge to create animals at all, instead of simply leaving things the way they were. It is relatively easy to see how a Galenic response might be constructed to the second objection: it would rely principally, one supposes, on the idea that any life is better than none, because souls are superior to bodies; and it would no doubt involve the hierarchisation of goods and functions, in a manner already hinted at and to be developed further below. But such a reply would at best be speculative, and so I shall not attempt it here.

Having overcome that problem, at least provisionally, for Galen, I turn briefly to another, before returning to the main lines of the argument. Galen, it will be

³⁸ Most notably in the article of Cooper, cited above, n. 7 above.

³⁹ That Lakatosian language is deliberate, for reasons that will emerge later on.

⁴⁰ See *Elements according to Hippocrates* i.413–508 Kühn.

remembered, makes aesthetic considerations do teleological work. Things are the way they are partly at least because they are beautiful that way. There is nothing immediately problematic about that from within a framework of DTH. But there is a difficulty in reconciling such a claim with Galen's own view that, properly interpreted, beauty is essentially a functional concept: a thing is genuinely beautiful just in case it fulfils its function to the highest possible degree. If that is the case, how can the beauty of some part serve as an *independent* part of its teleological justification, *distinct from* its function? Galen repeatedly takes people to task for imagining that beauty is a matter of physical morphology independent of function: such things are merely

indications of a beauty meretricious and false, not natural and true. Hence the qualities a slave-dealer would value in a body are not the same ones Hippocrates would recommend. (*UP* i.17 Helmreich)⁴¹

Galen also holds that a failure to appreciate this basic fact of aesthetics often blinds people to genuine beauty:

On the other hand, although the eye is a far more beautiful part than any of these [*sc.* the foreskin and the buttocks], its beauty is disregarded because its usefulness (*chreia*) is so greatly admired. Beauty is disregarded too in the nose, lips, and other parts, because in them the beauty of their usefulness far surpasses the pleasure aroused by their appearance. (*UP* ii.153 Helmreich)

This passage contains the key to the resolution of the difficulty. It is not that Galen is impervious to the attractiveness of appearances; indeed he goes on to invite the reader to consider how ugly any of these parts would be if they were mutilated slightly, but not in such a way as to impair their function. But these things, which he earlier likens to the ornamentative decorations on buildings are produced in a secondary and incidental way 'in sport, as it were'.

Thus, genuine beauty is to be found in functional excellence, and that is 'the first goal in the construction of the parts' (*UP* ii.153 Helmreich); but that does not mean that Nature and the Demiurge will not strive to add ornamentation in the cases in which it is possible and compatible with the achievement of the basic goal of functional excellence, as for example in the case of women's hair (see above, p. 216). Put formally, an attribute is only genuinely beautiful if there is some natural function which it fulfils or towards which it contributes, a function which can be specified independently of any reference to its alleged beauty. The notion of genuine beauty, then, is capable of being completely explained on the basis of other properties: its crucial feature is its eliminability. Anything else is mere ornamentation.

Ornamentation turns out to be another case of the hierarchisation of intentional considerations in the construction of the parts. Essentially, the picture is this. The Demiurge has a quantity of more or less tractable material to deal with. His first aim is to make from it the best creatures that it is possible to make, where excellence is determined by function.⁴² But once that aim has been fulfilled, it is still open to him, and better for him, to put the rest of the material to use, both in the creation of lower

⁴¹ These are not isolated claims: see also *PHP* v.443, 447ff. Galen presumably has in mind slave-dealers who commend their wares solely on the grounds of their superficial physical attractiveness, and not because of their strength, or agility, or whatever; otherwise the point he is making would be somewhat obscure.

⁴² The story here, which I do not have the space to fill out, would presumably be broadly Aristotelian, resting on a hierarchy of excellence of psychic functions, starting with nutrition and ending with contemplation.

animals, and in the decoration of them. Human beings will be more decorative, then, than the other animals; thus, by comparison, the other animals will appear relatively mean (hence his remarks about apes). But they can still be the best they could possibly be: and it can still be the case that it is better to use material for them than it is simply to let it go to waste. No doubt that last series of propositions is controversial and controvertible: but it is not obviously incoherent or insane; and Galen's invocation of beauty turns out, when properly understood, to be capable of being defended against the most obvious attacks upon it.

