1. Introduction

Synthetic organisms are thoroughly engineered organisms. Synthetic biology makes use of genetic and other materials derived from modern biological life forms to design and construct organisms.[1] Among recent, high-profile events in the field are the genomic (or chromosomal) reconstruction of a Mycoplasma bacterium and its transfer to a host bacteria cytoplasm to run the cell (Gibson et al. 2008; Gibson et al. 2010; Lartigue et al. 2009), as well as the engineering of bacteria to produce the precursor to artemisinin, an effective but relatively scarce anti-malarial drug traditionally derived from wormwood plants (Ro et al. 2006). Other synthetic organisms (perhaps, more properly called artificial organisms), are not constructed from parts of existing biological organisms, but from non-biological or pre-biological materials. Researchers at Los Alamos Laboratory have reported creating "self-replicating cells assembled from nonliving organic and inorganic matter (AAAS 2010)," and a research team at Harvard Medical School has constructed proto-cells from fatty molecules using nucleic acids as the source code for replication (Szostak Lab n.d.; Mansy et al. 2008). The vision for both research programs is to "engineer living-technologies, which will be robust, autonomous, adaptive, and even self-replicating (AAAS 2010)."

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[1] There are a number of definitions of synthetic biology. Here are two that are representative:

Synthetic biology is "1. The design and construction of biological parts, devices and systems, and;

2. the redesign of existing, natural biological systems for useful purposes (Synthetic Biology Group, 2009)."

"Synthetic biology is a new research field that seeks to modify existing organisms to perform useful functions and to design and synthesize artificial genes and complete biological systems (COGEM, 2008)."

Synthetic organisms are at the same time organisms and artifacts. In this paper we aim to determine whether such entities have a good of their own, and so are candidates for being directly morally considerable.[2] On the one hand, non-engineered biological organisms such as plants and bacteria can be benefited and harmed in straightforward ways. Pouring acid on a plant or a bacterium harms it, providing nutrients and access to sunlight benefits it. These benefits and harms are benefits and harms to the individual plant or bacterium, independent of the aims and interests of others. This is just to say that they have a good of their own, and we must ask whether and how to take their good into account in ethical deliberations -- i.e. whether they are directly morally considerable. On the other hand, traditional artifacts do not seem to be the types of entities that can be benefited or harmed in and of themselves. While it is bad for a laptop to fall to the ground, this is because it constitutes a bad for its owner, not because it is a harm to the laptop itself. Artifacts do not appear to have a good of their own, and therefore do not appear to be candidates for direct moral considerability.

So, what are we to make of synthetic organisms? Do they share the features of traditional organisms in virtue of which they have a good of their own? Or, are they like artifacts in the relevant respects and thereby lack such a good? We approach this question by identifying what grounds the good of traditional, non-sentient organisms, and then determining whether these grounds obtain as well for synthetic organisms.

The best account of the good of non-sentient organisms is that such organisms are teleologically organized, goal-directed systems. Insofar as this goal-directedness can be

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[2] Following Goodpaster (1978), we are using the term 'moral considerability' in a technical sense to pick out a particular species of moral status. It is the moral status an entity has when it (a) has interests and (b) those interests are morally relevant (i.e. should be taken into account in moral deliberations).

explicated in ways that are independent of the interests of others, these entities will have a good of their own. We defend an etiological account of teleology on which non-sentient entities have such a good. On this account, the goal-directedness of an (non-sentient) entity is given by the selection process from which it results. Furthermore, the content of this good can be given in terms of what will promote or frustrate the achievement of their goals.

If teleological organization is sufficient for having a good of one's own (what we will call the *sufficiency thesis*), synthetic organisms will also have a good of their own, since they are so organized. However, there is a complication with this line of argument. Most artifacts--not just those that are also organisms--are also teleologically organized. For example, thermostats are organized toward accomplishing an end, regulating the temperature of a space. Thus, this approach to grounding the good of an entity appears to have the counter-intuitive implication that (nearly) all artifacts have a good of their own. There are three possible ways to respond to this implication. One might reject the etiological account of teleology; reject that teleological organization is sufficient for an entity having a good of its own (i.e. reject the sufficiency thesis); or accept the conclusion that artifacts have good of their own. We argue that the last of these—accepting that artifacts have a good of their own—is the best justified option.

2. Non-sentient Organisms

We claimed above that naturally occurring, non-sentient living things (from here on, *non-sentient organisms*) have a good of their own.[3] What we mean by this is that they can be

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[3] By "naturally occurring" we mean independent from human design, manipulation, and control. Naturalness so conceived comes in degrees. Deep sea organisms are more natural than suburban deer, which are more natural

benefited or harmed, and that this benefit and harm can be understood without reference to the good of any other entity. In claiming this, we are asserting that these entities have interests. It is in the interest of a sugar maple to get sunlight and not be exposed to acid rain, for example. These things are in its interest even if nothing cares about the tree, is benefited by it, or even knows about it. In this section, we explicate this claim and defend it by providing an account of the interests of non-sentient living things on which their interests are neither arbitrary nor reducible to the interests of others.

