

Teleonomy

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Abstract

The distinction between teleology and teleonomy that biologists sometimes refer to seems to be helpful in certain contexts, but it is used in several different ways and has rarely been clearly drawn. This paper discusses three prominent uses of the term “teleonomy” and traces its history back to what seems to be its first use. This use is examined in detail and then justified and refined on the basis of elements found in the philosophy of Aristotle, Kant, Anscombe and others. In the course of this explication, it will also be shown how the description of end-directed processes relates to their explanation.

Die Unterscheidung zwischen Teleonomie und Teleologie, auf die Biologen manchmal verweisen, scheint für manche Zwecke hilfreich zu sein. Sie wird jedoch nicht in einheitlicher Weise verwendet und nur selten klar bestimmt. Der Beitrag untersucht drei prominente Gebrauchsweisen des Begriffs „Teleonomie“ und verfolgt seine Geschichte bis zu der Verwendung, die die erste zu sein scheint. Diese wird im Detail analysiert und unter Rückgriff auf Aristoteles, Kant, Anscombe und andere verteidigt und ergänzt. Im Zuge dieser Begriffsklärung wird außerdem gezeigt, wie sich die Beschreibung zielgerichteter Vorgänge zu ihrer Erklärung verhält.

1. Introduction

Biologists sometimes accuse philosophers of failing to distinguish between teleology and teleonomy. Michael Ghiselin, for instance, writes that when Jim Lennox speaks of teleology in the context of Darwin’s theory, he uses the word “teleology” in a way “that just about any professional biologist would consider not just trivial, but downright perverse” (1994, 489). According to Ghiselin, teleology is associated with the idea that a phenomenon is caused by an end, and this idea is out of place in biology. Therefore, says Ghiselin, the use of “teleology” in the context of Darwin’s theory causes confusion. He goes on:

To prevent the effects of such equivocation we avoid that unfortunate way of expressing one’s self, perhaps using the word ‘teleonomy’ to designate the sort of adaptationist thinking that ought not to be confused with teleology. (Ghiselin 1994, 489)

Lennox is rather unimpressed by this suggestion (1994, 493). One reason for this is that there are no obvious differences between the literal meaning of the two terms, “teleology” and “teleonomy,” so that it would be clearly wrong to use one instead of the other. Further, to the extent to which there are such differences, they would rather suggest that “teleology” should be preferred. On the face of it, teleology is any kind of thought and discourse (λόγος) about ends (τέλῃ), whereas teleonomy has to do with laws (νόμοι) concerning ends. Obviously, to establish

laws concerning ends is just another kind of discourse about ends, and it seems to be more metaphysically involved than other kinds of discourse about ends. Therefore, if teleology in general is out of place in biology, this should apply even more to teleonomy.

There is one rather superficial reason why one might prefer the term “teleonomy”: Like “astronomy” it ends in “-nomy,” as opposed to “-logy,” and astronomy is better science than astrology. By analogy, teleonomy should be scientifically more acceptable than teleology (cf. Lorenz 1978, 25). However, there are important differences between the two cases. For instance, astrology and astronomy refer to two different kinds of cognitive enterprise that involve statements about the movement and position of celestial objects. I will argue that teleology and teleonomy, in contrast, do not differ from one another by involving substantially different theories about the same kind of object. Rather, I maintain, teleonomy is confined to a subset of the statements that are involved in teleology. A further difference between astrology and teleology is that today, there is no longer a set of phenomena to which astrology uncontroversially applies. People still practice astrology, but scientists generally think that they ought not to. In contrast, even Ghiselin does not seem to think that the term “teleology” should have no application at all. In some areas of psychology and the social sciences, for instance, teleological explanations are still quite legitimate. Ghiselin does not think that teleological discourse should be avoided in general, he only objects that in the context of Darwin’s theory it causes confusion.

Given these differences between astrology and teleology, there are no good reasons to expect that the difference between teleonomy and teleology is very much like the one between astronomy and astrology. We are left with the vague idea that for some unspecified reason, teleonomy is better science than teleology. If this were all, the distinction between teleology and teleonomy would not be much more substantial than the one between “deaf” and “hearing impaired”: Although both expressions apply to the same phenomena, using the latter is more acceptable in public.

