Wings, Spoons, Pills, and Quills
A Pluralist Theory of Function

Preston's "Why is a Wing Like a Spoon; A Pluralist Theory of Function"[1] contains misunderstandings of my theory of proper functions and of its relation to the notion she calls "system functions." I should like to clear some of this misunderstanding away, and at the same time show why "system function" is not a determinate notion and certainly cannot do the job Preston wants it to do in defining artifact functions.

After citing my Language, Thought and Other Biological Categories[2] (and only that) Preston sums up "function theorists" generally, remarking, "it is altogether common to assume that a theory of artifact function will simply fall out of the general theory of function now being articulated, even though this purportedly general theory of function is based on an examination of biological function" (p. 216). This comes immediately after remarking on my treatment in LTOBC that "[t]he one difference she notes [between tools and other things with functions] is that the proper functions of biological devices, language devices and representational mental states are not the result of purposive design, as are the proper functions of tools" (p. 215). Now I thought that that particular difference between artifacts and, for example, body organs, was apparently a huge difference, indeed, a seemingly insurmountable difference. Moreover, I believe a unique feature of my discussion of proper function in LTOBC was the care with which I tried to articulated the notions of derived and adapted functions (Chapter 2) in an attempt to show exactly how, despite first appearances, human purposes themselves have proper functions, and how a result of this is, first, that all human actions have proper functions, and then that artifacts have proper functions. The attempt to show exactly how such things as artifacts could be subsumed under the same notion of function as for language devices and biological devices was one of the central and most difficult tasks of LTOBC. Indeed, Preston engages in an extended critique of my way of doing this, clearly belying her claim that "[t]he nature of artifacts generally, and the nature of their functionality in particular, is taken to be so transparently obvious...that virtually nobody has bothered to examine it at any length" (P. 215). Dennett, of course, is another who has examined the nature of artifacts at some length.[3]

Nor was my "purportedly general theory of function ... based on an examination of biological function." Let me quote from the Introduction and from Chapter One of LTOBC:

> **Proper function is intended as a technical term. It is of interest because it can be used to unravel certain problems, not because it does or doesn't**

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[1] This journal, Volume XCV no. 5 (May 1998):215-254.

[2] (Cambridge MA: The MIT Press, 1984), hereafter LTOBC.

[3] See, for example, "The Interpretation of Texts, People and Other Artifacts," Philosophy and Phenomenological Research, supplement to vol. V (Fall 1990):177-194.

accord with common notions such as "purpose" or the ordinary notion "function." My program is far removed from conceptual analysis; I need a term that will do a certain job and so I must fashion one. (p. 2)

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I need [the definition of "proper function"] in order to talk about analogies and disanalogies among things belonging to quite diverse categories—body organs, tools, purposive behaviors, language elements, inner representations, animal's signals, customs, etc. ...the purpose being to make as explicit as possible analogies among categories of things, which analogies had struck me as useful to reflect on...the spirit in which I offer [the definition] to the reader is as a handle by which to grab hold of the analogies... If the analogies are really there, it will undoubtedly take time and an interchange of ideas before they can be explicated entirely adequately" (p. 38).

From these passages, and also from the definition I gave, and from my examples which were mainly of language functions in the early chapters of LTOBC, I thought it would be clear that the term "biological" in my title was used not literally, but broadly or metaphorically. It should be noted as well that the compound term "proper function" was my own coinage. I intended (as suggested at LTOBC p. 2) Webster's first meaning of "proper," which coincides with that of the Latin p<u>ropium</u>, meaning <u>one's</u> <u>own</u>.[4] Certainly nothing "judgmental" was meant here (Preston, p. 224), and if proper functions are capacities a thing "ought to have" (Preston, p. 224), then remember that the sky can also look "like it ought to rain tomorrow." Normative terms are not always evaluative, but can indicate any kind of measure from which actual departures are possible. For example, a numerical average is also a "norm." (These last two points are trifling in the context of Preston's essay and I mention them only because other commentators have misunderstood me in the same ways, resulting sometimes in serious confusions. Clearly, I should have been more explicit before.)