V. THE MODEL COMPLETED: TELEOLOGY AS A REGULATIVE PRINCIPLE

But we have yet really to confront the reasons for Galen's acceptance of DTH. Why should he invoke a Demiurge at all? One answer is simply that even if he was not a Platonist as such he was still strongly influenced by the *Timaeus*. But a further reason, I suggest, is that given the state of the science of his day, and crucially given the unavailability of sophisticated accounts of cybernetic systems which can be used to explain how complex mechanisms can mimic intentionality, it was the best available hypothesis. Anything else, along the lines adopted by the atomists, was simply too implausible; the mechanisms they invoked lacked the power required of them to save the appearances. Yet equally the undirected teleology of Aristotle and Theophrastus in which final causes are somehow just there in nature itself, but there is no consciously entertained plan or design, doesn't seem to make much sense either. For how *could* there be such a force? The only good examples we have of goal-directedness actually *do* involve consciously-entertained goals. Galen enumerates a series of examples in *Caus. Proc.* vi.56–60, = *CMG Supp.* ii.14.33–15.34, of final causes, along the lines of the Peripatetic cases; they all involve explicit purposes. A carpenter makes a bed because there's a need for the bed. A weaver weaves a coat because coats are in demand;⁴³ and these descriptions among other things involve intentions. How can the evidently purposive features of nature be accounted for in a radically distinct manner?

But there is more to be said than just this. Galen regularly attacks other doctors (most notably Erasistratus and Asclepiades) for failing to appreciate the extent of natural teleology. In contrast to Aristotle (as we noted above), Galen holds that there are no genuinely superfluous parts of animals' bodies, not even ones that can be explained as being the necessary residual outcomes of further processes which are in themselves purposive: for a benevolent and skilful Demiurge would surely have made *some* use of such residues, even if only an ornamental one. Erasistratus and Asclepiades go further than Aristotle, however: they simply roundly declare that certain organs, that are to be found throughout particular species, are useless and inexplicable. Galen takes them to task in *On the Natural Faculties*; having asserted that there is only one thing in common between the Peripatetics and the followers of Erasistratus, namely their adherence to the principle that Nature does nothing in vain, he adds that the latter group pay lip-service to it only:

Even as regards this doctrine, their agreement is only verbal. In practice, Erasistratus destroys it on countless occasions. For, according to him, the spleen was made in vain, the omentum in vain, the arteries that originate in the kidneys in vain. (*Nat. Fac.* ii.91 Kühn)⁴⁴

⁴³ Cf. *UP* i.338–9 Helmreich.

⁴⁴ Cf. *ib.* 35–6, 38–9, 132 Kühn.

And he goes on to blame this omission on Erasistratus' ignorance of anatomy, a fact that will assume some importance shortly. In a passage of *UP*, he takes Asclepiades to task for the inadequacy of his account of the 'venous arteries' (actually the pulmonary veins: lacking a circulatory theory of the vascular system, the ancients generally confounded pulmonary veins and pulmonary arteries); Asclepiades thinks they are thin because they labour excessively, as a result of the dual motion caused by the pulse and by respiration which is peculiar to them, whereas in fact they are thin *in order* to labour hard: that is their function (*UP* i.340–1 Helmreich). Asclepiades gets the direction of the explanation wrong (on this, see above, pp. 209–210); and he also confuses an insignificant type of cause (the instrumental cause)⁴⁵ with the proper cause, namely that it is better so (*UP* i.341–4 Helmreich):

He has given one cause, but not the real, primary one; on the contrary, his is an instrumental cause, a *sine qua non*,⁴⁶ but one that is not really a cause at all. (*UP* i.339 Helmreich)

And again, one of the reasons for this is an ignorance of anatomy (*UP* i.341 Helmreich).

This indicates, among other things, that anatomy is not entirely, or even principally, a practical enterprise for Galen. At the beginning of his great treatise on the subject, *On Anatomical Procedures* ii.286, Galen holds that there are four reasons for doing anatomy, only one of which is to develop practical skills. The others are to get knowledge for its own sake, to demonstrate that Nature does nothing in vain, and to secure data for the investigation of an activity (*energeia*).⁴⁷ Anatomy, if done properly, will actually support the teleological hypothesis: for in dissection, the anatomist discovers not only the complexity, but also the degree of adaptation, of the structures of the body. It is, among other things, ignorance of anatomy that allows some theorists to overlook the teleological structure of Nature.

Thus, developed anatomical research serves to confirm DTH,⁴⁸ as indeed any proponent of it would expect that it would. For the hypothesis asserts that the natural world is the product of conscious purpose, executed by a superior intelligence, that being the only plausible way of explaining how things are the way they are; but given that the intelligence must be superior, and benevolent, and powerful, it is not going simply to leave things lying around to no purpose if there's something better that can be done with them. And there almost always is.