That there are no obvious reasons for preferring teleonomy over teleology does not necessarily mean that one should not draw a distinction between teleology and teleonomy after all. It only means that authors who recommend replacing one of these terms by the other have to give us such reasons. They owe us an explanation as to what the difference is between them, whether or not the second is just a subkind of the first, and why any one of them is preferable in a given context. In this paper, I will discuss three prominent accounts of the distinction between teleology and teleonomy in more detail. I will extract from this discussion requirements that a distinction between teleology and teleonomy should satisfy, and provide my own account that meets them.

2. Some Uses of “Teleonomy”

In the context of discussions of natural end-directedness, the introduction of the term “teleonomy” is usually attributed to Colin Pittendrigh. Like Ghiselin, Pittendrigh only mentions the possibility of using it in passing:

The biologist’s long-standing confusion would be more fully removed if all end-directed systems were described by some other term, like “teleonomic,” in order to emphasize that the recognition and description of end-directedness does not carry a commitment to Aristotelian teleology as an efficient causal principle. (Pittendrigh 1958, 394)

Although this sounds as if Pittendrigh had picked up a suggestion made by someone else, he claims to have invented the term (in a letter quoted in Mayr 1976, 391), and most biologists take this at face value. In fact, however, the adjective “teleonomic” has been used in a very similar way some twenty years earlier by the personality psychologist Floyd Allport. I will discuss Pittendrigh and Allport in some more detail below. Before doing so, I will briefly consider a small and arbitrary selection of other accounts.

The term “teleonomy” is used in a rather broad variety of meanings. Pittendrigh suggests applying it to end-directed systems, so that some things are teleonomic, others are not. George C. Williams, in contrast, uses “teleonomy” for a branch of science, suggesting that “Pittendrigh’s term be used to designate the study of adaptation” (1966, 258). Teleonomy, in this sense, is a scientific discipline rather than a feature of things or processes. This may seem to be a marginal difference. Both Pittendrigh and Williams emphasize that teleonomy has to do with the recognition and description of end-directed phenomena, as opposed to their causal explanation. Their accounts can be mapped onto each other. Pittendrigh’s teleonomic systems are systems that may be recognized and described by reference to ends, Williams’ science of teleonomy is about recognizing and describing certain end-directed systems. However, since there are many things that one may both describe and explain in terms of ends, there is in fact no real and exclusive distinction between the objects of teleonomic and teleological discourse. Pittendrigh’s way of drawing the distinction obscures this. By drawing the distinction between kinds of systems rather than kinds of discourse, he suggests that teleonomy has to do with things that can only be described but not explained by reference to ends. Since this seems wrong, Williams’ proposal is to be preferred.

Like Pittendrigh, Jacques Monod takes “teleonomy” to refer to a feature of things. As he puts it, teleonomic things differ from other end-directed things in that they are living beings that have a specific objective – the conservation and multiplication of their species (1970, 22–26). They are directed at this end in the same sense in which all other end-directed things are directed at their ends. The difference between teleological systems and teleonomic ones is thus rather like the distinction between knives and french bread knives: Like all other knives, french bread knives are devices for cutting things; they differ from other knives only by being french and being suitable for cutting a specific kind of thing. Likewise, according to Monod, teleonomic systems are as end-directed as all other end-

directed systems; differ from them only by being alive and being directed at a specific kind of end.