[4] LTOBC, p.2. The root is found, for example, in "property" and in the verb " to appropriate." "Functioning properly" is, of course, a perfectly ordinary English phrase, but there "proper" tends toward an evaluative meaning.

Preston's first serious error results from the assimilation, under her term "system functions," of the sort of functions Cummins had in mind in his classic paper "Functional Analysis"[5] to Gould and Vrba's "exaptations."[6] The categories "exaptation" and "adaptation," as defined by Gould and Vrba, are exclusive. If a thing has been selected for because it has had a certain effect, that effect is an "adaptation," and is <u>therefore</u> <u>not</u> an "exaptation." Cummins's functions, on the other hand, clearly include functions that a system was selected for performing. "Functional analysis in biology is essentially similar. The biologically significant capacities of an entire organism are explained by analyzing the organism into a number of 'systems'Cthe circulatory system, the digestive system, the nervous system, etc.Ceach of which has its characteristic capacities" (Cummins p. 760-61, quoted by Preston, p.220). Obviously many of the capacities of these systems were selected for and Cummins is well aware of that. But it is not <u>because</u> these capacities were selected for that he calls them "functions."

Having conflated Cummins functions with exaptations by calling both "system functions," Preston now claims that "Millikan's pluralist tolerance for system function should translate into a similar tolerance for exaptation, but in fact she is very critical of this notion, arguing that the vast majority of the phenomena taken to be exaptations are actually adaptations, that is, the functions in question are actually <u>proper</u> functions rather than system functions." But, of course, the claim that something is an adaptation rather than an exaptation has nothing to do with the question whether it has a Cummins function. All adaptations have (or once had) Cummins functions when they are given analyses in the context of appropriate biological systems. Thus I remain a staunch pluralist. There are (at minimum) two kinds of functions, Cummins's functions and proper functions, and lots of functions belong to both these kinds.

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[5] Robert Cummins, "Functional Explanation," this journal LXXII, 20 (November 1975):741-765.

[6] S. J. Gould and E. S. Vrba, "Exaptation: A Missing Term in the Science of Form," <u>Paleobiology</u> VIII (1982): 4-15.

Cummins functions are dispositions of parts of some designated containing system, or simpler dispositions of the whole system that, added together, account for some complex capacity one wants to explain. Exaptations are supposed to be Cummins-style functions where (1) the chosen capacity to be explained is how the system contributes to survival and proliferation of a particular species of organism, and (2) the capacity also happens not to be an adaptation. The crucial question for a theory of exaptations is not, as Preston supposes, how often and how soon exaptations become adaptations, but whether "contributes to the survival and proliferation of a species" is a well defined notion.[7]

In describing the general form that functional analyses take, Cummins himself mentions flow charts, circuit diagrams and computer programs. The most common uses we make of these items, however, is to describe how a system is designed, that is, quite literally, what someone designed it to do. Designed systems come with all kinds of specifications, both explicit and implicit, attached. They come with assumptions about what to count as parts of the system versus parts of the outside world or things accidentally dropped into the system; about what to count as appropriate background conditions in which the system is to operate; about what to count as appropriate input to and output from the system, about what to count as "state changes" within the system as opposed to damage, breakdowns or weardowns; about what to count as the system itself having a certain capacity versus some interference from outside the system's being partly responsible for someting it does; and so forth. Unfortunately, members of living species do not come with directions telling what is relevant to proper operation of the system rather than external to it or irrelevant. To be an exaptation, however, a thing must first of all be a part of the system under analysis. How do we determine what is to count as part of the biological system?

