

Oughts without intentions: a Kantian approach to biological functions

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Talk of functions is pervasive both in the biological sciences, and in our everyday talk about organisms and their parts and behaviour. We say, for example, that the function of the heart is to circulate the blood, that the function of ribosomes is to make proteins, that grooming behaviour in cats serves a primarily hygienic function, and so on. And we use the notion of function to register a distinction between the kinds of performances and roles just mentioned, and other causal roles played by the elements of biological systems: for example, making a thumping noise in the case of the heart, increasing a cell's RNA content in the case of ribosomes, and expending energy in the case of the cat's grooming behaviour.

But while biologists are typically happy to talk about functions in this connection, philosophers often consider such talk to be problematic. Talk of the functions of the parts and behaviour of living things seems on the face of it to rely on a conception of living things as analogous to artefacts: in saying that the function of the heart is to circulate the blood rather than to make a thumping sound, we seem to be making the same kind of point as when we say that the function of the fan in the computer is to keep it cool rather than to produce white noise. But in the case of artefacts, we know that they were designed by an intelligent agent, and our function ascriptions typically reflect our beliefs about the designer's intentions. And at least since the Darwinian revolution, biologists are in agreement that organisms do not come into existence as a result of intentional design. So the question arises of what entitles us to ascribe functions, and in particular to distinguish functions from mere side-effects, in a biological context. Does our talk of functions rely on an implicit, and illicit, conception of organisms as designed by an intelligent agent?

One familiar response to this problem is to try to explain the notion of function in a way which does not appeal to the notion of design, intelligent or otherwise. Various versions of this response can be seen in the considerable literature on functions which has emerged since the 1970s. Surveys of this literature typically distinguish two main lines of approach: the historical or etiological approach pioneered by Wright, and continued by Millikan and Neander among others, and the "causal role" approach suggested by Cummins. On Wright's original version of the historical approach, to say that Y is a function of X, rather than a mere side-effect, is to say, very roughly, that X is there because it does Y. More recent versions of the approach, aimed at accounting specifically for biological as opposed to artefactual functions, make explicit appeal to etiology through natural selection: to say that Y is a function of X is to say that it was "selected for" (Neander 1991, 173), or, somewhat more precisely, that it contributed to the fitness of the ancestors of the organism to which X belongs (ibid., 174). The causal role approach, on the other hand, explains the notion of function by appeal to the current as opposed to the past effects of whatever has the function. The functions of entities or traits, on this approach, are, roughly, the causal contributions they make to the overall activities of the system to which they belong.

However, both lines of approach are subject to well-known difficulties. In the case of the etiological view, problems stem from the fact that in many biological fields, such as physiology and cell biology, functions are ascribed without reference to the history of the relevant organism. Biologists in these fields have no intention of making historical claims when they ascribe functions to the parts of an organism or cell: they are concerned only with how the part actually contributes to the workings of the containing system. So the proposed approach seems to fall short of an (even partial) explanation of what we mean by 'function,' providing instead only a characterization which, is, at best, coextensive with it. Relatedly, versions of the approach which make specific reference to natural selection are unable to account for the apparent continuity, either between pre- and post-Darwinian ascriptions of biological functions, or between the ascription of biological functions and the ascription of functions to artefacts and their parts. And while this last difficulty does not apply to Wright's original version of the view, which has as one of its strong points that it offers a unified account of biological and artefactual function, that

version is systematically vulnerable to counterexamples (requiring us to ascribe functions to the gas leak which renders unconscious the scientist who would otherwise mend it, the obesity which prevents someone from exercise that would enable him to lose weight, and so on [Boorse 1976]). Some of these difficulties are avoided by Cummins's causal role approach, which does justice to the practice of biologists in ascribing functions without regard to historical fact and which accommodates the ascription of functions to the parts of artefacts as well as of organisms. But that approach has difficulty allowing for functions of artefacts which are not part of complex systems (for example paperweights and doorstops [cf. Wright 1976]). Conversely, it seems to commit us to ascribing functions to parts of complex systems which we intuitively do not think of as functional, either because they are neither biological nor the products of intentional design (clouds in weather systems [Millikan 1989, 294]), or because they are themselves evidence of dysfunction (mutant DNA sequences in the formation of tumours [Kitcher 1993, 272]).