Other authors associate teleonomy closely with cybernetic and system theoretic accounts of end-directedness. Guy Cellier, for instance, distinguishes between two interpretations of end-directed systems, a “finalized” or teleonomic one and a causal one (1983, 214). Like Pittendrigh and Williams, he contrasts the teleonomic interpretation of an end-directed system with its causal explanation. Cellier further maintains that this finalized or teleonomic interpretation is only legitimate for cybernetic systems (Cellier 1983, 218), so that “cybernetic” and “teleonomic” ultimately refer to the same. He writes that “the terms ‘cybernetic’ or ‘teleonomic’ designate the set of systems, i.e., biological, psychological, or technological, born of the evolution of self-replicating systems” (Cellier 1983, 224). Despite his initial distinction between descriptive and explanatory interpretations, he thus associates teleonomy with a specific explanation as to why certain systems are directed at ends. Teleonomic systems are end-directed systems that result from a certain kind of process, namely the evolution of self-replicating systems. According to Cellier, if an end-directed system does not result from the evolution of self-replicating systems, it is neither cybernetic nor teleonomic. Teleonomic systems are thus end-directed systems whose end-directedness admits of a certain kind of causal explanation. Similarly, Eve-Marie Engels thinks that Pittendrigh’s term is confined to the kind of end-directedness that is the subject matter of cybernetics. She does not any longer distinguish between description and explanation and thinks that “teleonomy” refers to a certain kind of causality, namely the one that can be explained in terms of cybernetic control loops (“Regelkreiskausalität”, Engels 1982, 141).

These examples show that the term “teleonomy” has been used in many ways, so that no single explication of its meaning will do justice to all its possible uses. They also illustrate an apparent trend: to neglect the distinction between description and explanation that was initially drawn by Pittendrigh and others, and to associate teleonomy with a specific kind of causal explanation of end-directedness. One main reason for this seems to be that teleonomy is thought to be a feature of things, rather than a kind of discourse about things. As a consequence, the distinction between teleology and teleonomy must be one between different kinds of end-directed things. For instance, teleonomic systems are taken to be living things that are directed at certain kinds of ends, or end-directed systems that result from a certain kind of process, or things whose end-directedness may be accounted for by a certain kind of causal explanation. This trend culminates in the “new analysis” provided by Ernst Mayr, according to which teleonomic processes are processes that are end-directed because of the execution of a program (Mayr 1976, ch. 23 and 26). Mayr’s teleonomy is not any longer concerned with the description, as opposed to the explanation, of end-directed phenomena. The distinction between teleonomy and other kinds of teleological discourse is not any longer one between description and explanation, but one between a kind of end-directedness that may be explained in one way and another kind of end-directedness that may be explained in another way. Mayr’s analysis is the third proposal that I will discuss in this paper. I will now take a closer look at Pittendrigh.

3. Pittendrigh

Pittendrigh assumes that teleology involves the assumption that things are not only directed towards ends, but are also caused by so called “final causes.” He further thinks that final causes are causes in a strict sense, so that they efficiently cause what they are causes of. This is only possible if teleological processes are literally caused by their own end state, or involve an agent that represents this end state and is thereby caused to aim at its realization. Teleology, in this sense, thus involves either backwards causation, or some kind of mental representation (cf. Ayala 1970, 13). If teleology is indeed inseparable from these assumptions, it is inappropriate to employ teleological descriptions and explanations in scientific biology, where backwards causation and mental representations have no place.

The term “teleonomy” is introduced in order to avoid these implications. More specifically, Pittendrigh’s idea is that it is possible to merely describe things in terms of ends, rather than explaining them as caused by these ends. He writes that the view “that the efficiency of final causes is necessarily implied by the simple description of an end-directed mechanism” is mistaken (Pittendrigh 1958, 393), and that certain proximate ends are discernible “fully by direct observation” (Pittendrigh 1958, 392). As introduced by Pittendrigh, teleonomy is associated with the mere description of a system or process in terms of ends, without assuming any causal efficacy of these ends. Teleonomy is thus a more general notion than teleology, for if something is caused by an end, it may also be described as directed towards this end. To merely describe an item teleonomically, on the other hand, is not yet to make any claim as to why it is directed at this end. To give a teleological account of a phenomenon is to describe it teleonomically by reference to an end and in addition assume that this end causes the phenomenon in some sense. As far as biological theory is concerned, teleology is thus teleonomy plus bad metaphysics, and the virtue of teleonomy is that it works without the metaphysical surplus (cf. Hassenstein 1981, 63 and 69–70).