2.1 *Having an interest vs taking an interest*

That non-sentient organisms have interests is often contested. For example, Peter Singer (1977; 1989) argues that sentience is a necessary condition for having interests. A non-sentient entity cannot be aware of itself, so it cannot, even in a minimal sense, care about its own good. However, it is important to distinguish between the claim that 'S has an interest in X' and 'S is interested in X.' 'S is interested in X' requires cognitive capacities. To claim that S is interested in X is to claim that S has attitudes or desires regarding X, which requires being aware of X. We are not suggesting that non-sentient living things can have attitudes regarding anything. We are claiming that there are things that are in their interests (or good for them). So while cognitive capacities are necessary for an entity to have an interest in something, it

than genetically modified crops, for example. In referring to naturally occurring non-sentient organisms we mean to pick out almost all non-sentient organisms, but to exclude highly engineered organisms, such as non-sentient synthetic biological organisms.

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doesn't follow from this that cognitive capacities are necessary for something to be in an entity's interests.[4]

Still, in order to make the case that non-sentient organisms have a good of their own, an account of what grounds their good needs to be provided. That is, there must be an explanation for why acid rain is bad for maples and sunlight is good for them. If there is no such explanation, then any assertions about what is good or bad for them are arbitrary. Moreover, since they lack cognitive capacities, the explanation cannot trace back to their caring or wanting (or otherwise taking an interest in) anything. It cannot be that acid rain is bad for maples because it defoliates them in late summer and maples do not like to lose their leaves before autumn. The account also cannot depend on the attitudes of others – e.g. that people like maples to hold their foliage late in the autumn. If it does, then the good at issue will not be the maple's, but that of the valuers'. Thus, if non-sentient living things have a good of their own, it must be grounded independently of the aims, desires, interests, and intentions of sentient beings.

2.2 *An etiological account of teleology*

In this sub-section we argue that non-sentient organisms are teleologically organized – they are goal-directed systems with parts and processes with ends, purposes, and/or functions. Prior to Darwin, design and teleology were prominent parts of scientific descriptions of

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[4] Taylor (1989) and Varner (1998) appeal to this distinction in their defense of the moral considerability of non-sentient organisms. Feinberg (1963) also recognizes that there is a sense in which plants may have interests, but he believes they are interests only in only an attenuated sense.

organisms and their parts. However, in a Darwinian world--one where organisms are shaped by the unintentional process of natural selection--design, teleology, purpose, and function of non-sentient organisms and their parts strikes many as out of place.[5]

Nevertheless, there is a naturalistic understanding of non-sentient organisms as teleologically organized entities that is possible precisely because of Darwin's theory of natural selection. *Etiological accounts of function* appeal to *selection etiologies*—i.e. casual explanations of the existence of a trait in terms of the consequences that trait brings about—to ground teleological facts about organisms.[6] Natural selection preserves parts and processes *because* of the consequences they bring about. It isn't merely that flowers produce nectar and this attracts organisms that spread its pollen, rather nectar is produced by flowers for the purpose of/in order that/with the goal of attracting organisms that will spread its pollen. Nectar

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[5] Sentient organisms that take actions and behave in ways that help realize their aims and desires are teleologically organized towards those ends. This kind of psychologically oriented teleological organization gives rise to psychological interests. Still, the internal parts and processes of sentient organisms, which they have no control over (except in rare cases), are not teleologically organized because of their aims and desires. This kind of teleological organization can be understood as biological teleological organization. The account we give of the biological teleological organization of non-sentient organisms also applies to this aspect of sentient organisms.

[6] Williams (1996) employed an etiological account to describe the functions of organisms, but Wright (1973) was the first to explicitly develop a general etiological account of functions. Millikan (1989; 1999), Neander (1991; 2008), and Mitchell (1993) have revised and defended etiological accounts of biological function and explored the roles these functions play in grounding teleology.

production is a trait that is selected for and exists in current plants because of the

consequences it brought about in those plants' ancestors.[7]

A variety of other (i.e. non-etiological) accounts of functions have been developed that

are consistent with the Darwinian worldview. These accounts define the functions of parts and

processes in terms of, for example, the role they play in the system of which they are a part

(Boorse 1976), the contribution those parts and process make to the achievement of the goals

of an organism (Cummins 1975), or the contributions parts and processes make to the fitness of

an organism (Bigelow and Pargetter 1987).[8] What is common to these accounts is that they are

a-teleological. None of them ground claims about the purposes of parts and processes of an

organism. The accounts are merely descriptive; they define a function by the role it plays or a

property it confers, but do not, and do not attempt to, ground a part or process's having a

purpose or goal. In contrast, etiological accounts of functions ground teleological claims about

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[7] There are other evolutionary forces such as drift that influence the evolution of any trait. However, selection will

be sufficient for grounding teleological organization despite other forces. It is also possible that some traits that

seem to confer great advantage to an individual were never selected for, or are useful for purposes that they were

not selected for. To simplify things, we assume for the sake of our examples that there was selection for the traits

as described. For example, we assume that nectar production was selected for attracting pollinators.

