Goal-directed systems and the good

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We can readily identify goal-directed systems and distinguish them from non-goal-directed systems. A woodpecker hunting for grubs is the first, a pendulum returning to rest is the second. But what is it to be a goaldirected system? Perhaps the dominant answer to this question, inspired by systems theories such as cybernetics, is (roughly) that goal-directed systems are distinguished by;their tendency to seek, aim at, or maintain some moreor-less easily identifiable goal. Cybernetics and the like would hold that physical systems subject only to physical laws can exhibit such behavior. If sound, this systems approach to teleology would unify a diverse range of goal-directed phenomena and neatly side-step many traditional bogey-men of teleology, such as anthropomorphism and future causation. Goaldirected phenomena would be a normal feature of the natural causal world that could be described in purely descriptive and quantitative terms, and receive (a distinctive variant of) ordinary causal explanations. Thus, the systems approach promises to provide a naturalistic-cure-descriptive account of teleology suitable for use in naturalistic accounts of other phenomena, including the intentionality of mental states and even selfconsciousness. [1]

This paper aims to show that, despite these advantages, the systems approach is fundamentally flawed; furthermore, its flaws can be traced precisely to its attempt to be quantitative, descriptive, and value-free.

1. The Systems Approach to Goal-Directed Systems.

The ability of systems theories like cybernetics to give efficient causal explanations of apparently goal-directed phenomena has been exploited to explicate the notion of being goal-directed.[2] The founder of cybernetics, Norbert Wiener, first attempted this, and many others have since made similar attempts.[3] By reference to the explication of goal-directed systems, additional relic notions, such as that of a function, are then explicated.[4] The general methodology followed by the systems approach is to identify the simplest systems-theoretic condition shared by all (and only) goal-directed systems.

Followers of the systems approach agree that goal-directed systems are, roughly, those systems that have a tendency to maintain a state (the "goal" state) in the face of external and internal perturbations. That is, a distinctive feature of goal-directed systems is that, when changes in the environment or system threaten to deflect the system from its "goal" state, the behavior of the system alters in such a way that the system restores its direction toward the state. Since not all goal-maintaining systems successfully maintain their "goal" states, the systems approach requires only that goal-directed systems oscillate around their goals or approach them asymptotically. There are two traditional behavioral signs of goal-directed systems: plasticity and persistence.s According to the traditional view, goal-directed systems are systems with the capacity for exhibiting a plastic and persistent range of behaviors that result in the production of the "goal" state. It is convenient to think of goal-directed systems in terms of the distinction between two kinds of forces (or variables). Deflecting forces deflect a system from its "goal" state, and restoring forces restore the system to its "goal" state. The behavior of a goal-directed system is plastic, then, if restoring forces can come in a variety of strengths and from a variety of directions; and its behavior is persistent if (within certain limits) deflecting forces are eventually balanced by equally strong and oppositely directed restoring forces. Or, as Nagel puts it, a system's behavior is plastic with respect to a goal state if it can reach the state by following alternative paths or starting from different initial positions, and its behavior is persistent with respect to a goal state if it can within limits adjust its behavior and respond to internal or environmental contingencies that threaten to prevent the realization of the state.'

A nice illustration of this approach to goal-directed systems is the biological system that keeps the concentration of water in the blood of mammals at about 90%.[8]The system has two main components: the kidneys, which remove water from the blood, and the muscles, which release water into the blood. If the organism drinks some water, perspires, or does something else that makes the concentration of water in the blood rise much above or sink much below 90%, then there is a corresponding change in the rate at which the kidneys take water out of the blood and the rate at which muscles release water into the blood. The direction and magnitude of these changes is such that, due to their combined effect, the system has a plastic and persistent disposition to maintain a narrowlycircumscribed goal state, so that, unless there is a breakdown in the system, the concentration of water in the blood constantly hovers near 90%.

2. Systems Diagnoses of the Equilibrium Problem.

Although the systems approach has been the target of many criticisms, with suitable modifications it can handle a wide variety of problems? But one problem continually recurs. Systems that nobody would think are genuinely goal-directed pass the systems tests for being goal-directed. The counterexamples are certain systems that tend toward some steady state or state of equilibrium; such systems can be called equilibrium systems. Some equilibrium states are states of rest, states in which all motion stops. A damped pendulum, for example, is an equilibrium system and its equilibrium state is the state in which the bob is motionless at the bottom of its arc. Other equilibrium states consist of regular cyclic motion, such as the constant swinging back and forth of the bob of a frictionless pendulum. Equilibrium systems exhibit persistent and plastic behavior with respect to their equilibrium state.