Partly as a result of these various difficulties, some philosophers have proposed rehabilitating the association between function and design. Philip Kitcher, in particular, has suggested that we identify the function of a trait or entity as what it is designed to do. This is compatible, he says, with the ascription of biological functions since, as he sees it, we can see not only the intentions of agents, but also the action of natural selection, as sources of design. As he puts it: "design is not always to be understood in terms of background intentions... one of Darwin's important discoveries is that we can think of design without a designer" (1993, 2). While his account qualifies as a version of the etiological view, Kitcher accommodates the initial difficulty I mentioned for that view -- that many biologists do not take function-ascriptions to be responsible to facts about etiology -- by claiming that functions do not always need to map on to explicit intentions. If an organism or machine was designed to perform in a certain way, then we can ascribe functions to the structures, traits or behaviours contributing to that performance, whether or not these were specifically designed to perform that contribution. (For example, if a screw which has accidentally fallen into a machine enables the machine to perform as the designer intended, then we can describe its contribution to the working of the machine as a function of it.) So by relying on a basic

notion of function in terms of design, Kitcher is able to offer a unified account of functions which applies to both organisms and to artefacts, simple as well as complex. But his modification of the basic view to allow for some unintended functions allows us to do justice to the ahistorical basis of most functional ascription in physiology and molecular biology, and to make room for some "Cummins functions" without opening the floodgates of indiscriminate function attributions in complex systems generally.

Kitcher's account has the advantage of mapping very closely on to our intuitions about when it is appropriate to ascribe biological functions. Intuitively, the contexts in which we are inclined to say that something has a function are just those contexts in which we would be inclined to say, if it were an artefact, that there was something that it was designed to do, or some necessary role it plays in fulfilling a design. But these intuitions leave open a range of criteria for function ascriptions in different contexts of biological enquiry, and it is a further, and related, advantage of Kitcher's account that it respects that diversity. For it leaves open that, depending on our explanatory interests, the criteria we employ for function ascription might refer variously to past selection pressures, to more recent selection pressures, or to an item's current contribution to the behaviour of the system to which it belongs. And this is very appealing, given that, in actual biological practice, criteria for function ascription typically vary depending on the relevant discipline: ecologists tend to favour criteria in terms of selection pressure, whereas physiological and molecular biologists are typically concerned only with the current contribution of the item to the system to which it belongs.

Where Kitcher's view falls short, as I see it, is in his assumption that natural selection is a process of design. The notion of design on which he draws is, as Ulrich Krohs points out (2009), not a technical notion but rather our ordinary intuitive notion; and this is important for his view given that he aims to capture a correspondingly intuitive notion of function. But, as Krohs also points out, the ordinary meaning of "design" seems to carry with it a reference to intention, and there is no intention involved in the operation of natural selection. Natural selection, very roughly, is a process whereby certain chance mutations of genetic material come to be perpetuated because of their contribution to the survival and reproduction of the organisms containing that material. This process results in organisms which are

relatively well-adapted to their environment in the sense that they have a relatively high probability of surviving and reproducing in it. But, to state the obvious, this result is not planned or intended, and while there is indeed "selection" -- in the form of the elimination of less well-adapted organisms -- it is not the kind of selection typically involved in design processes, where certain alternatives will be rejected on the grounds that they fail to meet criteria which the designer has in mind. In fact, as far as our intuitive notion of design goes, the process is in a way the antithesis of design, taking place as it does through a combination of chance (in the occurrence of genetic mutations) and natural, non-purposive, necessity (in the differential reproduction of the resulting phenotypes). If there is an analogy between artefacts and products of natural selection, it is not due to any common element in either the ontogenetic or the phylogenetic processes through which they come to be, but rather to something about the end-products regarded in abstraction from their history. Our use of functional language suggests that we do indeed consider organisms as if they were products of design, but if this is so, it is in spite of, rather than because of, what we know about the processes which actually give rise to them.¹

In this paper I want to suggest an alternative approach which is in the general spirit of Kitcher's but which takes as fundamental, not the notion of design itself, but a notion which I take to be presupposed by the notion of design, that of normativity. Like Kitcher's, my view aims to hew very close to our ordinary intuitions about functions and, relatedly, to accommodate the diversity of function ascription in biological practice. But, unlike Kitcher's, it does not depend on any assumptions about the actual etiology of the entities to which functions are ascribed. The approach is based on Kant's account of organisms as natural purposes, and I take it to be, in essence, a Kantian view, although I will not try here