Let me first parody. Cats have an interesting capacity to walk that it would be interesting to have analyzed. But anaesthetized cats have exactly the same capacity, indeed, dead cats do, if strung up as puppets. If only the capacity to walk is in question, it is not logic that rules out attached puppet strings as suitable conditions for function and forces exerted on these strings as "input" while ruling in a surrounding atmosphere containing the right amount of oxygen, the right force of gravity and a surface underfoot that affords enough friction. To define a biological system it obviously is not enough to indicate a chunk of matter and an interesting capacity that it has. Which among the various ways that various members of the species might be maintained are relevant to a

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[7] See my White Queen Psychology, Chapter Two (Cambridge MA: The MIT Press, 1993).

biological system? An obvious beginning answer is that the appropriate conditions and input must characterize or have characterized various actual members of the species. Which actual members?

Given conditions that obtain in a modern hospital, the sounds that one's heart makes can easily become an operative part of a set of sufficient conditions leading to quick diagnosis and medical attention for a life threatening heart ailment, producing helpful "inputs" to one's system via needles and pills. Does this make these sounds exaptations? Similarly, if the heart emits a healthy sound, this may function immediately to focus medical attention somewhere else, failing which one's life might be lost. Do the conditions and inputs associated with modern hospitals count as appropriate ones in which to consider the species-maintaining functions of parts of human bodies? Have enough humans survived yet due to kidney machines to admit their presence and interference as allowable conditions for the human biological system to run in? How about penicillin injections or pills? Compare these conditions and inputs, for example, with what loving parents put into human infants. A carefully structured environment and proper input is necessary for the continued normal functioning of many biological systems. On what principled line then do we distinguish between "within" and "without" for the species-maintaining Cummins system, hence in what principled way do we define "exaptation"?

Nor is this sort of difficulty in delimiting the biological system's boundaries tied just to purposive interactions with such systems. Porcupines are occasionally saved from breaking bones when they fall out of trees (something which they do astonishingly often) by the springiness of their quills. Should we include this helpful disposition of their quills as an exaptation? Porcupines are especially fond of pine tree bark, hence when they fall out of trees, it is often on soft pine needles. Is their love for pine bark an exaptation to prevent harm when falling? Should we also include as exaptations the dispositions toward religion which sometimes result in bibles in breast pockets which stop stray bullets that would otherwise have killed soldiers? How frequently do such events have to occur in the life of a porcupine or a soldier to be exaptations? Why exactly that frequently?

Flow charts, circuit diagrams and programs typically describe systems that are purposefully maintained by humans in conditions that will not relevantly alter the materials of which they are made, and that are purposefully isolated from all but appropriate inputs. Their analyzed capacities correspond to purposes humans have for them and their analyzing capacities are how humans intend them to operate. For these reasons it is clear how they should be analyzed as having Cummins functions. A life system maintains itself. Often it does so, moreover, in an environment that changes in important respects both over the individual organism's lifetime and from generation to generation. The question what counts as part of the "species-maintaining" Cummins system as opposed to helpful but accidental interference from outside, has no determinate answer for

such systems.

Systems described by flow charts, circuit diagrams and programs generally fulfill their assigned capacities deterministically, so that if the system does not break down, the capacity is always realized. Many important capacities of animals, on the other hand, are stochastic capacities. The hunting behaviors of predators typically enable them to capture prey only some of the time. The eye blink reflex protects the eye from damage only once in a while, usually being triggered unnecessarily. If we set aside whether a capacity has been selected for, and also whether it is required to help fulfil another capacity that has been selected for, there is no principled way to distinguish among such capacities whether to count them within a species-maintaining Cummins system or not. Nor will it help to require that each member of the continuing species use a stochastic capacity some of the time. The basic needs of the organism are often met in alternative ways. What serves a certain function often is not actually necessary to its accomplishment. A domestic cat may never successfully employ either its ability to see prey in the dark or its ability to fish, making a good living none the less, by daytime mouse hunting, perhaps, and by charming people. For animals that learn or reason out ways to do things, if one path to "species maintenance" is blocked, another will be taken instead. Many humans have survived in part because they have learned to hang warm clothes from their shoulders, but if they didn't have shoulders they would attach the clothing some other way instead. The capacities to see prey in the dark, to be a shoulder clothes hanger, and so forth, are thus not necessary to species maintenance. Do they count then as part of the Cummins-style system of species maintenance? Do shoulders have supporting clothes as one of their species-maintaining Cummins functions or not? If they don't, does the pancreas also not have as a species- maintaining function the production of insulin because in its absence people take insulin by injection?