[8] For an overview of the various accounts of function, see Wouters (2005).

purposes, ends, and aims in a selection process. A trait that has been selected for is there in the

organism to serve a certain purpose.[9]

Whether the etiological account of function or some other account is correct is a subject

of continued debate. Some of the main objections to etiological accounts of function are

considered in Section 4.1. However, much of the debate arises due to the belief that there must

be a single correct notion of function. For example, Larry Wright (1973), the first to fully

develop an etiological account of functions, was concerned with providing a unified analysis of

'function' such that anything satisfying its conditions was a function and anything not satisfying

those conditions was not. However, due to the wide variety of contexts in which function

ascriptions are made (e.g., evolutionary biology, molecular biology, anatomy, medicine,

engineering), the wide variety of aims of the inquires in those contexts, and the wide variety of

purported counterexamples to functions of each kind (several of which are discussed in 4.1), it

seems implausible that there would be an analysis of function that would capture every

function ascription accurately (and nothing else). Therefore, rather than defending the

etiological account (or any other account) as the sole acceptable notion of function, we endorse

pluralism about functions -- i.e. that there are multiple kinds of functions and different kinds of

function ascriptions are appropriate in different contexts. Something may have a function of

one kind because of the role it plays in a given system; it may have a function of another kind

because of the contribution it makes to accomplishing a goal; and it may have a function of a

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[9] Even critics of the etiological account concede this point. For example, Wouters (2005) admits that the etiological

account is suited to grounding teleology, but denies that the etiological account and teleology have any role to

play in the biological sciences.

third kind because of its etiology.[10] If pluralism about functions is correct, then assigning

etiological functions to parts and processes of non-sentient living things does not preclude that

these organisms (and their parts) may also have functions of other kinds. Furthermore,

providing a non-arbitrary account of the teleological organization of non-sentient living things is

a context where the etiological account of functions applies, since only the etiological account

of functions can ground teleology.[11]

The etiological account of functions, by grounding functions in selection processes, is

able to capture the teleological element inherent in some function ascriptions and to capture

the teleological nature of non-sentient living things. Indeed, etiologies of the relevant kind (in

the case of non-sentient living things, natural selection etiologies) ground teleological

organization independently of whether the analysis of 'function' in terms of etiologies is

correct. It is the goal directedness, the teleology that is generated by the selection process that

is significant for present purposes. Therefore, instead of using the term 'function', we will refer

to this naturalized account of teleology as the e*tiological account of teleology.*

2.3. *Teleological organization is sufficient for non-sentient organisms having a good of their own*

Selection etiologies of the parts and processes of an entity enable specifying their ends

non-arbitrarily and without appeal to the interests or desires of sentient entities. Therefore,

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[10] Sterelny (2006) and Odenbaugh (2010) endorse this kind of pluralism.

[11] We know of no viable alternatives that ground teleological organization non-arbitrarily and in a way that is
compatible with naturalism.

selection etiologies are sufficient for genuine teleological organization. Non-sentient living things are genuinely goal-directed systems because the parts and processes of the organism were selected for in their ancestors and thereby exist in the organisms for the purpose of realizing certain ends.[12]

Furthermore, if the teleological organization of non-sentient organisms can be explained non-arbitrarily and without the teleology being reduced to the aims, interests, desires, or goals of sentient beings, then non-sentient living things have a good of their own. Once non-sentient organisms can be understood as genuinely goal-directed systems, things can also genuinely be in their interest – what is good and bad for them (what benefits and harms them) can be specified in terms of those resources, conditions, and treatments that are conducive to or detrimental to the realization of their goals.[13] The relationship between teleological organization, an entity's having a good of its own, and the content of its good (its interests) is captured by the following thesis:

Sufficiency Thesis: If an entity is teleologically organized, then it has a good of its own (and the content of the good is provided by the teleological organization).

3. Synthetic organisms and artifacts

[12] Even though the selection process is historical, the trait persists as it does in current entities because of what it does in and for entities of that type (Crane and Sandler In Press).

[13] Cahen (2002) and Varner (1998) offer similar accounts of the good of non-sentient organisms, though Cahen does not commit explicitly to etiological functions being sufficient for such organisms to have a good of their own.

In the prior section we presented the following argument that non-sentient living things have a good of their own:

Non-Sentient Organisms

1. The parts and processes of non-sentient organisms have selection etiologies - i.e. they were selected for because they had certain consequences in the organism's ancestors.

2. If an entity's parts and processes have selection etiologies, then the entity is a teleogically organized (i.e. goal-directed) entity.

3. If an entity is teleologically organized, then it has a good of its own (and the content of the good is provided by the teleological organization).

4. Therefore, non-sentient organisms have a good of their own.

This argument seems to extend straightforwardly to synthetic organisms.[14] Synthetic organisms have parts and processes selected for because they contribute to certain goals, and are thus teleologically organized, goal-directed, systems. They thereby have a good of their own, the content of which is provided by their teleological organization. In this way, they

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[14] By synthetic organisms we mean non-sentient organisms that are designed and constructed though chemical synthesis by humans. Sentient synthetic organisms are possible, but we focus here on non-sentient organisms because (a) sentient synthetics are a long way off and (b) the mental capacities of sentient organisms make grounding their good, at least their psychological good, more straightforward than grounding the good of non-sentient organisms.

appear to have a good of their own in the same sense as non-engineered non-sentient living things.