Some equilibrium systems are genuinely goal-directed. For example, the biological system that keeps the concentration of water in the blood at about 90% is an equilibrium system. However, many equilibrium systems are not goal-directed even though they exhibit persistent and plastic behavior with respect to a state that one can label the "goal" state. In addition to simple pendula, a familiar example of this is a marble inside a bowl. This system is not really directed to any goal, even though the system plastically and persistently pursues the "goal" state of keeping the marble in the bottom of the bowl. The behavior of the system is plastic, since the goal can be reached from many different directions and initial conditions; it is persistent, since the marble's behavior automatically adjusts if it is deflected from its goal. Similarly, a damped pendulum persistently and plastically pursues a "goal" state, if given impulses by gusts of wind. But the pendulum is no more goal-directed than the marble in the bowl. Equilibrium counterexamples are pervasive. Defenders of the systems approach admit that persistence and plasticity apply in "well nigh all processes in which some equilibrium state is restored," including a vast number that are not goal-directed. [10] Finding a condition that excludes non-goal-directed equilibrium systems can be called the equilibrium problem.

Some might be inclined to make the radical move of accepting all equilibrium systems as goal-directed, even pendula and marbles in bowls. But equilibrium systems are quite pervasive and all would be goal-directed, contrary to what common sense suggests. As Nagel admits, "the designation [of being goal-directed} would apply to well nigh all processes, so that the concept of being goal-directed would not be differentiating, and would therefore be superfluous." [11] Furthermore, defective or malfunctioning goal-directed systems would be directed to the wrong goal, because they would be pesistent and plastic with respect to the wrong state.

To accommodate these points, the defender of the systems approach might admit that goal-directedness is to an extent in the eye of the beholder, maintaining that a persistent and plastic system is goal directed only relative to appropriate human interest in the system. The difference between goaldirected systems and non-goal-directed equilibrium systems would then be whether anyone takes an interest in their "goal" state, whether it catches anyone's attention, or the like. But this view has a number of implausible consequences. [12]: First, the existence of goal-directed systems would be contingent on the existence of humans. Second, in fact people do not care about most goals of most. goal-directed systems. To put this point vividly, there are undoubtedly forms of life that are so far undiscovered and might well remain unknown forever, and nobody takes any interest in their goals. Third, someone might have an interest in an equilbrium system and its "goal" state without that system being goal-directed. Caring about whether a marble returns to the bottom of a bowl does not make the marble-plusbowl goal-directed.

So, the most promising strategy for those who would defend the systems approach is simply to frame an additional systems condition suitable to rule out equilibrium systems. The search for an appropriate condition would be guided by the idea that pendula and marbles in bowls are too simple to be goal-directed. Persistent and plastic behavior is goaldirected only in suitably complicated systems. Developing this line of thought, Nagel supplements the requirements of persistence and plasticity with the following condition:[13]

[S] The behavior of goal-directed systems is governed by "orthogonal" or independent variables; that is, within certain limits the value of a variable at a given moment is compatible with any value of the other variables at the same moment.

It is clear enough what Nagel means by two variables being independent. However, it is not so clear exactly which variables Nagel thinks must be independent in goal-directed systems. All the variables that affect the behavior of the system? Only the deflecting and the restoring forces? Only the separate components in the total restoring force? Different answers to these questions generate different interpretations of IS], each of which must be evaluated.

The most straightforward interpretation of IS] is that the variables that must be independent are simply the variables governing the system's behavior. This interpretation fits with Nagel's suggestion that [S] is a routine condition imposed to avoid redundant descriptions of systems, [14] This suggests the following condition to solve the equilibrium problem:

[S1] The system must be governed by at least two independent variables.

(Without at least two independent variables, the condition will be trivially satisfiable.)

Condition [S1] does rule out some traditional equilibrium systems, such as the marble in the bowl and a simple pendulum. [15] But the condition is still flawed; it lets in many systems that are not goal-directed. Consider some slightly more complex pendula, Which involve changes in either the length of the string holding the bob or the magnitude of the force of gravity. First, consider what we might call the rubber pendulum. The bob of this pendulum hangs from a rubber band which changes length as a result of local temperature fluctuations. One variable governing this system is gravity. A second variable is the length of the pendulum, which in this case is controlled fundamentally by the local temperature. Although the local temperature is partially related to gravity, it is not redundant information that can be derived from gravity, so local temperature and gravity are both needed to describe the system. Next, consider what we might call the balloon pendulum. This pendulum is suspended beneath a balloon that is floating in the atmosphere. As the altitude of the balloon fluctuates, so does the magnitude of the force of gravity on the bob. Since the balloon's altitude is controlled fundamentally by the local atmospheric pressure, and local atmospheric pressure cannot be derived from gravity, the balloon pendulum is controlled by two independent variables. The rubber pendulum and the balloon pendulum exhibit persistence and plasticity with respect to their equilibrium states, just as virtually all equilibrium systems do. Furthermore, they are controlled by at least two independent variables. Thus, they satisfy [S1]. But surely the rubber pendulum and the balloon pendulum are no more goal-directed than is a simple pendulum. Unpredictably varying a pendulum's length or altitude would not turn a pendulum that was not goal-directed into one that was. Thus, the independent variable condition does not rule out slightly more complicated counterexamples.