That last sentence is somewhat more circumspect in tone than Galen himself generally is; Galen, carried away by his own rhetoric, tends to claim that matter never

⁴⁵ For this late addition to the canonical Peripatetic four causes, see *Caus. Proc.* vi.60–4, = *CMG Supp.* ii.15.35–16.37; see my notes *ad loc.* in my forthcoming *Galen on Antecedent Causes* (op. cit., n. 29 above); and my 'Galen's theory of causation', forthcoming in W. Haase (ed.), *Aufstieg und Niedergang der Römische Welt* ii.37 1.

⁴⁶ This language, *ὅν οὐκ ἄνευ*, deliberately recalls Plato's account in the *Phaedo*; cf. *Caus. Proc.* vii.84, = *CMG Supp.* ii.20.39–21.2; see also G. E. R. Lloyd, *Magic, Reason and Experience* (Cambridge, 1979), pp. 53–4. And it is instructive to compare the types of explanatory category invoked by Galen here, with Plato's distinction between 'intelligent' and 'divine' causes on the one hand, and 'necessary' and 'co-operative' ones on the other: see above, p. 208.

⁴⁷ I discuss this passage in detail in 'Galen explains the elephant', and 'Galen's anatomical procedure' (n. 1 above); in the former I also discuss how the final two of those reasons differ from one another.

⁴⁸ I examine in detail one particular case in point in my paper 'Galen explains the elephant', art. cit. (n. 1 above).

goes to waste, and that things never really go wrong.⁴⁹ But it is actually a theoretical strength of his position that it allows one to be cautious in this way. Indeed, there are two constraints on the Creator's ability to achieve the best possible results. His Creator, as we have seen, is *not* omnipotent; nor need he have any infinite attribute, or perfection in the Judaeo-Christian sense. He is restricted by material and causal necessities, and in this he is in the same position as Plato's Demiurge.⁵⁰ But crucially (and this is where Galen goes further than Plato), he is not even omniscient. He is capable of making mistakes, and Galen explicitly allows as much at the very end of *UP* (ii.441–9 Helmreich). The Demiurge is a craftsman; and craftsmen occasionally foul things up. But the number of mistakes the divine craftsman makes will be fewer and less significant in proportion to the superiority of his intelligence; and there certainly will not be general, uniform errors that cover entire species. If there were such errors, or superfluities, they would undermine the whole plausibility of DTH. Thus Galen allows that there are sports, freaks of nature: and he discusses the case of individuals born, like Anne Boleyn, with six fingers on one hand (*UP* ii.443–4 Helmreich),⁵¹ even though, as he explains at enormous length throughout Book 1 of *UP*, five is the best number for the fingers. But such things happen unimaginably rarely, and do not serve as counter-examples to DTH. The argument for DTH is, in its essentials, as follows:

- (1) Teleology is plausible only on the assumption of a benevolent, skilful creator (that is the DT hypothesis);
 - (2) if there is a benevolent, skilful creator there will be no superfluities, at least of a general kind, in Nature;
- so (3) if there are such superfluities, DTH is implausible.

That argument is valid. I have argued that, given the state of knowledge of Galen's time, it was rational to espouse DTH in preference to anything else on the market. This means that (1) commits Galen to explaining away all *apparent* cases of purposelessness on a general scale; they are apparent only, and a proper investigation by a skilful practitioner will show that even the apparently useless parts are there to some purpose. But because of two crucial features of Galen's system, namely the constraint of material necessity, and the fact that the Demiurge is not perfect (merely extraordinarily good), the analogues to Judaeo-Christian Problem of Evil arguments are far less damaging to the hypothesis. You don't have to show, heroically and implausibly, that this world is absolutely the best of all logically or conceptually possible worlds; you simply have to establish that it's pretty nearly the best of all causally possible ones.

⁴⁹ One might however claim that there was a legitimate sense of 'waste' such that something could only be said to be wasted if as a matter of fact something better could (for a causal sense of 'could') have been done with it: in that case, there will be no waste materials, provided that the Demiurge maximises the possible material potential of the world. However, as Galen allows, he may not quite manage to achieve even that.

⁵⁰ See in particular *Tim* 75a–c, where Plato implicitly allows that there might be better logically possible arrangements of things if 'nature which has arisen and been nourished along with necessity' did not preclude the possibility of having a hard, sinewy and fleshy organ which could also perceive acutely; as such a combination is precluded, there is a necessary choice to be made between durability and intelligence in the case of the human head; and nature has opted for intelligence at the expense of durability.