¹ Krohs himself defends an analysis of function in terms of design, by proposing that we can think of the ontogeny of individual organisms as a case of production by design (roughly, we can think of an organism's DNA as the locus of the design, like the construction plan in the case of an artefact [2009, 75-78]). But I find Krohs's account unconvincing, in part because he takes the distinctive feature of production by design to be that a designed entity -- in contrast to an individual work of art -- is produced as one of a series, or, at least, can in principle be multiplied. The DNA of an organism qualifies as a design plan because it "fixes" types of proteins, rather than individual (token) proteins. However, unless "fixing" is understood intentionally, so that the DNA in effect tells the agents assembling the organism which types of protein to use (the way a construction plan tells the builders which types of component to use) an intuitively essential element of design seems to go missing. Conversely, it seems to me that the notion of design is not limited to the production of series (or possible series), and that a unique work of art is no less designed than an industrial product.

to defend my ascription of it to Kant.² Very roughly, I want to say that the function of a trait or entity is not what it was in fact designed to do, or what it contributes to what the organism was designed to do, but simply what it should, or ought to, do. To say that the function of the heart is to circulate the blood, as opposed to making a thumping noise, is to say that, in so far as a heart circulates the blood, it is doing what it should or ought to do, or as we might also put it, doing what is appropriate to it. Here I am picking up on an aspect of the notion of biological function which is underlined by a number of philosophers on different sides of the debate, for example Millikan 1989, Neander 1991, Hardcastle 2002, Krohs 2009 and McLaughlin 2009. But, in contrast to these philosophers, I am taking the normativity of function ascriptions not as a feature to be explained by some other account of the meaning or significance of function ascriptions, but as itself capturing the meaning or significance of function ascriptions.³

Now one of the intuitions motivating my approach is that our ascription of functions to biological entities reflects a conception of them as analogous to artefacts. So we might characterize my approach as one on which the function of a biological entity is what it is *as if* designed to do. This would relate it to the kind of view offered by C.D. Broad, on which the notion of teleology (which for Broad is closely connected with that of function in the sense which concerns us) is "involves a hypothetical reference to design" (1925, ***PAGE REF***). And it would also relate it to Kant's view of biological teleology as it is often understood, namely as resting on the idea that organisms must be regarded by us as if they were products of a designing mind, even though their actual origin is unknown to us.⁴ However, as I take Kant himself to have recognized, there is something puzzling about the idea of treating organisms as analogous to artefacts, while at the same time recognizing them to be products of nature rather than

² The reading on which it draws is presented in Ginsborg 2001 and 2006.

³ Note that I am not proposing this as a full-blown analysis of the notion of function, but only as a partial analysis which is intended to make sense of the contrast between functions and side-effects. There is more to the notion of a function than a trait which a thing must have to be as it ought, as can be seen when we think of whole organisms: a squirrel which cannot climb trees is defective, but it is implausible to hold that climbing trees is its function (cf. Godfrey-Smith 1994, 349). Many proposed accounts of functions, including Kitcher's, are in the same position. While the point cannot be pursued here, I think that the goal of a full-blown analysis is unrealistic, since almost all concepts -- not just philosophical ones -- resist analysis (for a classic discussion, see Fodor 1981, 284-288). However, unlike Millikan 1989 (289ff), I do not think that the correct alternative, in the case of the notion of a function, is to offer what she calls a "theoretical definition," i.e. the kind of definition we give when we say that water is H₂O.

⁴ See for example the defence of Kant's "analogical" approach to biological teleology in Breitenbach 2009.

design. What is it to think of organisms *as if* they were produced by design, if not to think -- as both we and Kant denied that we should -- that they *were* produced by design? The idea that organisms can be characterized in normative terms is, as I see it, the answer to that puzzle, and I take it to be Kant's answer as well. We treat organisms as analogous to artefacts precisely by taking them to be governed by normative constraints, and it is these normative constraints which we express when we characterize their parts and behaviour in functional terms, or, in Kant's terms, regard them as "purposive." So while we might indeed say that the function of the heart is to circulate the blood because it is as if designed in order to circulate the blood, this would be a circuitous way of expressing what I take to be the essential significance of the functional ascription, namely that a heart which circulates blood is not merely doing something, but doing what it should be doing.

II

An obvious objection to my suggestion is that talk of what a biological trait or entity "ought" to do is just as problematic, and for the same reason, as talk of what its function is. How can we make sense of the idea that the heart ought to circulate the blood⁵ without supposing that it was consciously designed, or intended, to circulate the blood? Indeed this reference to intention, or at least conscious thought, seems to be built into the locutions "is meant to" and "is supposed to," which are typically interchangeable, in regard to organisms and artefacts, with "ought to" and "should." When we say the fan is meant to, or is supposed to keep the computer cool, so that when it does not keep the computer cool it is not doing as it ought, it seems clear that we are referring to what the designer in fact intended. So don't these locutions in a biological context carry the same implication?