Note that [S1] does not just misclassify a few hypothetical systems imagined by an armchair philosopher. Complicated equilibrium systems abound. Most actual pendula in the real world are affected by (more or less significant) variables that change things, like the mass of the bob, the length of the pendulum, or the air resistance, and usually these variables are independent of gravity. So most actual pendula satisfy [SI]. There are lots of other complex equilibrium systems. For example, float a bowl containing a marble in a pond and let the waves rock it, or construct the marble of material that wears away or melts. Condition [S1] rules out only "ideal" or "frictionless" systems, and there are few of these in the real world.

Defenders of the systems approach can try to identify a different systems condition that the rubber pendulum and the balloon pendulum lack but genuinely goal-directed systems possess. They might observe that the rubber pendulum and the balloon pendulum are affected by a number of independent variables, but all the additional variables are extraneous to the goal-directedness of the systems. The systems have only one independent restoring variable--the force of gravity. By contrast, in the kidney-plusmuscle system, there are two restoring variables: the rate at which the kidneys remove water from the blood, and the rate at which the muscles release water into the blood. Each contributes toward the total restoring force. So, perhaps the equilibrium problem can be solved by requiring restoring variables to be independent, which leads to this condition:

[S2] The system must be governed by at least two independent restoring forces.

This condition excludes the rubber pendulum and the balloon pendulum. At the same time, it does not exclude the kidney-plus-muscles system and many other seemingly genuine goal-directed systems.

Upon examination, however, condition [S2] still fails to exclude slightly more complicated equilibrium systems. Consider what we might call the magnetic pendulum. The bob of this pendulum is made of steel and there is a magnet beneath the pendulum. The magnetic pendulum's behavior is plastic and persistent. Furthermore, when this pendulum is disturbed two independent variables govern the return of the bob to its equilibrium point: the force of gravity and the magnetic force. The magnetic pendulum behaves as if goal-directed, as do all equilibrium systems, but it is no more genuinely goal-directed than the others. Merely adding a magnet will not turn a pendulum that is not goal-directed into one that is. So, condition [S2] fails to solve the equilibrium problem.

Defenders of the systems approach can propose other systems conditions. Perhaps the magnetic pendulum is not goal-directed because the restoring activity of gravity and magnetism are not coordinated. Gravity and magnetism do not bring about the goal by working together, and this suggests the following condition as a solution to the equilibrium problem:

[S3] The system must be governed by at least two independent but coor-dinated restoring variables. This condition successfully excludes the magnetic pendulum, as well as the rubber pendulum and the balloon pendulum.

As it turns out, condition [S3] is too broad, because certain complex equilibrium systems can satisfy [S3] without being goal-directed systems.[16] Furthermore, [S3] is too narrow, because it rules out the kidney-plus-muscle system. The kidneys and muscles are independent restoring variables, but their behavior is not coordinated in the right way. Variations in the rate at which the kidneys or the muscles work are controlled directly only by the concentrations of the water in the blood. The kidneys and the muscles are no more coordinated than are gravity and magnetism in the magnetic pendulum, so condition [S3] rules out both.

Defenders of the systems approach might now try a different tack and propose that independence must obtain between the deflecting and restoring forces, rather than (as before) among different components of the restoring force. After all, recall that Nagel proposed excluding the simple pendulum on the grounds that its deflecting force was not independent of its restoring force (quoted above). This suggests the following condition as a solution to the equilibrium problem:

[S4] The deflecting variables must be independent of the restoring variables.

Condition [S4] rules out many simple and complicated equilibrium systems, including the rubber pendulum, the balloon pendulum, and the magnetic pendulum. All of these systems fail to satisfy condition [S4], for the same sort of reason that [S1] rules out simple equilibrium systems.s? Once the sundry factors governing the behavior of the system have been identified, the vector sum of the disturbing forces at a moment is equal in magnitude to the vector sum of the restoring forces, and opposite in direction from it. That is, the disturbing forces and restoring forces are balanced.

Condition [S4] will not save the systems approach, however, for it is well known that it also rules out most genuinely goal-directed systems.[18] Recall that the behavior of goal-directed systems is persistent in that deflecting forces are balanced by equally strong but oppositely directed restoring forces. That is, goal-directed systems are structured in a way that guarantees that, as long as the system does not break down, the deflecting force and the restoring force are balanced. Thus, the disturbing and restoring forces in (well-functioning) genuinely goal-directed systems are not independent, and [S4] is false for goal-directed systems.

At this stage, defenders of the systems approach might try to identify exactly which kind of factors bring about the balance between deflecting and restoring forces in goal-directed systems. Thus, Nagel, responding to criticism of his earlier position by Woodfield, proposes the following condition:[19]

[S5] Apart from the balance between the variables brought about by the system itself (because of their role in goal-directed processes), the deflecting variables must be independent of the restoring variables.