My conclusion is that there can be no well-defined notion here unless without principle, by arbitrarily stipulating some percentage of individual lives in some stipulated population that must have happened to be furthered by a candidate exaptation. And even so, it is not clear how to deal with the things that have sometimes been useful but were none the less entirely dispensable. And because there is no such thing as <u>the</u> Cummins functions associated with maintenance of a species, there is no such thing as <u>the</u> exaptations associated with it.[8]

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[8] Formore careful reflections on this matter, see my "Bio-functions: Two Paradigms," forthcoming in R. Cummins, A. Ariew and M. Perlman, eds, <u>Functions in Philosophy of Biology and Philosophy of Psychology</u> (Oxford: Oxford University Press).

The only way to place non-arbitrary limits on what counts as part of a biological system is to bound it with adaptations, with proper functions. Only Cummins functions that either are adaptations or support adaptations are sensibly treated as belonging to biological systems. That was the conclusion of my 1993 chapter on exaptations with its "expanded" notion of proper function that Preston decries. She herself ignores all problems concerning delimitation of the biological system. She also ignores the restrictions I placed on these "expanded" proper functions, namely, that they must be functions of reproduced parts of the same organism.[9] I now think Preston is right, however, that it would be better not to treat these expanded functions as varieties of proper function for the other reason she gives. The notion of a proper function was introduced as a tool for understanding purpose and failure of purpose. If an item has been selected for producing some effect, production of this effect can be held up as a measure or norm from which departures are possible. But my expanded functions were not selected for, hence they fail to exhibit this most essential property of proper functions.

Most important, Preston has thoroughly misunderstood my notions "adapted proper function" and "derived proper function." These are not add-ons to my original definition of proper function, and they are not established "without any history of reproduction" (p. 233) or through some kind of equivocation in the notion of selection. Let me try to explain.

Consider the perceptual, cognitive and behavioral systems of an organism. These mechanisms, I have argued, have proper functions.[10] These functions are performed by altering the relation between the organism and the environment as needed so that the environment will provide appropriate conditions and inputs for the organism. Some of these functions involve changing the environment to fit the organism, some involve changing the organism to fit the environment, and some involve changing merely spatial relations between organism and

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[9] Preston claims, for example, that my expanded definition of "proper function" will give human noses the function of holding up eyeglasses. Her idea is that eyeglasses, having continued to be reproduced because they helped people see better, have making people see better as a proper function, and a normal condition for performance of this function is the presence in the right place of a human nose. But this ignores the restriction I gave on those normal conditions that were to have proper functions, namely that they were to result from reproduced structures of the same organism. I suppose it might be possible to define a "species-maintaining" Cummins system for eyeglasses that would require humans in the environment for its operation, but this system would not be a human organism, nor would it be this system that was responsible for reproducing noses. She has not shown then that on my definition it is any more a proper function of my nose to hold up my eyeglasses than it is a function of a dog's stomach to provide shelter for roundworms. For further discussion, see my "Bio-functions: Two Paradigms."

[10] White Queen Psychology, Chapter Two.

environment, or involve some combination of these three. The characteristic systems that are employed in coordinating states and happenings between organism and environment have relational proper functions of one kind or another. That is, their job is to make it the case that the organism and the environment bear some particular relation to one another. Their job is to create relational structures.

As with any other proper function, a relational proper function of a mechanism corresponds to an effect that ancestors of the mechanism have historically had that accounted for their selection. In this case the effect was creation of an abstract relational structure. Consider a photocopier. Does it do the same thing every time you use it? One time it turns out a manuscript on Frege, the next time a picture of Marilyn. But the important thing is that it turns out, every time, something that looks like your original. In this sense it does the same thing every time. Its effect is always production of the very same abstract relational structure, namely, sameness between the pattern of surface marks on what is in its scanner and what is in its output tray.