It will be helpful to approach this question by distinguishing our use of the term "ought" in connection with artefacts and (perhaps illicitly) in biological contexts, from two other uses of the term.

⁵ I am using locutions of the form "X ought to Y" as shorthand for the more longwinded "In so far as X Ys, it is doing as it ought," although the latter are more idiomatic, and I suspect (for reasons which I will not go into here) that there are philosophical reasons to prefer them.

One of these uses applies exclusively to rational beings, and picks out, correspondingly, a kind of normativity which is directly associated with reasons. We use the term in this way in practical contexts when we talk about what a rational agent ought to do, or perhaps more precisely, what she ought to intend. The same use is manifested in theoretical contexts when we talk about what a rational thinker ought to believe. In these contexts the term "ought to" can typically be paraphrased directly as an attribution of reasons: to say that someone ought to act in a certain way or to form a certain belief is to say that she has good or conclusive reasons for the action or belief. This use can be uncontroversially described as normative. The other use I want to mention applies to phenomena of all kinds, and is typically used either to express predictions or to convey that something might be, or might have been predicted. We say for example that the weather ought to be sunny tomorrow, that the train ought to be here any minute, or that the poison ought to have taken effect by now. This use is typically not thought of as normative, although it might be indirectly paraphrased in terms of reasons for belief: to say, on this use, that something "ought" to have happened is, plausibly, to say that there was reason to predict that it would happen.⁶ The use of "ought" with which we are concerned is different from both of these. When we talk about what the fan or the heart ought to do, or are meant to do, we are not saying that they have reasons to do such-and-such; we are not treating them as rational agents or subjects of belief. But nor are we predicting what they will do, or claiming that such predictions are or were reasonable. We might indeed say that the fan ought to make white noise, meaning thereby that it is reasonable to predict that it will, but this does not imply that it ought to make white noise in the sense with which we are concerned: conversely, to say that it ought to cool the computer (in that sense) does not imply that there is reason to predict that it will.

What are we saying, then, when we use the "ought" locution in connection with artefacts? Although we are not ascribing reasons to the artefacts, it still seems on the face of it that there is something normative about the locution, and in particular that it registers a norm or standard by which the artefact, or the relevant part of the artefact, is subject. This is indicated in part by the possibility of

⁶ [See JJT]

saying, for example of a fan which does not cool the computer, that it is defective or malfunctioning. However, it might be argued that no normativity is in fact being ascribed. Perhaps all we doing is characterizing a feature of the conception which is causally responsible for the artefact's production. To say, for example, that the fan ought to cool the computer is, on this line of argument, simply to say that the designer had the fan's cooling properties in mind when he or she included a fan in the overall design of the computer, and that the thought of those cooling properties was responsible for the fan's being there. And when we say that the fan is defective, we are making the purely descriptive claim that the fan does not in fact conform to the conception in the designer's mind which caused it to be in the computer. But I do not think that the apparently normative implication can be so straightforwardly eliminated. This is because, as I already suggested in considering the analogy between organisms and artefacts, I take the idea of design to imply that of normative constraint. Roughly: it is not sufficient, in order for something to count as designed, that there be a conception of the thing in a designer's mind, and that that conception be causally operative in the thing's production. It is required, in addition, that the designer recognize the conception as normatively binding on the thing. It is not enough for her to think of the fan's cooling the computer, and for that thought to be responsible for her including a fan in the design for the computer: she must, in effect, think that the fan *is to*, that is *should* cool the computer. We cannot make sense of an artefact as designed unless we suppose that the designer thinks of it in normative terms, as something which should or ought to be this or that way, and which will count as defective if it is not.

If that thought is correct, then there is after all something genuinely normative about the "ought" associated with design or intention. Relatedly, we can deny that the "ought" that applies to artefacts and their parts can simply be reduced to the notion of design. For such an attempt at reduction would be circular: we cannot make sense of the notion of design, I have argued, without appealing to the idea, albeit in the designer's mind, of how the designed object ought to be. But this does not on its own defuse the objection, for it can still be claimed that the notions of "ought" and intentional design⁷ are mutually

⁷ I use the expression "intentional design" even though, as the criticism of Kitcher's view in part I indicates, I think it is pleonastic.

dependent. Even if the notion of design presupposes that of how something ought to be, the question remains of how we can intelligibly ascribe "oughts" to objects that are not brought about by design, and more generally how we can speak of how things ought to be without supposing that they were, or are, intended to be that way.