This condition requires the restoring force and the disturbing force in goaldirected systems to be balanced not merely because of background laws of nature; rather, the balance must be something that the system itself brings about. A goal-directed system has the disposition to reorient itself toward its goal specifically because of the particular way in which the system is configured {designed or structured). When a goal-directed system is dismantled, the system loses its capacity to balance the deflecting and restoring forces and maintain its goal. For example, consider how Nagel explains what would happen if a Watt governor were dismantled:[20]

When the so-called "Watt governor" of a steam engine is not hitched up to the engine, any speed of the engine is compatible with any spread of the arms of the governor; for there are no known laws of nature according to which, in the assumed circumstances, the spread of the arms depends on the engine speed .... [This system] is goal-directed with respect to a certain rotation speed of the engine's driving wheel. But if the relations holding between the behavior of the governor and the engine speed were included among the laws of nature, that system could no longer be so characterized.

In a steam engine controlled by a Watt governor, the deflecting and restoring forces are balanced because of the general laws of nature and various facts about the structure of the system. If the structure of the system changes (because the governor is dismantled, for example), restoring forces will no longer balance deflecting forces. Nagel defends condition [S5] against criticism that it depends on a distinction between laws of nature and laws that hold only for various specialized structures.[21] But condition [S5] has a more fundamental problem, specifically, that it fails to rule out certain equilibrium systems. Take a marble-plus-bowl system, and change the internal structure of the system by shattering the bowl or slicing off its sides. Changing the system in this way destroys the system's capacity to balance deflecting forces by restoring forces. Thus, in the marble-plus-shatteredbowl system the deflecting and restoring forces are independent, and the system satisfies condition [S5]. Similarly, dismantle or destroy any other equilibrium system and restoring forces will no longer balance deflecting forces. Equilibrium systems balance deflecting forces with restoring forces in part because of the system's internal structure. So [S5] fails to rule out non-goal-directed equilibrium systems.

Another tack defenders of the systems approach might take is to conjecture that equilibrium systems are not goal-directed because the cause of their behavior is too simple or too direct. This conjecture suggests the following condition as a solution to the equilibrium problem:[22]

[S6] The causal connection between the deflecting variables and the restoring variables must not be simple and direct.

Although it is not completely clear what "simple and direct" causal connecfrans are, it is plausible that there is a simple and direct causal connection between the deflecting and restoring variables in the marble-plus-bowl system and other simple equilibrium systems, so it is plausible that condition [S6] (correctly) rules them out. The condition also seems to correctly rule in goal-directed systems, such as the kidney-plus-muscle system, a guided missile, or a woodpecker searching for grubs; whatever the causal connection between disturbing forces and restoring forces is like, it certainly is not simple and direct.

However, condition [S6] will not save the systems approach. Highly complex and indirect causal connections are not sufficient to make a system genuinely goal-directed. Our earlier examples of the rubber pendulum, the balloon pendulum, and the magnetic pendulum showed that making a simple pendulum slightly more complex does not turn it into a goal-directed system, and this conclusion can be generalized. It is easy to construct more and more elaborate modifications of a simple pendulum, in which there are more and more complex and remote causal connections between deflecting and restoring forces. For example, consider a pendulum suspended from a balloon with a steel bob hanging from a rubber band and swinging above an electro-magnet powered by a battery. Then, couple this pendulum with another by suspending the first from the bob of the second. Next, isolate the whole apparatus inside a gravity-free chamber, and power the electromagnet by a generator running off a waterfall far outside the chamber. Finally, concoct a mechanism that makes the temperature in the chamber (and, thus, the length of the rubber band) a function of, say, the current number of vehicles on the Golden Gate Bridge. By now, there would be a quite complex and indirect causal connection between the pendulum's deflecting and restoring variables. Furthermore, it would be easy to make the connections indefinitely more complex and indirect. But, just as with the rubber pendulum, the balloon pendulum, and the magnetic pendulum, making the causal dynamics of a non-goal-directed pendulum more complex and indirect does not turn it into a goal-directed system. Thus, the degree of complexity and degree of remoteness of causal connection do not provide a sign of goal-directed systems.

3. A Value Diagnosis.

It is one thing to know that the systems approach cannot solve the equilibrium problem; it is another thing to know why.[23] What do equilibrium systems lack? What property must an equilibrium system possess in order to be genuinely goal-directed? The system diagnosis focussed on complexity. I will briefly defend an alternative diagnosis: equilibrium systems fall to be genuinely goal-directed when their equilibrium-maintaining behavior is of no value for anything.[24]

Preliminary support for this value diagnosis comes from a two-fold pattern involving the role of value in examples of genuine and spurious goal-directed systems. On the one hand, systems that are not goal-directed can be value-free. Water flowing downhill, a marble rolling around in a bowl, a pendulum returning to rest--nothing in systems like these need be of any value to anyone or anything. One can easily conceive of cases in which the behavior of these things does benefit someone or something, but value need play no such role. In general, the behavior of those equilibrium systems that are not goal-directed need not benefit anything. On the other hand, value typically plays a central role in genuinely goal-directed systems. It is no accident that the grub-seeking behavior of a woodpecker benefits the woodpecker, the self-regulation of a steam engine with a governor benefits the people using the engine, or the mammal's temperature regulation system benefits the organism. This pattern of goal-directedness standing or falling with a suitable role for value suggests that the right role for value is at least part of what is missing from equilibrium systems.