One obvious problem with Pittendrigh’s suggestion is that he is wrong about Aristotelian teleology. Aristotle distinguishes between final and efficient causes (τέλος), and there is nothing in his treatment that suggests that teleology is an efficient causal principle (Kullmann 1979, e.g. 20). In particular, nothing in Aristotle suggests that teleological phenomena are always caused either by backwards causation or by representations of ends. Aristotle does not actually use the labels “teleology” or “teleonomy,” but if anything, his philosophy of biology should be described as teleonomic in Pittendrigh’s sense of this term (Kullmann 1979, 61; Hassenstein 1981, 70). This, however, is a minor problem. Pittendrigh’s valid point remains that there is an important distinction between describing a thing as directed towards an end and providing a causal explanation that involves a reference to this end. If and as long as the neologism “teleonomy” serves to remind scientists of this distinction, it has a good use.

There are in fact several good reasons for separating the description of end-directed phenomena from their explanation. As Nicholas Thompson writes, “before we began to construct our natural selection explanation of adaptation we must have previously described and identified it” (1987, 262). Therefore, it

must always be possible to describe a phenomenon in terms of certain ends without already explaining it in terms of these ends. In particular, it must be possible to identify a phenomenon as end-directed before explaining this by reference to a theory such as Darwin's.

Another good reason for separation description from explanation is that one should in general not introduce more theoretical assumptions than necessary when describing a phenomenon. As far as possible, the description of a phenomenon should not depend on theories and assumptions that might need to be given up at a later stage. It should be possible to explain the same phenomenon in different ways, and this is not possible if the description by which it is identified already depends on a particular explanatory hypothesis. Otherwise, if we had to reject an explanation that is already built into the description of a phenomenon, we would have to redefine all parts of our descriptive vocabulary that depend on the explanation (cf. Hofstadter 1941, 32). On the other hand, if we separate description from explanation, we can stick to our description and simply look for another explanation of the same thing.

As a side effect, when description and explanation are clearly separated, certain facts cannot be explained away. For instance, if there is indeed a way of describing certain processes as end-directed independently of any explanatory issues, then no explanation should be able to alter this fact (Hofstadter 1941, 36).¹

I take this to be the core of Pittendrigh's suggestion: Teleonomy has to do with the identification and description of end-directed phenomena, and not yet with their explanation, whereas teleology may also involve explanations of end-directedness and explanations by reference to ends. Biologists should use the term "teleonomy" in order to be constantly reminded that to describe a thing in terms of ends is not the same as explaining it by reference to these ends.

4. Allport

When Floyd Allport introduced the term "teleonomic" in 1937, he wanted to separate description from explanation, too. He was concerned with the limitations of certain kinds of trait psychology. Traits are often thought to be "some kind of neural or psychical dispositions" (Allport 1937, 202) or certain "fundamental forces" and "qualities" that have a "long and important history in the life of the individual" (Allport and Allport 1921, 36). As a number of psychologists have pointed out, there is a certain temptation to treat traits as if they were efficient causes of behavior. Ross Stagner, for instance, writes that "[t]oo many

¹ Imagine, for instance, that mental states have been successfully explained in purely physical terms, and that there is consequently no use for the term "mental." This would not mean that mental phenomena have been explained away. There are two possibilities: (1) The term "mental" is compatible with explanations in purely physical terms, and then it would still be appropriate to speak of mental phenomena. (2) The term "mental" is not compatible with explanations in purely physical terms, and then description and explanation have not been separate to begin with. Rather, that something is mental would already have implied that it could not have a purely physical explanation.

psychologists write as if a trait were an effective cause of behavior” and that “[t]his is quite incorrect and misleading” (1948, 144). Likewise, Jerry Wiggins argues that a trait name such as “aggressiveness” does not refer to an agent’s “disposition to perform aggressive acts in this or other circumstances” (1997, 100), but rather indicates that an action “belongs to a class of actions that are likely to lead to a particular outcome” (1997, 101). These authors argue that traits should not be taken to be efficient causes of an agent’s behavior, and that they rather are generic descriptions of what this agent typically aims at.² Allport, in contrast, wants to do without traits, which he takes to be efficient causes, and suggests that one should instead account for behavior only in terms of the immediate ends that are pursued by the agent. He writes:

We really have no justification for projecting into an individual some organic disposition known as a trait. A trait, so far as we know, is only a convenient way of expressing a prediction about the individual’s future instances of behavior. [...] We are interested, in other words, not in traits, but in behavior trends. We can describe the individual’s trend of behavior teleonomically, that is, in terms of the purpose or purposes which he seems to be trying to carry out. (Allport 1937, 203–4)