I want to try to address this question by appeal to a notion which I have discussed elsewhere under the name of "primitive normativity."⁸ If I am right in thinking that the notion of primitive normativity makes sense, then its possibility shows that we can intelligibly ascribe "oughts" without corresponding intentions: more specifically, that we can intelligibly characterize natural phenomena as being or not being as they ought to be, where the "ought" is normative rather than that associated with reasonable prediction. This does not directly warrant our characterizing organisms in normative terms. But it does remove what I take to be the major conceptual obstacle to our doing so. Once we recognize, from the kind of case which I'm about to describe, that there can in principle be oughts without intentions, that is, natural oughts, then we need no longer have a bad conscience about regarding other natural phenomena -- in particular biological phenomena -- in normative terms as well. The strategy here is again a Kantian one. It corresponds to the move which Kant makes from the principle of nature's purposiveness for our cognitive faculties -- which I interpret as the assumption of a normative relation between the natural capacities responsible for our cognition of nature, and nature as an object of cognition -- to our entitlement to help ourselves to the notion of purposiveness in order to make sense of one specific domain within nature, namely the biological domain.⁹ But again, I will not attempt to defend the attribution here.

The notion of primitive normativity, while not itself Wittgensteinian, is most easily introduced in the context of a point which is emphasized by Wittgenstein, about the way in which our use of language, and relatedly our grasp of concepts, is conditioned by our proto-cognitive dispositions to react to the

⁸ See Ginsborg forthcoming.

⁹ The key passage is from section VI of the First Introduction: "because we already have a ground for ascribing to nature in its particular laws a principle of purposiveness, it is still possible and permitted, if experience shows us purposive forms in its products, to ascribe these to the same ground on which the first rests" (218). For some discussion of how this passage relates to the line of thought I am characterizing here, see Ginsborg 2006.

world, dispositions that are sometimes referred to as "ways of going on." The locus classicus of this point is §186 of the *Philosophical Investigations*, where Wittgenstein considers the case of the pupil for whom it comes naturally to continue the series "2, 4, 6, 8... 1000" with "1004." Part of the moral of this example is that our being able to grasp the meaning of the expression "add 2" and, relatedly, to grasp the concepts both of addition by 2, and of addition more generally, depends on our having the natural reactions which we, in contrast to the pupil in the example, in fact have -- in other words, on our having a natural tendency to "go on" with "1002." Wittgenstein compares the case of the pupil to that of someone who naturally responds to a pointing hand by looking in the direction from fingertip to wrist. Our understanding of the hand as pointing in the direction that it does -- an understanding that is crucial for the possibility of ostensive learning -- depends on the contingent fact that we do not react to it in the aberrant way described in the example. The examples here can be multiplied indefinitely, in particular for all of the responses that are responsible for our sorting objects in the ways that we do, and which we tend to describe as "finding similarities" among things. A child who had no natural tendency to group together things of the same colour or shape, but who instead was inclined to sort in "grue"-like ways (finding it natural, for example, to sort blue cubes with green spheres, and blue spheres with green cubes) would not be able to acquire concepts like *green* and *blue*, at least not in any normal way.

To this Wittgensteinian point I want to add a further claim: that, in exercising our natural tendencies to react as we do, we not only react, but also take our reactions to be appropriate to the contexts which engender them. We do not merely feel ourselves impelled to say "1002" after "1000," as if in the grip of a compulsion to produce that number and not some other, we take the numeral "1002" to fit the preceding sequence; that is, we take it that, in saying "1002," we are going on as we should or ought. Similarly, when we look in the direction of the pointing finger, we take ourselves to be reacting appropriately: we are conscious of our reaction as "called for" by the hand, and not as merely elicited by it. We are thus ascribing normativity to our natural reactions, taking them to be as they ought to be with respect to what we are reacting to. But -- and this is a crucial point -- I want to claim that this ascription of normativity does not derive from, but rather makes possible, our grasp of the corresponding concepts

and hence our cognition of the objects or situations to which we are responding. The child's sense, when she puts the green cube with the other green cubes, that this is where the cube "belongs," or where she "should" or "ought to" put it, is not based on her having recognized that the cube is green and that she is sorting it with the other green cubes. That she has this sense of appropriateness is rather, like the natural tendency itself, part of the conditions for her grasping the concept *green* in the first place. So I take this awareness of normativity itself to be immediate, as opposed to being based on an inference from the applicability of a concept. Relatedly, the normativity she ascribes to her reaction is "primitive." The idea of responding as she ought which is implicit in her attitude cannot be reduced to, or explicated in terms of, that of responding in a way which conforms to an applicable rule.