Further support for the value diagnosis comes from considering how to turn an equilibrium system, such as a marble-plus-bowl, that is not goaldirected into one that is. According to the value diagnosis, at least part of the shortcoming of the marble-plus-bowl system is that the behavior of the system provides no benefit to anyone or anything. To test this diagnosis, consider the effect of changing the system so that its behavior does provide value.

A marble-plus-bowl system could benefit either an organism containing the system or a person using the system. As an illustration of the first of these possibilities, consider a creature with a marble-plus-bowl system as a proprioceptive organ--call it the marble-plus-bowl organ. The creature maintains its balance if the marble-like object is kept at the bottom of the bowl-like object. It is good for our hypothetical creature to have a good sense of balance, and the marble-plus-bowl organ is structured in such a way that (under normal conditions) it provides a good sense of balance. So, the behavior of the marble-plus-bowl organ is good for the creature. As an illustration of the second way in which the behavior of a marble-plus-bowl system could provide a benefit, consider people who measure the stability of surfaces with a marble-plus-bowl system--call it the marble-plus-bowl instrument. It is used by placing it on a flat surface and checking the marble's behavior, thereby measuring the stability of the surface. Since knowing how stable a surface is benefits these people, the behavior of the marble-plusbowl instrument is of value for them.

A simple marble-plus-bowl system is not only not goal-directed; it also lacks all other teleological properties. It has no function, no purpose, is not for the sake of anything, etc. But, when value is added, as in the marble~ plus-bowl organ and instrument, teleology emerges. The marble-plus-bowl organ and instrument clearly have functions, and they clearly are at least parts of goal-directed systems. The marble-plus-bowl organ is part of a creature's proprioceptive system, which is a classic example of a goaldirected system, on a par with the systems regulating body temperature and blood-sugar concentration. The marble-plus-bowl instrument is part of a goal-directed system consisting of the people who are using it to accomplish their goals. Furthermore, their behavior has a goal-directed quality because it contributes to the goals of these larger systems. The behavior of the marble in the marble-plus-bowl organ contributes to the creature's goal of balance, and the behavior of the marble in the marble-plus-bowl instrument contributes to the person's goal of measuring stability. The causal dynamics of a marble-plus-bowl system is not altered when it becomes an organ or an instrument. Instead, that dynamics is exploited to provide some benefit. Thus, changing an equilibrium system in such a way that its behavior provides a benefit can be enough to make it part of a goal-directed system. In other words, at least part of what seems to be missing from equilibrium systems is an appropriate role for value.

There no doubt are complex systems-theoretic conditions met by the goal-directed systems containing the marble-plus-bowl organ and instrument, but failed by simple marble-plus-bowl systems. This might make someone think that it is not value but these complex systems conditions that make the marble-plus-bowl organ and instrument parts of goal-directed systems. But this is not so. The creature with the proprioceptive system containing the marble-plus-bowl organ, and the person using the marble-plus-bowl instrument, fulfill crucial roles for the value diagnosis: they are the beneficiaries of the behavior of the marble-plus-bowl system. Two basic ways to link beneficiaries with the behavior of a system are to make the operation of the system good for some creature containing it or good for some person using it. So, if the value diagnosis is correct, larger systems are to be expected when making a marble-plus-bowl system into an organ or an instrument. However, merely putting a marble-plus-bowl system into a larger, more complex system is not by itself sufficient to make it part of a goal-directed system. Simple equilibrium systems can be contained in complex systems that are value-less and goal-less. A complex solar system (with many planets, rings, moons, comets, etc.) could contain a part that is just a simple equilibrium system, but neither the equilibrium system nor the planetary system containing it need be goal-directed. Thus, the complex systems conditions satisfied by the systems surrounding the marbleplus-bowl organ and marble-plus-bowl instrument are not responsible for making the marble-plus-bowl systems goal-directed. Rather, what brings teleology into the picture is at least partly the fact that the behavior of the systems is of value for something. Thus, the value diagnosis of the equilibrium problem, but not the systems diagnosis, can explain the contrast between simple marble-plus-bowl systems, on the one hand, and the marble-plus-bowl organ and marble-plus-bowl instrument, on the other hand.

4. Value in Teleology

The value diagnosis can be no clearer than the notion of value involved. Although this is not the occasion to develop and defend a full theory of value, in this section I will digress to expand on the nature of the value in a value-centered theory of goal-directed systems and teleology in general, and to discuss the consequences for some central themes in normative theory.