However, the same reasoning also seems to apply to non-living artifacts (from here on, just "artifacts") such as tables, chairs, clocks, cars and bombs. Their parts and processes have the relevant causal explanations. There is a reason why a wheelbarrow has two handles set roughly three feet apart; there is a reason why a thermos has a lid; and there is a reason why cars have wheels. These parts were selected for, intentionally, because of the roles they play in achieving certain ends - the wheels are there because the car has the end of transport, and they function well when they play their selected role in accomplishing that end (and function poorly when they do not). It seems, then, that according to the line of reasoning defended above, all (or almost all) artifacts have a good of their own.[15]

Here is the analog of the above argument for the claim that artifacts have a good of their own:

Artifacts

1. The parts and processes of (almost all) traditional artifacts have selection etiologies - i.e. they were selected for by humans because they had certain consequences relevant to achieving our ends.

2. If an entity's parts and processes have selection etiologies, then the entity is a teleologically organized (i.e. goal-directed) entity.

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[15] "Almost all" because some artifacts may be byproducts or accidentally created. Insofar as these are artifacts, they are not teleologically organized.

3. If an entity is teleologically organized, then it has a good of its own (and the content of the good is provided by the teleological organization).

4. Therefore, (almost all) traditional artifacts have a good of their own.

The conclusion of this argument is counter-intuitive. While it may seem plausible that synthetic organisms have a good of their own, it seems less plausible that computers, cars, chairs, bombs and thermostats have goods of their own. Premise 1 of each argument is empirically accurate; premise 2 of each argument follows directly from the etiological account of teleology; and premise 3 is the Sufficiency Thesis defended above. Given that premise 1 is true (and the argument is valid), this leaves three options for responding to the Artifacts argument:

1. Reject the etiological account of teleology (premise 2).

2. Reject that teleological organization is sufficient for an entity having a good of its own (premise 3)--i.e. reject the sufficiency thesis by claiming that there is some distinction among teleologically organized entities that explains why some such entities have a good of their own while others do not.

3. Accept the etiological account of teleology and accept that teleological organization is sufficient for an entity having a good of its own—i.e. accept the conclusion that artifacts have goods of their own.

Each of these options, including its implications for the good of synthetic organisms, is discussed below.

4. Evaluating the Options

4.1. *Reject the etiological account of teleology*

In arguing that non-sentient organisms are etiologically organized, an appeal was made to the etiological account of functions. It was claimed that of the plurality of kinds of functions, only etiological functions could play the role of grounding teleology in non-sentient living things. Nevertheless, it may be that etiological accounts of functions are problematic in ways that require rejecting them even in the absence of any other basis for non-arbitrarily fixing the good of non-sentient living things. In this section, several objections to the etiological account of teleology are considered.

Soon after Wright published his etiological account of functions, Christopher Boorse (1976) raised a series of objections to it. Boorse's primary criticism is that Wright's account requires that we arbitrarily limit the power of different kinds of selection processes (e.g. artificial v. natural selection) to generate functions. If natural selection processes are taken to generate functions in artifacts, or if artificial selection processes are taken to generate functions in biological entities, the result will be function attributions that are strongly counter-intuitive:

Consider first a counterpart to evolutionary etiology for an artifact. Suppose that a scientist builds a laser which is connected by a rubber hose to a source of gaseous chlorine. After turning on the machine he notices a break in the hose,

but before he can correct it he inhales the escaping gas and falls unconscious.

According to Wright's explicit proposal one must say that the function of the

break in the hose is to release gas. The release of gas is a result of the break in

the hose; and the break is there - that is, as in natural selection, it continues to

be there because it releases the gas (Boorse 1976, 72).

He then considers a counterpart to an artifactual etiology:

A man who is irritated with a barking dog kicks it, breaking one leg, with the

intention of causing the animal pain. The dog's pain is a result of the fracture,

and the fracture is there because its creator intends it to have that result (Boorse

1976, 72).

These cases purportedly yield counter-intuitive conclusions: in the first case that it is the

function of the break in the hose to release gas and in the second case that it is the "function of

the fracture to cause the dog pain" (Boorse 1976, 72). If the function ascriptions follow from

the etiological account of teleology and cannot be explained away, they count against the

etiological account of teleology as a plausible way of grounding teleological organization.

While Wright's particular account may be susceptible to Boorse's criticisms, these

counter-examples can be avoided. First, consider the leaking hose. It is true in some sense that

the break in the hose is there because it releases gas. It is true in the sense that the break

persists because it leaks gas, but that is not why it *exists*. In natural selection, there is a

distinction between viability selection, selection for a trait because it enhances an organisms survival, and fertility selection, selection for a trait because it enhances an organisms reproductive fitness. The break in the hose is akin to viability selection, but this isn't the relevant kind of selection to generating teleology. The relevant sense of "there because" in generating teleology in organisms is the sense that means "exists because." To see why, consider again the nectar production in flowers. Nectar production exists in current flowers because it attracts pollinators. This is also why it will, probably, persist in future generations. But, these may come apart. Suppose that a new predator evolves that prevents flowers from producing pollen, eats their nectar, and kills any flowers that don't produce nectar. Consider the population of flowers that exist immediately after the introduction of this predator. Flowers that produce nectar persist because they provide food to the predator, but this is not the goal or the end of nectar production, it is merely a byproduct of the real goal-directed behavior of the flower to produce nectar to attract pollinators.