⁵¹ These cases are further mentioned at *UP* i.60–1 Helmreich, and in *On the Causes of Diseases* vi.862 Kühn.

So DTH provides Galen with what is effectively a methodological rule: if you see something apparently functionless, investigate it until you discover its hidden function.⁵² That, I submit, is an extremely effective methodological rule in biology. For it entails, among other things, what I have elsewhere described as the Principle of Creative Economy and the No Redundancy Assumption,⁵³ linked principles about natural explanation to the effect that a Demiurge with Galenic attributes, even one restricted by material necessity, will choose the best and most economical engineering solution to a particular problem. If possible, functions will be combined and the amount of material expended reduced; parsimony is a creative virtue, because among other things it is an artistic and technical virtue.

And, Galen further claims, anatomical investigation lends powerful empirical support to his contentions; because the works of Nature are, when put under the microscope (in Galen's day of course in a metaphorical sense only: it is worth reflecting on the enormity of his achievements given the primitive state of his technology), enormously more complex than they appear on the surface. To return finally to the case of the hand, with which we set out. At the end of his discussion (*UP* i.56–7 Helmreich), Galen considers the arrangement of the insertions of tendons into the joints of the hand. There are, he says, thirty joints in the ten fingers, three in each finger; and one might initially compute the total number of tendon-insertions as 120, given that in general there are four per joint, one at the front, one at the back, and one on each side. But careful investigation shows that as a matter of fact there are only 118: the first joint of each thumb lacks the interior insertion. Why? Is this an accident? Of course not, Galen asserts, with a fair amount of characteristic rhetorical hand-waving. For, when one considers the motions of the hand and of its parts, one realises that there is no need for the first joint of the thumb to flex in the same way as the first joints of the other fingers. If each thumb had the interior tendon-insertion, they would have them to no purpose:

Certainly if we flexed this joint in the same way as the others, I know you would then harshly and vehemently criticise the uselessness of Nature's labour in creating an unserviceable motion, and a tendon that was superfluous. (*UP* i.56–7 Helmreich; trans. May, with adaptations)

There are thus two criteria that Nature must fulfil to be excellent: firstly she must allow for all the functions that are necessary for a particular animal (and for the particular parts of particular animals); but no less importantly, she must not supply a function that has no purpose to it. Consider the anatomy of the hand, Galen claims, and you will see that she's got it just right; and the fact that things in this case do turn out so closely to conform to the hypothesis that these are indeed nature's criteria in itself tends to corroborate the hypothesis. The hypothesis explains the phenomena; and the phenomena provide some limited support for the hypothesis. This success, supplemented of course by more general similar successes elsewhere, justifies the adoption of this particularly sophisticated version of the principle that nature does nothing in vain as a methodological rule, a rule which should be used to guide actual practice in the biological sciences.

Such rules will, no doubt, result in some implausibilities if applied absolutely rigorously; but they are progressive, and consequently part of a good science; and

⁵² Galen's attitude to redundancy is interestingly paralleled by that of Wallace, who also held that there could be no evolution of a functionless structure: see S. J. Gould, 'The evolution of the human brain: Darwin and Wallace', in his collection *The Panda's Thumb* (New York, 1980), p. 51.

⁵³ In 'Galen explains the elephant' (n. 1 above).

they ought to encourage fruitful research. The fact that in Galen's case they didn't (anatomy as an investigative science collapsed for more than a millennium after his death) is no fault of Galen's. Galen, as it turns out, was no Pangloss: but nor does he think we should rest content with cultivating our gardens.⁵⁴

McGill University

R. J. HANKINSON

⁵⁴ Much of the original work for this paper was done while I was researching my doctoral thesis: a very early version of some of the arguments of Section 4 appeared there, and I am grateful to my supervisor, Myles Burnyeat, and to my two examiners, Richard Sorabji and David Sedley, for discussing these issues with me; I am further indebted to the Editors of *CQ* for their remarks. I should also like to thank the participants of a conference that took place in May, 1987, in Edmonton, where I read one related paper, and to the members of the McGill History and Social Studies in Medicine Unit seminar, where I read another, for stimulating discussions which helped me to clarify some of my ideas. In virtually its final form, the paper was read to the Classics Department at Berkeley on February 1st, 1988, and am grateful in particular to Tony Long and Alan Code for their comments; finally, on 22nd April, 1988, I read it to the Philosophy Department at the University of Texas at Austin; on that occasion I benefited particularly from the incisive remarks of Hans Kamp and Ed Allaire, although I fear I have not been able to do justice to all the issues they raised. Those must wait for another time.