In order to produce this relational structure, to effect that this relation exists, it does not need to produce both relata. It produces only one of the relata, but in such a fashion as to effect the existence of the designated relation. Nor is there any cheating here. No device can produces an effect, a result, a product, ex nihil. Every function performed is performed using materials of some kind, using properties of materials already at hand. Producing a relational structure by being guided by one relatum to produce the other is as legitimate a form of producing as producing a wooden spoon by choosing a piece of wood and carving it.

The example I originally used of a mechanism with a relational proper function was the chameleon's pigment rearranging mechanism.[11] Its function is to produce the relational structure skin-bearing-the-same-color-as-its-background for the chameleon, a further proper function being, of course, to prevent predators from seeing the chameleon. To create this relational structure, the mechanism effects changes in the chameleon but not in the environment. Other animals effect production of similar relational structures by moving into parts of the environment that match them, that is, by changing the spatial relation between themselves and the environment. And likely there are animals that change the environment, say, the surroundings of their nests, in order to produce this kind of relational structure.

[11] LTOBC, chapter 2.

There are a great number of relational structures besides those involving sameness relations that mechanisms may have as proper functions to produce. I have argued that any mechanism whose job is to produce a representation of fact (or to produce an "indicative intentional icon"Ca more general category than that of representations of fact) has as a proper function to produce a relational structure.[12] An accessible example that I keep repeating is the mechanisms that produce the dance of the honey bee. The job of these mechanisms is to produce a relational structure having a location of nectar as one relatum and a certain aspect of the pattern of the dance as the other. The relation in question is the one given by the abstract function (mathematical sense of "function") describing the semantic rules for the B-mese used by the particular species of bees. In most species, an angle that the dance pattern movement marks out relative to aspects of the hive always bears the same definite relation to the angle of the location of nectar relative to hive and sun. The properly functioning dance mechanism always produces exactly the same thing, namely, this designated relational structure.

I have also argued that any mechanism whose job is to produce a representation of a goal (or to produce an "imperative intentional icon"Ca more general category than that of representations of goals) has as a proper function to produce a relational structure.[13] An accessible example, once again, is the bee dance, which is both indicative and imperative.[14] The mechanisms that produce bee dances have as a further proper function, beyond producing the dance, to send watching fellow worker bees off in a certain direction. The relational structure thus produced has as relata (1) the angle that the dance pattern marks

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[12] LTOBC, chapter 6.

[13] LTOBC, Chapter 6.

[14] It is a "pushmi-pullyu representation." See my "Pushmi-pullyu Representations," in James Tomberlin, ed., Philosophical Perspectives vol. IX (Atascadero CA: Ridgeview Publishing, 1996): 185-200. Reprinted in Mind and Morals, ed. L. May and M. Friedman (Cambridge MA: The MIT Press 1996):145-161.

out relative to aspects of the hive and (2) the angle in which the watching bees fly relative to the hive and the sun. In this case, the mechanisms create this relational structure by making changes not in the organism itself but in its environment—changes not in the bee itself but in the bee's fellow workers. As a result of producing, first, the proper dance/nectar-location structure, the properly functioning dancing-making mechanism later effects always exactly the same thing, namely, existence of this second relational structure between angle of dance and angle of flying workers. (This requires the right environment, of course, one in which there are well-functioning fellow workers available. Their presence is an historically "normal condition" for managing to perform this function.)

Where the proper function of a trait is to produce a series of effects each causing the next, on the definition of proper function that I gave it is also the proper function of each stage to produce the next stage. So what we have here is the production of one relational structure—dance/nectar-location—having as a proper function the production of another—dance/direction of flying. Finally, and as a logical result (given Euclidean geometry), one more relational structure is produced, namely, workers flying toward nectar. This is typical. Proper functional relational structures typically do their jobs by producing further relational structures that eventually produce a relation between organism and environment yielding conditions or inputs the organismic system needs. Sometimes the whole process involves changing only the environment, and sometimes only the organism, but sophisticated relational proper functions typically involve both. They also typically cooperate with other structures having other relational proper functions, such as the bee dance producers' cooperation with answering mechanisms in fellow worker bees, which mechanisms could be given a similar relational analysis.