What about the case of the fracture in the dog's leg? This example trades on the idea that an artifactual selection process that involves any kind of intention and action is sufficient for generating teleology. However, this doesn't seem right. There is a difference between "the function of a thing is X" and "a thing functioning as X." It seems that an intention and action will make an artifact function as something. We may, in a hurry, decide to hold a door open using a laptop, such that the laptop *functions as* a doorstop. Yet, it seems plausible to deny that *the function* of the laptop is to hold the door open, or even that it is one of *the functions* of the laptop. We do not know of (and will not here offer) any well developed account of how action, intention, and other factors must relate to one another in the generation of the functions or

goal-directedness of artifacts. However, Boorse's counter examples require that almost any combination of intention and action generates artifactual functions. The discussion above suggests that this is an implausible account of artifactual selection processes; it is far too inclusive. Given this, the dog's fracture in Boorse's case is not clearly an instance of an artifactual function, and so not clearly a counter example to the etiological account of teleology.[16]

Another objection to the etiological account of teleology follows from the fact that, according to the account, intrinsically, qualitatively identical entities may differ with respect to (a) whether they have a good of their own and (b) the content of their good. That is, the etiological account of teleology violates the following equivalence theses:

Strong Equivalence: Two entities that are intrinsically identical are the same with respect to (a) whether they have a good of their own, and (b) the content of that good.

Weak Equivalence: Two entities that are intrinsically identical are the same with respect to whether they have a good of their own.

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[16] There are cases where a dog's fractured leg may appropriately be understood as having the purpose of causing pain. Imagine a science experiment where a population of dogs is being experimented on with the aim of determining how it impacts the brain activity of the animal. All of the dogs have their legs broken and then are subject to fMRI scans. In this case, it seems plausible that the purpose of the break, its function, in each animal is to cause pain.

Synthetic organisms, even if intrinsically identical to some naturally occurring organisms, will come about via different selection processes.[17] According to the etiological account of teleology, the content of an organism's good depends upon the details of its goal-directedness, which in turn depends upon the selection process that gave rise to it. Thus, it is possible that what is good or bad for two intrinsically identical organisms (one naturally occurring and one synthetic) might differ--i.e. the strong equivalence thesis is violated.

To see how the weak thesis may be violated, consider instant organisms. An instant organism is an organism that is neither a product of any evolutionary process, nor the product of design, but rather the result of pure chance.[18] Imagine that an instant organism comes into existence that is intrinsically identical to a naturally occurring flower. According to the etiological account of teleology, the instant flower is not a goal directed system (because its parts and processes have no selection etiologies of the relevant kind), whereas it's intrinsically identical counterpart is goal directed (because the relevant etiologies obtain). Both flowers produce nectar, attract pollinators, photosynthesize, and absorb CO_2, for example. However, only the naturally occurring flower does these things with the goal or end of survival and reproduction; the instant flower merely does these things. Therefore, only the naturally occurring flower is teleologically organized and has a good – i.e. both the strong and weak equivalence theses are violated.

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[17] By intrinsically identical we mean qualitatively identical. They share all the same internal properties, behaviors, and dispositions, for example, but may differ in their relational properties.

[18] Davidson's (1987) Swampman is an example of an instant organism. See also, Dretske (1995).

The etiological account violates the equivalence theses; if the etiological account is true, the equivalence theses are false. But, how plausible are the theses? They are intuitive. It seems that two identical entities, doing the same sorts of things in the same environment ought to have the same good, regardless of their origins. However, there are other considerations that count against the equivalence theses. As we have argued, it seems that non-sentient organisms have a good of their own, and the etiological account of teleology is the best available account of this fact. If the equivalence theses are true and no alternative account of the teleological organization of non-sentient organisms is provided, we are left without any explanation as to whether and how non-sentient organisms have a good of their own.[19] Thus, to the extent that it is intuitive and plausible that non-sentient living things have a good of their own (e.g. that acid rain is bad and sunlight good for sugar maples) it is implausible that the sufficiency theses are true. Therefore, because it is plausible that non-sentient living things have a good of their own, the problems raised by the equivalence theses are insufficient grounds to reject the etiological account of teleology.

4.2 *Reject the sufficiency thesis*

There are substantial reasons to accept the etiological account of teleology, particularly in the absence of an alternative account of how teleology and, thereby, the goods of non-

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[19] If these objections (or others) are sufficient to show that the etiological account of teleology is mistaken, the question of whether synthetic organisms and traditional artifacts have a good of their own remains open. Without a principled account of the good of non-sentient organisms, it is difficult to say whether synthetic organisms share features that make them relevantly like non-sentient organisms with respect to having a good.

sentient entities are grounded. However, one might accept the etiological account of teleology, but reject the sufficiency thesis. This would be justified if there were some property (or set of properties) in addition to teleological organization that were necessary for a non-sentient entity to have a good of its own. If the additional property is possessed by natural non-sentient organisms, but not by non-living artifacts, then there are grounds to accept the Non-sentient Organisms argument, but reject the Artifacts argument.