In the context of teleology, I take claims of the form X is good for Y to amount (roughly) to three things: (i) Y is the kind of thing that has its own interests (a "good of its own"); (ii) Y's good is independent of any value that some third party might place on Y; and (iii) X is in the interests of Y, i.e., X promotes Y's interests or constitutes (at least part of) Y's interests.[25] For example, the claim that water is good for a plant would amount to the claims that the plant has its own "intrinsic interests" (e.g., survival and flourishing), independent of any interests of third-parties, and water promotes those interests. Saying that water promotes the plant's interests does not entail that the plant takes an interest in the water. Presumably the plant has no psychological attitudes, so cannot take an interest in anything. Still, the water is in the plant's interests because it promotes its welfare, makes it better off. Contrast the plant with the vortex that forms in the bathtub as it drains. A continual influx of water is required to sustain the vortex, but this water is not in the requisite sense "good" for the vortex because the vortex has no intrinsic interests, is not an "end-in-itself" (to use the classical philosophical terminology). So, the claim that X is good for Y entails more than that X tends to cause Y to obtain or persist; Y must be the kind of thing that can be better or worse off irrespective of third-party interests. People, other animals, even plants seem to be such, while sticks and stones, specks of dust and solar systems, do not. To explain why this is so would require a theory of value; still, that this is so is apparently a widely shared view.

A value-centered theory of teleology, especially one that takes seriously the idea that biological creatures have intrinsic interests, might be thought to entail that teleology has no objective place in the natural world. This reasoning, originating from the putative fact/value distinction, was recently expressed clearly and forcefully by Callicott:

The objective physical world is sharply distinguished from subjective consciousness in the metaphysical posture of modern science as originally formulated by Descartes. Thought, feeling, sensation, and value have ever since been, from the point of view of scientific naturalism, regarded as confined to the subjective realm of consciousness. The objective, physical world is therefore value-free from a scientific point of view. [26]

If the natural world is value-free and teleology essentially involves value, then the natural world must also be teleology-free. Those who adopt a value-free view of the natural world are often attracted to a roughly Humean view of value judgments, including those attributing intrinsic interests. Again, consider Callicott:

Value is, as it were, projected onto natural objects or events by the subjective feelings of observers. If all consciousness were annihilated at a stroke, there would he no good and evil, no beauty and ugliness, no right and wrong; only impassive phenomena would remain. [27]

The fact/value distinction and projectivist accounts of value might be thought to undermine any value-centered theory of teleology, but for three reasons this is not so.

First, a value-centered theory of teleology is committed to a theoretical link between teleology and value; teleology involves a certain role for value. But this link thesis does not mandate every detail about value. What is entailed is that a given view of value would be constrained to some related view of teleology. For example, a projectivist view of value might entail a projectivist view about teleology, and the view that values are objectively "out there" in the natural world might entail the view that the way the world is makes teleological judgments objectively true or false. By the same token, a given stance toward teleological judgments would entail some related stance toward value. For example, if teleological explanations of biological organism are taken as literally true then those biological creatures must have real interests of their own that circumstances can objectively promote or hinder. So, a value-centered theory of teleology is compatible with a wide range of theories of value.

Second, it should be noted that not all kinds of values are equally subject to fact/value worries. Ethical values--rightness, or justice, or fairhess--are the main focus of controversy. However, the theory of teleology appeals not to specifically ethical values but to goodness--the idea that certain kinds of entities have interests (independently of any interests of third-parties) that are promoted by certain kinds of states of affairs. For the plant, water is not right or just or fair but simply good; it makes it better off. Biological teleology might presuppose that circumstances can make plants more or less healthy and can affect the degree to which they flourish, but it is not so controversial that these matters are matters of fact discoverable by empirically investigating the natural world.

Third, as the recent rise of ethical realism amply attests, the fact/value distinction is no longer thought to be so cut and dried? It is less clear what facts and values are, how if at all they differ, and whether and in what respect the natural world enters into the truth conditions of judgments involving them. Rather than a tool for solving philosophical problems, the fact/value distinction itself is a philosophical problem. It is interesting to ask what a value-centered account of teleology would imply about the proper understanding of facts and values, but the fact/value distinction cannot be used to criticize the value-centered theory of teleology.

The idea of a value-centered theory of teleology--that something's goal or purpose is to be explained by reference to its good--reminds one of the thesis in ethics that something's good is to be explained by reference to its natural function, end, or telos[29] In fact, this symmetry might prompt the worry that a value-centered account of teleology is viciously circular. This worry need not prove serious, for three reasons. First, of course, the value-centered account of teleology would be susceptible to this circularity only if it were combined with the function-centered account of value, but there are many other approaches to value to which it could be linked which would not threaten circularity. Second, even if the value theory of teleology /s combined with a function-centered theory of value, the threatened circularity still might not materialize; it would depend on how the details of each theory mesh. But finally, if the combination should be genuinely circular, that does not mean that the two theories in combination would be uninformative or would undermine each other. Value and teleology would be part of a unified theoretical system of concepts, as a theory forming a package to be taken together or not at all. Being theoretically unified is not a flaw; many groups of concepts form similar theoretical systems. Each theory could still be informative. We can grasp teleological notions such as goal and purpose without recognizing that they involve value, as we can grasp the idea of value without seeing it as involving natural functions. A value-centered theory of teleology and a function-centered theory of value might both be true but not be trivially analytic, so sensible and intelligent people could disagree about them. So, even if teleology and value are part of an interdefined family of concepts, a value-centered theory of teleology can be a significant and informative theoretical advance.