The general picture, then, is of proper functional processes that involve series of interweaving stages each of which is an abstract relational structure, some moments in these processes producing changes in the organism, others producing changes in the world, but involving always the exactly the same relations, although among different relata each time they are run. They are reproduced invariant processes, always the same when described in the way that explains how they work, that is, what their relevant Cummins functions are, yet different in their elements each time. It was to simplify the description of these complex relational structures and processes that I introduced the terminology "adapted proper function" and "derived proper function" in LTOBC. I intended this merely as useful nomenclature. It is not an addition or a set of extra clauses widening or narrowing the original definition of "proper function," but merely a way of talking more easily about phenomena that had already been captured by that notion, given that traits and mechanisms can have relational proper functions.

When a mechanism has a relational proper function, it may produce one of

the relevant relata while the other relatum is not affected but either (1) remains the same or (2) undergoes its own independent course of development. A simple example of (1) is the chameleon's pigment arranging mechanism which changes he chameleon's color while the color of the background remains the same. A simple example of (2) I take from Brian Smith.[15] Suppose that a species of sunflower not only tracks the sun, but continues to move when the sun goes behind a tree so as to catch up with it on the other side. Here the mechanism produces changes in the organism designed to maintain a certain organism-environment relation, and does so as the environmental relatum is changed, but not, of course, by the flower. Similarly, the relational structure that consists in the retinal image of a male hoverfly mapping the position and angle of approach of a passing female has as an eventual proper function production of another relational structure consisting in the male's intercepting the female.[16] As with the sun and the sunflower, the female is (as yet) unaffected by the male. Only a change in the direction of flight of the male is effected.

Now examine the relatum that is actually produced by a mechanism with a relational proper function. Consider the brown skin produced by the pigment arrangers of the chameleon sitting on a brown background. The job of the pigment arrangers is to produce the relational structure, skin-color-matching-its-background. But neither relatum, brown background nor brown skin, is an operative part of an historically normal set of sufficient conditions explaining the capacity of the chameleon to become camouflaged. Either relatum might have been replaced, and so long as the other was similarly replaced, the chameleon would have been properly camouflaged. Being brown is not an operative part of a normal set of sufficient conditions for performance of any of the chameleon's functions. Neither the relatum produced nor the relatum to be matched has a proper function nor, notice, any kind of Cummins function either. Not all by itself! Only the whole relational structure has either kind of function.

However, given that brown is the color of the background, the job of the pigment rearrangers is certainly to make the skin brown. I call this kind of job an "adapted proper function" of the mechanism. Turning the skin brown is not usually a proper function of the mechanism, and it will not remain a proper function of the mechanism when the chameleon no longer sits on something brown. However, right now, given that it is on a brown background, it is an

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[15] Brian C. Smith, The Origin of Objects (Cambridge MA: The MIT Press, 1996).

[16] For details, see my White Queen Psychology, Chapter 11 .

adapted proper function of the mechanism to make the chameleon brown. Turning the skin brown is a proper function of the mechanism "as adapted to" the brown color underneath. It is not of course a simple, but only a conditional proper function of the mechanism, an "iffy" proper function, but the "if" part has been asserted.

The product produced by a device performing an adapted proper function I called an "adapted device." The chameleon's brown color is an adapted device. It is not, of course, brown itself that is an adapted device, but only the brown skin color of a chameleon produced in the right way in the right circumstances. Thus Preston is certainly right that we don't want to move, for example, from the premise that a certain English word token has a function derived from its particular speaker's intention to the conclusion that the English language has changed (p. 237). But the idea that derived proper functions are, as she rather misleadingly puts it, "established for particular exemplars" clearly is not "inconsistent" with the notion that all proper functions "essentially involve a selection history" (p. 234).