There are many differences between artifacts and organisms. Organisms are living and artifacts are not; organisms are the result of natural selection, while artifacts are the result of artificial selection; and artifacts exist for our sake whereas organisms (largely) do not. In what follows we consider whether any of these differences are relevant differences, in the sense that they explain why some but not all teleologically organized entities have a good of their own. We also discuss the implications of each difference for synthetic organisms.

4.2.1 *Living vs. non-living*

One difference between natural organisms and (non-organism) artifacts is that the former are living and the latter are non-living. If this is a relevant difference between artifacts and non-sentient organisms, synthetic organisms will have a good of their own, since they are living things.

Does the living/non-living distinction explain why organisms have a good of their own and artifacts do not? Despite some intuitive appeal, it does not. The issue is that the reasoning in the Non-sentient Organisms argument seems to have the counter-intuitive implication the soda cans and cell phones have a good of their own, in the same sense as non-sentient

organisms. So, claiming that being a living thing is a relevant difference is a solution (in that it avoids the problematic implication). However, if no reasons as to why it is a relevant difference is given, then it is completely ad hoc and question begging. It just asserts that the difference at issue, which appears not to be relevant, is relevant.

Is there any justification for thinking that the living/non-living distinction is relevant, and so not just an ad hoc, question-begging response? Such a justification would have to appeal to some feature of living things that artifacts lack. But the most promising (and most often appealed to) internal features have already been considered -- i.e. that organisms are internally organized and goal directed (Taylor 1989; Varner 1998). Artifacts have these properties to the same extent as non-sentient organisms (natural and synthetic).

4.2.2 *Static vs dynamic*

A feature of organisms is that they are dynamic systems. They are responsive to perturbations, attempt to self-repair, and metabolize. Synthetic organisms are similarly dynamically organized. Therefore, if this is a relevant difference between artifacts and non-sentient organisms, synthetic organisms would have a good of their own.

Is an entity's being dynamic a plausible supplementary criterion to teleological organization for an entity to have a good of its own? Probably not. First, there are many traditional artifacts that are dynamic systems. Computers (being artifacts) do not metabolize, but they do depend on external resources (such as electricty) to operate; they respond to changes in their condition in order to maintain a certain range of states (for example, the CPU fan speeds up or slows down in response to changes in internal temperature); and they attempt

to preserve and repair themselves when they are exposed to potential threats or when damages occur (for example, detecting and removing potential viruses, quarantining contaminated files, and preventing hardware failures). The requirement of dynamic organization will rule out some artifacts from having a good of their own, but many others--e.g. cell phones, computers, cars, and thermostats--will still satisfy the condition.

Second, while it is true that all organisms metabolize and perhaps all respond to perturbations and attempt to self-repair, these last properties are the results of an evolutionary process. If things had been radically different, and there were no selective advantage to having these properties, living things might have evolved without being responsive to perturbations and without the ability to self-repair. If these things are organisms, it leaves only metabolic processes as the difference between organisms and artifacts, and it is unclear that "metabolic processes" is any different than a minimal condition for being alive, in which case this condition begs the question (as discussed in Section 4.2.1).

4.2.3 *Naturalness of origin*

We have so far considered differences between artifacts and organisms in themselves. Perhaps there are external differences between natural organisms and artifacts that explain why the former but not the latter have a good of their own. One candidate is that organisms and artifacts differ with respect to how or why they came to be as they are (discussed in 4.2.3). A second candidate is that the good of artifacts is in some way instrumental to, or in the service of, the good of others (discussed in 4.2.4). We discuss each of these possibilities in turn.

A common view among environmental ethicists is that an entity's being natural - i.e. independent of humans and connected to historical evolutionary processes - is ethically significant (Elliot 1982; Katz 1992; Rolston 1989; Preston 2008). Christopher Preston has argued that environmental ethicists that are committed to the ethical significance of naturalness in this sense are likely to be (and ought to be) opposed to synthetic organisms, since they "depart from a core principle of Darwinian natural selection - descent with modification - leaving them with no causal connection to historical evolutionary processes" (23). It has been argued elsewhere that this conclusion is not warranted (Sandler and Simons, In Press). At most, if there is value to naturalness, then some synthetic organism will be very low on (and may even have no) natural value (at least in the early generations), in comparison to more natural entities. Some synthetic organisms will consist of parts and designs that are the product of a natural selection process (Gibson et al. 2008; Gibson et al. 2010) and so may have some natural value, while others are more fully artificial (AAAS 2010). Is it possible that synthetic organisms also lack, in virtue of their artificialness (or non-naturalness) a good of their own (or possess it to a lesser degree)--i.e. is it possible that naturalness is a necessary condition for having a good of one's own?

Consider an idealized minimal organism, one that has been genomically reduced so that it has only the minimum amount of genes needed for survival, self-repair, and reproduction (Hutchison III et al. 1999). Even such a minimal organism has ends (survival, self-repair, and reproduction) toward which its parts and processes are directed. Moreover, it can be treated in ways that increase or decrease its capacity to pursue or accomplish its ends. If the nutrient source of a minimal organism is withdrawn, the capacity of the organism to pursue its ends is

diminished. This seems everything necessary to ground claims about what is harmful and beneficial for it; and it is difficult to see why it would be wrong to say that withdrawing the nutrient source is bad for the organism (independent of the effects that it has on others). Pointing out the naturalness of the selection process that gave rise to organisms of this type was of a particular sort seems irrelevant. If this is right, then naturalness is not a necessary condition for an entity's having a good of its own (whether the entity is an organism or not).