5. Whither the Systems Approach?

Adherents to the systems approach tend to try to couch the distinction between gnat-directed and non-goal-directed systems in quantitative terms. The number of (kinds of) variables governing a system, the degree of como plexity of (kinds of) causal connections that the system brings about--conditions like these are interesting in part just because they are quantitative. However, the difference between a genuine goal-directed system and a system that merely behaves as if it were goal-directed is fundamentally qualitative. A non-goal-directed system cannot be turned into a goaldirected system merely by adding more independent variables or making the connection between deflecting and restoring variables more complex and indirect. In this respect the value diagnosis contrasts sharply with the systems approach, for the value diagnosis proposes that a distinctive feature of goaldirected systems is the value they produce. So, with the value diagnosis there is a qualitative difference between goal-directed systems and systems that merely behave as if goal-directed, depending on whether or not their behavior is really of any value.

The success of cybernetics and other systems theories has been impressive, but it can also be misconstrued; in particular, it does not vindicate the systems approach to teleology. The equilibrium problem shows that the intrinsic causal dynamics of a system do not determine whether the system's behavior is goal-directed. Interesting and distinctive systems conditions are not sufficient for goal-directed systems. Thus, the hope for a naturalistic, purely descriptive theory of teleology cannot be supported by the systems approach. The value diagnosis recommends that equilibrium systems be . screened off by requiring the behavior of goal-directed system to provide a real benefit. This suggestion might turn its back on naturalism and descriptivism, and it obviously needs clarification and qualification, but it deserves serious consideration.

NOTES

[*] For comments and discussion, many thanks to George Bealer, Hugo Bedau, Nancy Cartwright, Bob Fogelin, Mark Hinchliff, Jim Moor, David Reeve, Alex Rosenberg, Walter Sinnott-Armstrong, and Carol Voeller.

[1]. R. Van Gulick, "Functionalism, Information and Content," Nature and System 2 (1980): 139--62; also in W. Lycan (ed.), Mind and Cognition (Cambridge, MA: Basil Blackwell, 1990), pp. 107-29; and "A Functionalist Plea for SelfConsciousness," The Philosophical Review 97 (1988): 149-81. See also F. Dretsky, Explaining Behavior: Reasons in a World of Causes (Cambridge, MA: MIT Press, 1988); J. Fodor, "Semantics, Wisconsin Style," Synthese 59 (1984): 231-50; and W. Lycan, Consciousness (Cambridge, MA: MIT Press, 1987).

[2]. Given that systems theories provide teleology-free explanations of apparently teleological phenomena, some are tempted to use systems theories to eliminate rather than explicate teleological explanations. R. Dawkins apparently feels this inclination; see his The Selfish Gene

(New York: Oxford University Press, 1976), and also his aptly subtitled The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design (New York: Norton, 1986).

[3]. A. Rosenblueth, N. Wiener, and J. Bigelow, "Behavior, Purpose, and Teleology," Philosophy of Science l0 (1943): 18-24, and N. Wiener, Cybernetics, or Control and Communication in the Animal and the Machine (New York: Wiley, 1948). See also G. Sommerhoff, Analytical Biology (New York: Oxford University Press, 1950); R. B. Braithwaite, Scientific Explanation (Cambridge: Cambridge University Press, 1953); E. Nagel, The Structure of Science (New York: Harcourt, Brace and World, 1961) and "Teleology Revisited," The Journal of Philosophy 74 (1977): 261-301; C. Hempel, "The Logic of Functional Analysis," in his Aspects of Scientific Explanation (New York: Free Press, 1965), pp. 297-330; L. Von Bertalanffy, General System Theory (New York: George Brazillier, 1968); M. Beckher, The Biological Way of Thought (Berkeley, CA: The University of California Press, 1968); C. Boorse, "Wright on Functions," The Philosophical Review 85 (1976): 70-86; Van Gulick, "Functionalism, Information and Content" and "A Functionalist Plea for Serf-Consciousness;" A. Collins, "Action, Causality, and Teleological Explanation," Midwest Studies in Philosophy 9 (1984): 345-69; and J. Bigelow and R. Pargetter, "Functions," The Journal of Philosophy 84 (1987): 181-96.

[4]. Nagel, The Structure of Science and "Teleology Revisited;" Hempel, "The Logic of Functional Analysis;" and Boorse, "Wright on Functions."