Now ask about the functions of the relata themselves in a proper functional relational structure. The proper function of a whole relational structure, as was said, is often to produce another relational structure. The bee-dance mechanism produces the relational structure, dance-mapping-the-location-of-nectar, a proper function of which is eventually to produce another relational structure, worker-bees-heading-toward-nectar. The nectar, of course, is and remains an independent relatum (nor, of course, is it reproduced by the biological system) so taken by itself, it cannot have a proper function derived from that mechanism. But the other relatum, the bee dance, is produced by the mechanism in accordance with an adapted proper function: it is an adapted proper function of the mechanism, as adapted to the location of the nectar, to produce a certain bee dance, one that maps this location. Further, it is an adapted proper function of the dance-producing mechanism to produce, as a result, a certain direction of flight in fellow worker bees. Is it also a proper function of the dance itself to produce this direction of flight?

The answer may at first seem to be *no*, for it seems theoretically possible, at least, that the particular bee dance has no ancestors. Perhaps no bee in the bee's lineage ever danced this particular dance before, because there never happened to be nectar located in this particular direction from their hives before. Then this particular bee dance, having never occurred in the past, certainly could not have been selected for any effects that it had, hence could not possibly have any proper functions.

But this overlooks a principle that is fundamental. Because bee dances that map different directions are different from one another does not mean they are not also the same. The original and the Xerox copy may be different colors because colored paper was used for one but not the other, but the manuscript about Frege, or the picture of Marilyn, is the same. What is of interest is whether

there is *a* sameness among the dances such that they are all able to do something that is the same, and whether that very something is what their ancestors were selected for doing.

The various dances of a given species of bees are very much the same, indeed, to an untutored observer, hardly discriminable. And when they function in the way that has accounted for the natural selection of their producers and of their answering mechanisms in other workers, they always do exactly the same thing. They produce a direction of flight that is a given function (mathematical sense) of certain aspects of their form—in every case exactly the same function of that form. In LTOBC I put this rather awkwardly by saying that they have ("direct") proper functions which are adapted to their own concrete forms.[17] I am not sure that I have put it less awkwardly here. But the phenomenon itself is really quite easy to grasp. The bee dance has been selected in part for its capacity to cause other worker bees to be guided in their direction of flight by its form. In this respect, all bee dances (of the same species) have exactly the same proper function. Strictly speaking, this function is a relational proper function. The dance's job is to cause the workers to fly in a direction that bears a certain relation to itself.[18]

Because of this relational proper function, depending on the particular form of the bee dance, it has as an adapted proper function to cause worker bees to fly in some particular direction, say, south-south-west—just as the relational proper function of making the chameleon's skin match its background results in an adapted proper function to turn the skin brown when the chameleon is sitting on something brown. I have called this kind of function a "derived proper function," derived originally from the proper function of the dance-producing mechanism. It is derived from the particular form of the bee dance which is itself an adapted device, derived from the adapted function of the dance-producing mechanism as operating in a certain context. All derived proper functions are adapted in the same sort of manner.

In LTOBC I generalized this idea:

> **The proper functions of adapted devices are derived from proper functions of the devices that produce them that lie beyond the production of these adapted devices themselves. I call the proper functions of adapted devices "derived proper functions." (P. 41)**

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[17] Chapter 2 and elsewhere.

[18] For example, LTOBC, p. 42.

I was not careful to distinguish in this particular passage between proper functions of adapted devices that are relational but not derived from the producer's particular adaptor (e.g., the function common to all bee dances) and those that are not relational and are derived from the producer's particular adaptor.[19] I had in mind the latter kind. Indeed, an adapted device <u>described</u> <u>qua adapted</u> is different from other adapted devices derived from the same producer but in different adapting circumstances. And I emphasized that the interesting thing about derived proper functions is that things that have them can be things that are "quite new under the sun." That is, I meant things with adapted proper functions as being named or described in accordance with their adapted aspects (they point in different directions, they are different colors) not the aspects that make them like their ancestors (they are all bee dances, they are all pigmented skins of chameleons). Things with derived proper functions, then, are individual things, not lineages or types of things. It is the brown color of this chameleon that has a derived proper function, not brown itself, indeed, not even brown chameleon skin color, for maybe someone painted a chameleon brown.