4.2.4 *The derivative nature of artifacts*

Another possible difference between naturally occurring, non-sentient, living things and artifacts that could explain why the former but not the latter have goods of their own is that artificial selection yields entity's whose goal-directedness is in some way derivative on the good of its creators or users.[20] In this section we consider whether the goal-directedness of artifacts is derivative in a way that the goal-directedness of organisms is not and, if it is, whether this is a relevant difference to their possessing a good of their own. We consider two different senses in which goal-directedness could be derivative: *explanatory derivativeness* and *use derivativeness*.

One sense in which the goal-directedness of artifacts is derivative is that in order to adequately explain the goal-directedness of an artifact, why its parts and processes are organized as they are to bring about some end, things external to those parts and processes must be cited. The intention of a clockmaker to create an accurate timepiece and the intention to use certain parts to accomplish certain goals is a crucial component of the explanation of the

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[20] For an example of this kind of view see Hale (2007).

goals of the timepiece and of the parts. The parts and processes of the watch are goal-directed, in part, because of those intentions.

While the goal-directedness of artifacts is derivative in this explanatory sense, it is not relevant to whether artifacts have a good of their own. The goal-directedness of naturally occurring, non-sentient, living things is also derivative in this sense. In order to adequately explain the goal-directedness of the parts of an organism, we must appeal to facts about the environment and individuals of other species that are co-present in their environment. To explain why the secretion of toxins in poison ivy is directed towards the goal of protecting the plant, we must appeal to the fact that this trait evolved because it discouraged other organisms from eating it. This explanation appeals to entities that would harm poison ivy plants to explain why the process of secreting toxins evolved. The explanations for the goal-directedness of many, if not all, teleologically organized entities will be derivative in this explanatory sense. Therefore, natural living things do not differ from artifacts with respect to their ends being explanatorily derivative.

The goal-directedness of naturally occurring, non-sentient living things and of artifacts are both explanatorily derivative. However, they seem to be derivative on different kinds of explanations. Goal-directed artifacts are the result of a directed selection process, one driven by human intention and with a final end in mind. Naturally occurring organisms result from an undirected selection process; nature does not have in mind anything, let alone a form or goal toward which it directs evolution of organisms. So, while the goal-directedness of artifacts and organisms are both explanatorily derivative, they seem to be derivative on different kinds of explanations.

The difficulty with appealing to the idea that the goal-directedness of artifacts is derivative on intentions in order to ground the distinction between organisms and artifacts is that this conflates the explanation for goal-directedness with the subject of goal-directedness. Even assuming that to explain the goal-directedness of artifacts, intentions must always be cited and that this is never the case with respect to organisms, it will not follow that artifacts are not the subject of goal-directedness.[21] To see this, consider a world where parents have the choice to genetically and environmentally predispose their offspring toward certain career choices. Assume that one couple produces an offspring that they predisposed in these ways to want to be a musician. Assume also that the child desires strongly to be a musician and takes steps to achieve this goal. There is a sense in which the explanation of this child's goals is derivative on the intentions of her parents. Still, the child is the one that is goal-directed. This shows that the goals of a cognitive being are a function of what that being aims at or desires, no matter the explanation for those desires and aims. The same is true in the case of the minimal organism described earlier. The explanation for why the minimal organism has the ends that it does certainly includes that those ends were intended by the organism's designer. Still, the minimal organism has its own ends and goals and so it's good is its own. It is a mistake to infer from the fact that the explanation for why an entity is oriented toward certain goals cites the intentions of others to the conclusion that the goals are not the entity's own. The explanation of goal-directedness is independent of the subject of goal-directedness.

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[21] Even this assumption is probably untenable. After all, the evolution of some beings will reference the intentions of other beings. The evolution of many non-sentient organisms will be influenced by the actions of intentional beings in their environment.

There is another sense in which artifacts are derivative. Organisms that evolved through natural selection are often used by others, including entities with intentions, as a means to an end. However, they are not created by others in order to be used by them. This is true even when species co-evolve in a mutual relationship. The individuals of one species may have the features that they do because it benefits the individuals of another species, which in turn provides some benefit to it.[22] However, this is different from individuals of one species creating the other for its own use. In contrast, artifacts are typically created by us to be used by us -- i.e. to help promote our ends. Does this preclude them from having a good of their own? If it does, then synthetic organisms engineered for human use would lack of good of their own.

There are cases that suggest that an entity's being created for a particular use does not preclude its having a good of its own, and that this applies to living things and so to synthetic organisms. For example, people selectively bred dogs to be ratters or shepherds--i.e. for human use--but it seems clear that breaking their legs would nevertheless be bad for the dogs (in addition to diminishing their utility). The same seems to hold for non-sentient living things that have been bred for human purposes. People have selectively bred blueberry bushes to be more productive and provide tastier fruit, but alkaline soil reduces their growth rate, hardiness, and resistance to diseases and pests (as well as their productivity)--i.e. it is bad for the bushes. The fact that a living thing is selected and created for a purpose does not imply that it cannot have a good of its own.