What is the character of the "ought" which figures in the attitude which I have described, and, in particular how does it relate to the three senses of "ought" I distinguished earlier? We can rule out, I think, that it is the non--normative "ought" which I associated with prediction. It might indeed be reasonable to predict that someone continuing the series of even numbers up to "1000" will go on with "1002," but this is not required for us to be able to take ourselves, when we say "1002," to be going on as we ought. But, although less obviously, I think we can also rule out that it is the "ought" through which we ascribe reasons to a rational agent or epistemic subject. That is, the thought that "1002" is appropriate is not the thought that we have reason to say "1002," whether we conceive of the possible reasons here as practical or theoretical. Someone continuing the series might indeed take it that she ought to, in the sense of having a practical reason to, say "1002" after "1000." Perhaps she knows that if she does so, she will please her teacher or pass a test. But she need not take herself to have such a reason in order to find "1002" the appropriate thing to say. She may indeed have a reason not to say it -- perhaps she has reason to annoy, frustrate or tease her teacher -- and she may think, as a result, that she ought not to say "1002." But that is compatible with her continuing to take it that "1002" is the appropriate response, or in other words that her pre-reflective inclination to say "1002" -- her "natural reaction" to the series -- is as it ought to be. Turning now to theoretical reasons, someone might be aware, in saying "1002," that she is expressing a belief which is rationally justified, for example that 1000 plus two is 1002. So she may

ascribe to herself a theoretical reason for saying "1002," a reason which she could express by means of a very simple arithmetical proof. But her awareness of "1002" as appropriate to the preceding series does not depend on her appreciation of such a reason. Indeed, as in the practical case, she may take the belief that she would express by her utterance of "1002" to be false, and a fortiori unjustified, for example if she has been deliberately and explicitly following the rule "Add two up to 1000 and add four thereafter." In that case, her saying "1002" would express the claim that $1000 + 4 = 1002$, and there would be no theoretical reason supporting that claim. But she can recognize this and still take it that "1002" represents the appropriate continuation of the series of numbers as such. The point illustrated by these examples -- which I can here do little more than gesture at -- is that the primitively normative "ought" applies not to the intentional actions or beliefs of a rational agent or epistemic subject, but rather to the natural reactions of a human being responding to her environment. These natural reactions can indeed amount to, or express, actions and beliefs, and, correspondingly, the human being responding to her environment can also be viewed, and can view herself, as a rational agent and epistemic subject governed by rational norms. But this is possible only in virtue of the fact that, so to speak as a human being rather than a rational agent or subject, she takes her natural responses to be appropriate in the pre-rational sense I have described. It is only in virtue of her taking this more primitively normative attitude to them that her responses can come to have intentional content and thus to be the kinds of items to which the "ought" of reasons is applicable.

We now have a basis for responding to the objection raised at the beginning of this section. According to that objection, we can make sense of how something ought (in a normative sense) to be, only if we either understand that "ought" as the ought of rationality, or if we suppose that the thing was intended to be that way by an intelligent designer. This rules out, according to the objection, the ascription of oughts to natural phenomena, and in particular to organisms and their parts and traits. But according to the line of thought I have sketched, the possibility of intentional content, and a fortiori of cognition, depends on our being able to take a normative attitude to at least some natural phenomena -- specifically, our own precognitive responses to the world. So, if cognition is to be possible, the

ascription of (normative, non-rational) "oughts" cannot presuppose the assumption of design. What I am suggesting here is something like a transcendental argument for the intelligibility of natural normativity in general, which can then be deployed to defuse an objection to the application of norms to biological phenomena. The argument shows that we must regard one particular class of natural phenomena -- what I have called our pre-cognitive responses to the world -- in normative terms. From this it emerges that the kinds of "oughts" that we are tempted to invoke when we try to understand biological phenomena -- when we say, for example, that a heart which does not circulate the blood is not functioning as it ought -- cannot be ruled out simply on the grounds that the phenomena to which they apply are natural rather than the product of design. There may still be objections to the use of "ought" in a specifically biological context, but they do not include the objection that the relevant notion of "ought" implies that of design or intention.¹⁰

III

The argument presented in the last section might be challenged on the grounds that it licenses the ascription of norms -- and thus, according to the account in section I, of functions -- not only to the parts and traits of organisms, but everywhere in nature. If the indispensability of our ascriptions of primitive normativity to our own proto-cognitive natural reactions entitles us to apply normative notions to hearts, ribosomes and grooming behaviour, then why not also to clouds in weather systems, mutant DNA sequences in tumours, and, for that matter, falling rocks?