[19] I distinguished these in the pages immediately following, however.

Against this background, I argued in LTOBC that there could be relational proper functions that produced adapted devices themselves having relational proper functions, producing more adapted devices having further relational proper functions, to any degree of nesting, and that out of this sort of structure could come things (tokens) seemingly very new indeed under the sun but that still had derived proper functions. I argued that in this sort of way, human desires have derived proper functions derived from the mechanisms designed to form concepts (adapted to the individual's experience[20]) and then to form desires (adapted to other aspects of the individual's experience) and that the derived proper function of a desire is to get itself fulfilled (a relational function). (Reminder: that a thing has a proper function does not imply that it is likely to perform that function!)

Further, if the desire is to produce a certain result by means of making, for example, a certain tool or producing a certain sentence, then a derived proper function of the tool (token) or the sentence (token) is to produce this result. Thus it happens that artifacts have as derived proper functions the functions intended for them by their makers (contrast with Preston: not their users). I also argued that learned behaviors have the results that effected their having been learned as proper functions, direct proper functions when the learning is by trial and error, otherwise derived.

Notice, by contrast, that Preston's analysis of artifact function has the peculiar result that artifacts have no functions except in the sense that they may function as, say, a hammer or a screwdriver in someone's hands, and no function unless they have actually been reproduced on account of serving this function. So if I carefully design and make a new sort of implement for the purpose of opening cans, but nobody ever actually uses it, there is no sense whatever in which it is a can opener, or in which its function is to open cans. But surely its purpose, at least, is to open cans, and purpose is what proper functions were

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[20] For details, see my "A Common Structure for Concepts of Individuals, Stuffs, and Basic Kinds: More Mama, More Milk and More Mouse", Behavioral and Brain Sciences 22.1 (Feb 1998):55-65. Also in E. Margolis and S. Laurence eds., Concepts: Core Readings (Cambridge MA: The MIT Press, 1999). Also see my "Author's Response: With Enemies Like this I Don't Need Friends" Behavioral and Brain Sciences 22.1 (February 1998):89-100, and my On Confused Ideas (Cambridge University Press, forthcoming).

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originally supposed to cast light on. My claim in LTOBC was that artifacts can acquire proper functions either in Preston's way, that is, "directly," or through the maker's (not the user's) intentions, or in both ways. I also emphasized the possibility not only of shifts in proper function but also of conflicts in function when items have more than one source of function.

It should be clear from the above discussion that the way one describes the things that have proper functions, and the way one explains how a derived function is derived, makes a great deal of difference. Sloppy descriptions of these matters will get one into a lot of trouble—as they have Preston. Preston herself claims that in talking about these matters, the descriptions under which one considers various functional items doesn't matter because "there is a whole range of levels of abstraction on which such explanations may move, and which level is appropriate depends on our specific explanatory interests" (p. 235). This is a serious misunderstanding. What counts as a correct description of a proper-functional trait and what counts as the historically normal explanation for its proper functioning, hence as the historically normal conditions for its proper functioning are, ontologically, completely determinate matters, regardless of how difficult the epistemological issues become. These descriptions and explanations concern the actual historical selection pressures and historical causal mechanisms that produced the effects selected for in successful ancestors. The description of these causal mechanisms has to be one that applies univocally to all of the ancestors. There cannot be separate descriptions for separate ancestors, or there is no proper function but merely an accidental change in the gene pool. Indeed, it also matters very much how traits and mechanisms are described in order to ascribe Cummins functions to them—something that Preston overlooks as well.

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