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[22] This will often be the case in symbiotic relationships between organisms of different species such as clownfish and sea anemones.

One possible response to this is that the matter is different for non-living artifacts than it is for living things. If this is the case, then synthetic organisms created for human use would not be precluded from having a good of their own, but coffee mugs and key chains would, for example. However, this response does not retain the 'for use' criterion as a basis for denying that something has a good of its own. Instead, it substitutes the living/non-living distinction for it. We discussed above (section 4.2.1) the difficulties with using that distinction as a basis for asserting that non-sentient living things have a good of their own, whereas artifacts do not.

Is the matter any different if the entity is created de novo, from scratch, as opposed to selected for from prior existing organisms (as with sheep dogs and cultivated blueberry bushes)? It is not. We argued above that both natural organisms and artifacts (and so, too, synthetic organisms) are explanatorily derivative. It is not possible to explain why they exist with the parts and processes that they do without appeal to external entities. We further argued that even when those explanations involved the intentions of others, this is immaterial to whether they have a good of their own. What is determinative is whether and how they are teleologically organized, not why they came to be that way. The case of an entity being created 'for use' is just a particular instance of this. That humans believe artifacts or synthetic organisms will be of use, and that this is why they create them, is relevant to explaining why and how they came into existence. However, it is not germane to whether they have a good of their own, once they are created. What matters for having a good of one's own is teleological organization.

4.3 *Accept the etiological account of teleology, accept the sufficiency thesis, accept that*

artifacts have a good of their own

The prior sections demonstrated the difficulties with appealing to either the kinds of entities that natural organisms and artifacts are in themselves or the selection processes that produce them to try to establish that organisms but not artifacts have a good of their own. If the etiological account of teleology and the sufficiency thesis are both true, then synthetic organisms have a good of their own in the same way and same sense as do non-sentient organisms and artifacts.

The idea that artifacts have goods of their own initially seems counter-intuitive. However, we sometimes speak in ways that are suggestive of this. It is not uncommon to hear people say, for example, that not changing a car's oil is bad for the car, or that water is bad for electronics. Many people may find these expressions to be elliptical, but perhaps they are not. Consider a world where humans have gone extinct. It seems plausible to think that states of affairs in that world can be good or bad for the artifacts left behind. It would be bad for our cast iron pans if they were left soaking in water, bad for our cars to rust, and bad for our computers to catch fire.

Perhaps the idea that artifacts have a good of their own is not entirely implausible, but we find the idea counter-intuitive because of the implications it might have. What is even more counter-intuitive than artifacts having a good of their own is that we might have to take what is good for artifacts into account in all our practical and moral deliberations. After all, artifacts are created to serve our purposes, and if we choose to act in ways that are detrimental to them, why should that matter?

However, it doesn't follow directly from the fact that something has a good of its own that we must take that good into account (Taylor 1989; O'Neill 2003; Sandler 2007; Cahen 2002).The etiological account of teleology may yield the conclusion that traditional artifacts have a good of their own, but it does not establish the moral significance of their good.

5. Conclusions and Implications

We have argued that etiology is sufficient for generating teleology, and that an entity's being teleologicaly organized is sufficient for its having a good of its own. An implication of this appears to be that, given the etiological account of teleology, non-sentient living things, synthetic organisms, and artifacts all have a good of their own. In making this argument we have considered all the plausible distinctions that we are familiar with (or could think of) that could be the basis for asserting that non-sentient living things have a good of their own, whereas artifacts do not. We found each of the possible relevant differences to be problematic or wanting. We therefore conclude that, if the etiological account of teleology is true, one ought to accept the implication that non-sentient living things, synthetic organisms, and artifacts all have a good of their own.

This conclusion is contingent on selection etiologies being the only source of teleology in (non-sentient) entities. This appears to be the predominant view among philosophers of science and the most prominent view among those who defend the view that plants have interests. Furthermore, we are not able to identify any plausible alternatives. Therefore, if one rejects the etiological account of teleology, one is left (so far as we can tell) with no account of how it is possible that non-sentient living things (e.g. trees) have a good of their own and no

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non-arbitrary way of specifying their good. One is also left without any criteria for determining whether synthetic organisms have a good of their own.

This conclusion appears to be something of a dilemma. On the one hand, if the etiological account of teleology is correct, then the counter-intuitive implication that artifacts have a good of their own appears to follow. On the other hand, if the etiological account of teleology is false, then we are left with nothing but speculation and arbitrary claims about the good of non-sentient living things.

However, the first "horn" of this dilemma is less sharp than it might appear. The fact that an entity has a good of its own does not determine how it is that human moral agents ought to regard or respond to its good. That is, it does not determine the entity's moral status. Having a good of one's own is necessary, but not sufficient for being directly morally considerable. Therefore, the conclusion that living things, synthetic organisms, and artifacts all have a good of their own does not imply that they each have the same moral status and that we ought to care about their goods equally or in the same ways. It may be that the good of artifacts make a weaker (or no) claim on us in comparison to the good of non-sentient living things. However, exploring the question of how human moral agents ought to respond to the good of different types of entities is beyond the scope of this paper.

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