¹⁰ Gary Banham objects, to my (2006) ascription of this line of argument to Kant, that it "requires it to be the case that we are in some sense designed to view organisms as designed, a view that appears dangerously circular" (2008, 438). Banham's characterization does not strike me as accurate: the view does indeed require that we are "as if" designed to respond to, and thus view, the world around us in certain characteristic ways rather than others, but the point is not that we are "as if" designed to view organisms as "as if" designed; rather it is that the requirement to view our own responses to the world in terms of "as if" design licenses, or at least removes an obstacle, to our viewing biological phenomena in the same way. There would be a genuine threat of circularity in the argument if the awareness of normativity in our own responses depended on the kind of biological "ought" in question: if, for example, we took our response of '1002' to be appropriate on the grounds that it is the response characteristic of a healthy human being with faculties (including psychological ones) in good working order. But it is a part of the "primitive" character of the awareness of normativity that it does not rest on conceiving oneself as an organism subject to biological norms.

This challenge mistakes the aim of the argument, which was to remove a conceptual obstacle in the way of normative ascriptions in biology -- namely, the thought that we cannot ascribe oughts without intentions -- and not to provide a positive argument for their legitimacy. The argument does indeed imply that we can legitimately ascribe appropriateness to the kinds of natural reactions which figured in our examples, but it does not imply that we are entitled to any other specific claims to appropriateness, for example, that a heart which circulates the blood is functioning as it ought. It aims to conclude only that such a claim cannot be rejected, as a matter of principle, on the grounds that it presupposes that the heart was designed. Now it might be suggested here, by way of objection, that oughts without intentions are intelligible only in the special case of our own natural reactions. Although we may have to assume the intelligibility of oughts without intentions in order to make sense of the possibility of cognition, no inference is available to the intelligibility of oughts in other contexts. But here the burden of proof is on the objector, to show that ascriptions of natural oughts outside the cognitive context are not only false or unjustified, but also unintelligible or self-contradictory.

Another way of making the same point is to note that the argument of the previous section, while aiming to establish the intelligibility of ought- -- and thus, on my account, function- -- ascriptions to natural phenomena, does not commit us doing so in any particular circumstances (beyond the core case of our own natural reactions). My approach to function ascriptions thus differs from the etiological and causal role approaches considered earlier, both of which do require us to ascribe functions to phenomena which satisfy a certain set of naturalistic criteria. On a causal role view, it is sufficient for something's having a function that it contribute in a certain kind of way to the activities of a certain kind of system. Such a view, depending on how it is articulated, can commit us to ascribing functions, say, to clouds in weather systems; and that is one of the problems of the causal role approach. Similarly, etiological views require us to ascribe functions to items which have a particular causal history. This again, as we have seen, can be a problem for such views. For example, as we saw in section I, it is a *prima facie* objection to Wright's view that it requires us to ascribe a function to the gas leak which renders the scientist unconscious; and views which make specific reference to natural selection are vulnerable to examples

where past selection pressures are responsible for biological traits regarded as no longer having a function. But while these views do generate a difficulty about over-liberal ascription of functions, that difficulty does not arise for my account.

In response to this, my approach might be challenged from a different angle. If my account does not offer specific empirical criteria for function ascription, and, relatedly, does not claim to legitimize any specific aspects of our practice of ascribing functions (for example that we ascribe them to elements of biological systems but not weather systems), then what light does it shed on the notion of a function? Shouldn't we expect, from an account of biological function, that it offer criteria for function ascription by appeal to which our actual applications of the term "function" can be justified? I have offered one criterion, namely that if X does Y we are entitled to regard Y as a function of X only if, in doing Y, X is doing as it ought. But, leaving aside the difficulty (shared with other theories) that this offers at most a necessary condition for function ascription,¹¹ it can be objected that we are no less in need of criteria for determining when Y is what X ought to do, than we were for determining when Y is the function of X. What is needed, roughly speaking, are naturalistic criteria, such that it is a matter of empirically discoverable fact whether we are entitled to apply the notion of a function in a given context.

Here I want to claim that it is an advantage rather than a limitation of my analysis that it does not provide such criteria. For this allows it, like Kitcher's view, to respect the diversity of criteria which biologists in different areas invoke to justify ascriptions of function. It is true that it also leaves open -- and this is something which Kitcher does not intend -- that the notion of function could conceivably be applied to natural phenomena that are not biological. This again, however, seems to me to speak in favour of the analysis. I do not think that a philosophical analysis of the notion of function, even one intended to do justice specifically to the use of the term "function" in biology, should rule out in advance that we might encounter non-biological phenomena for which functional characterizations turn out to be scientifically indispensable.