[5]. Nagel, "Teleology Revisited," p. 272. Some advocates of the systems approach focus on internal rather than behavioral s/ins of goal-directedness. They characterize goal-directed systems in terms of certain general features of their internal causal structure, such as negative feedback loops, that are responsible for producing the characteristic goal-directed behavior. See, e.g., Rosenblueth et al., "Behavior, Purpose, and Teleology." I will focus on the more prevalent behavioral forms of the approach; the internal formulations are subject to analogous conclusions.

[6]. Nail, The Structure of Science, p. 411; Hempel, "The Logic of Functional Analysis," p. 323.

[7]. Nagel, "Teleology Revisited," p. 272.

[8]. My presentation of these biological facts is a simplification of Nagel, "Teleology Revisited," pp. 272ff., which itself is a simplified presentation of W. B. Cannon, The Wisdom of the Body (New York: Norton, 1952).

[9]. See, e.g., R. Taylor, "Purposeful and Non-Purposeful Behavior," Philosophy of Science 17 (1950): 327-32; L Seheffler, "Thoughts on Teleology," The British Journal for the Philosophy of Science 9 { 1959): 265-84; J. Canfield, "Introduction," in his (ed.), Purpose in Nature (Englewood Cliffs, NS: Prentice-Hall, 1966), pp. 1-7; Beckner, The Biological Way of Thought; Boorse, "Wright on Functions;" and Nagel, "Teleology Revisited."

[10]. Nagel, "Teleology Revisited," p. 274.

[11]. Nagel, "Teleology Revisited," p. 274.

[12]. Cf. Bigelow and Pargetter, "Functions," pp. 183f.

[13]. Nagel, "Teleology Revisited," p. 273, following Sommerhoff, Analytical Biology.

[14]. Nagel, The Structure of Science, p. 412.

[15]. Nagel, The Structure of Science, pp. 419-20, and "Teleology Revisited," p. 274; these passages can also be taken as support for [S4], discussed below.

[16]. See the discussion of pseudo-goal systems in my "Natural/sin and Teleology," in S. Wagner and S. Warner (eds.), Naturalism: A Critical Appraisal (Notre Dame, IN: The University of Notre Dame Pros, 1992).

[17]. Nagel, The Structure of Science, pp. 419-20, and "Teleology Revisited," p. 274.

[18]. A. Woodfield, Teleology (Cambridge: Cambridge University, Press, 1976); and Nagel, "Teleology Revisited."

[19]. Nagel, "Teleology Revisited," p. 275; Woodfield, Teleology, pp. 67-72.

[20]. Nagel, "Teleology Revisited," p. 275.

[21]. Nagel, "Teleology Revisited," p. 275.

[22]. Van Gulick, "Functionalism, Information and Content," esp. pp. 143-45; also "A Functionalist Plea for Self-Consciousness," p. 154, n13.

[23]. The previous section's criticisms of attempted solutions to the equilibrium problem can be complemented by a general argument against any possible systemstheoretic condition; see the discussion of pseudo-goal systems in my "Naturalism and Teleology."

[24]. This value diagnosis is intended as a necessary but not sufficient condition. In fact, to capture even a necessary condition requires a slight complication, for a goaldirected system need not actually be of value; an appropriate person might merely have believed or intended it to be of value. These details are beyond the scope of the present discussion, which is intended only to suggest that an appropriate role for value is the missing ingredient in equilibrium systems. Various aspects of the value diagnosis are developed more fully in my "Where's the Good in Teleology?" Philosophy and Phenomenological Research (forthcoming) and my "Naturalism and Teleology;" see also my "Can Biological Teleology be Naturalized?" The Journal of Philosophy 88 (1991): 647-655, and my paper (with N. Packard) "Measurement of Evolutionary Activity, Teleology, and Life," in C. Langton, C. Taylor, D. Farmer, and S. Rasmussen (eds.), Artificial Life II (Redwood City, CA: AddisonWesley, 1991). F. Ayala, "Teleological Explanations in Evolutionary Biology," Philosophy of Science 37 (1970): 1-15, and Woodfield, Teleology, defend more or less similar positions.

[25]. My view of value attributions has been influenced by P. Taylor, Respect for Nature (Princeton, NJ: Princeton University Press, 1986), and by J. B. Callicott, "On the Intrinsic Value of Nonhuman Species," in his In Defense of the Land Ethic: Essays in Environmental Philosophy (Albany, NY: State University of New York Press, 1989), pp. 129-55.

[26]. Callicott, "On the Intrinsic Value of Nonhuman Species," p. 132.

[27]. Callicott, p. 147.

[28]. E.g., P. Railton, "Moral Realism," The Philosophical Review 95 (1986): 163-207; D. Brink, Moral Realism and the Foundations of Ethics (New York: Cambridge University Press, 1989); see Brink for more references.

[29]. Various versions of this thesis have commanded wide agreement throughout the history of philosophy, perhaps starting with Aristotle, Nicomachean Ethics, bk. I. Rawls, to pick a contemporary example, seems to hold a version of this view; see A Theory of Justice (Cambridge, MA: Harvard University Press, 1971), [sigma]61. For a wealth of further references, see Rawls, p. 400, n2.