¹¹ See note 3.

This is not to deny that there can be any philosophical account of the circumstances in which function ascriptions are or are not justified. One such account, which is compatible with the analysis I have suggested and which, like that analysis, is broadly Kantian, would link the justification of function ascriptions with the demands of understanding.¹² We are justified in ascribing functions, on this account, when doing so is necessary in order to arrive at a satisfactory understanding of the relevant phenomena. In the case of a weather system, we can understand its behaviour satisfactorily if we grasp the underlying physical regularities concerning, for example, the effect of temperature on the movement of air masses, the conditions under which water evaporates and condenses, and so forth. (Prediction, notoriously, is another matter.) This does not require us to conceive of any of the elements of the system in functional or normative terms: while we might have to recognize that clouds have a tendency to produce rain under a certain range of circumstances, we do not need to entertain the further thought that it is one of their functions to do so, or that they ought to do so. But in the case of biological phenomena, it is at least arguable that a full understanding requires us to invoke normative notions. We might indeed understand an individual organism as an assemblage of inorganic molecules governed by physical and chemical laws, and if we could have enough information about the arrangement of the molecules we might even be able to predict its behaviour at one time from our knowledge of its state at a preceding time. But we would be missing something about it if we did not understand it also as a system of organic parts (a brain, lungs, heart, arteries and so forth), and, again at least arguably, this requires understanding of these parts not only as having tendencies to do various things (pump blood, make a noise, add to the total body weight) but also as meant to do them, or as malfunctioning when they fail to do them.

Furthermore, philosophers might be able to offer substantive answers to the question why -- assuming the account just sketched is correct -- our understanding of biological phenomena is unlike our understanding of meteorological phenomena in requiring the use of normative notions. For example, it is reasonable to suggest that this is due to their incomparably greater complexity. Perhaps, because of this complexity, organisms present us with such a diversity of empirical regularities that our only possibility

¹² I sketch such an account in my 2001.

of comprehending them is to distinguish, as a proper object of study, those regularities in fact tending towards the maintenance of the organism. And perhaps we can treat those regularities as privileged, for the purpose of scientific enquiry, only by thinking of them in normative terms. It might also be suggested, that where we discover such complexity in nature, it could only be as a result of some process like natural selection, so that, as a matter of fact, we will only be entitled to use functional concepts in domains where natural selection has operated.

But -- and now I am returning to the objection -- it seems to me to be not only undesirable but also unnecessary to try to build any of these substantive proposals into an account of what we mean by "function," that is, into a philosophical analysis of the notion of a function. That is, we might, as philosophers, argue that functional ascriptions are justified only where an understanding of the phenomena calls for them, or, more specifically, in attempting to understand highly complex systems, or, still more specifically, in connection with the products of natural selection. But we should not, and do not need to, incorporate such criteria into an account of what functions are. As I see it, philosophers have attempted to offer specific theoretical accounts of the notion of a function -- for example in terms of the role of an element or trait in a containing system, or in terms of natural selection -- only because of the worry that, because of its apparent dependence on the idea of intentional design, the intuitive notion of function cannot legitimately be applied to natural phenomena. In the absence of this worry, there is no obvious motivation for offering the kind of naturalistic criterion for function-ascription which my analysis can be accused of failing to provide. For it can simply be assumed that biologists are using the term "function" in the sense with which we are familiar from talk about, say, artefacts.

Now if my analysis of the notion of function in terms of the notion of normativity were meant to compete with these theoretical accounts, so to speak, at the same level, then the objection would be well-taken. But the point of my analysis is not to offer an alternative to these accounts, but rather to counter the worry which motivates them in the first place. As noted, that worry derives from the assumption that the intuitive notion of function depends on that of intentional design. But, on my analysis, the crucial distinction between functions and side-effects is made out not in terms of intentional design, but rather in

terms of the notion of "ought." If, as I argued in section II, we can in turn make sense of oughts without intention, then the worry about the intuitive notion of function is addressed. This does not put an end to questions about the justification for any particular functional claim or set of claims, whether in biological science or elsewhere, and exploration of such questions might throw up an alternative reason for denying that biologists are using "function" in the intuitive sense. But, I have tried to argue, the supposed dependence of functional ascriptions on the assumption of intentional design is an illusion. Functional ascriptions in biology depend on the ascription of norms to natural phenomena, but there is nothing intrinsically objectionable about regarding natural phenomena in normative terms.

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