Gordon Allport, Floyd’s younger brother, had also noticed a certain limitation of the notion of a trait: It fails to bring out the uniqueness of each person (1924). Floyd agrees:

The closer we come to the proof that personalities are reducible to some fundamental individual characteristic, the more difficult it becomes to name or identify that characteristic, to state it in communicable form, or to find any physiological correlate for it. (Allport 1937, 210)

However, whereas Gordon Allport speculates that there is a certain form-quality of a person as a whole that can be directly apprehended but cannot be seen when separate traits are investigated in isolation (Allport 1924, 133–139), Floyd objects that “[t]o say that there is a fundamental trait ‘expressing’ the individual, which he carries around inside him, is useless tautology” (1937, 213). His emphasis that we do not at all need to explain a person’s behavior in terms of her organic dispositions may thus be a conscious rejection of Gordon’s point of view. Floyd occasionally speaks of form-qualities, too (Allport and Frederiksen 1941, 142). However, he argues that the uniqueness of a person is not due to such a quality, but rather to a specific pattern of teleonomic trends, which is not at all a “quality” of the agent (1941, 172). He criticizes authors who attempt to explain the uniqueness of persons by postulating a “super trait” that would explain how their particular traits hang together, and concludes that “[t]he list of traits in which the inter-relationship is found should be replaced by teleonomic statements of the different things which the individual is habitually trying to do” (1937, 211).

² Cf. also Skinner 1953, 31. That traits are not efficient causes of behavior is important in the context of certain arguments against virtue ethics by reference to psychological experiments such as Milgram’s. These experiments seem to show that there is nothing in human beings that reliably causes virtuous behavior. It is sometimes argued that therefore, virtue ethics is based on a mistaken psychology (cf. Doris 2002). However, if virtues and other traits are not efficient causes of behavior at all, this criticism is misguided (cf. Hennig 2008).

Floyd Allport's general point is thus, again, that one should separate the explanation of behavior from its description. Instead of explaining and predicting the behavior of a person by furnishing her with traits that are supposed to reliably cause a certain kind of behavior, we should pay attention to what the person generally aims at in her actions. This is what Allport calls a teleonomic description. As Wilbur S. Gregory puts it:

A teleonomic trend is a generalized behavior tendency, not a motive or cause of behavior. [...] That generalization does not explain why he does these acts; it merely describes a common aspect of them. (Gregory 1945, 181)

Allport speaks of a "teleonomic method of description," as opposed to explanations by reference to efficiently causal traits. This method makes "no use of the notion of consciousness of a purpose imputed to the subject we observe, or of purpose as an agent, motive, or force behind his activities" (1937, 205), and it does not refer to any ends or purposes other than those that lie "within the act itself" (1937, 206). It differs from a trait analysis in that it focuses on the behavior itself, rather than on qualities or dispositions of a person that may or may not be manifest in her behavior (Allport 1937, 207).

The suffix "-nomic" is justified in this case because Allport thinks that on the basis of a teleonomic description of a person's behavior, one may establish a "hypothesis concerning a possible law of this individual's general behavior" (Allport 1937, 207). On this basis, he suggests, we can in many cases provide more accurate explanations and predictions of a person's behavior, and discover "those aspects of behavior in which the greatest consistency is to be found" (Allport 1937, 209; cf. Allport and Frederiksen 1941).

The suffix "-nomic" thus refers to a certain kind of law. In this context, "law" should probably be taken in a wide sense, similar to the one in which Kant uses the term "rule" in the *Second Analogy of Experience*. It will be useful to briefly review Kant's use of the term "rule." Kant argues that a mere succession of representations is not yet a representation of a succession. Even when we observe an unmoved object, our representations of it constitute a series. In order for such a series of representations to represent an actual series of events, there must be something in the represented series that makes necessary a certain order among the representations of its elements. If so, Kant says, the series of representations must conform to a rule, according to which certain parts of it can only follow and not precede others. He writes:

In the synthesis of appearances the manifold of representations is always successive. Through this no object is presented, however, since through this succession, which is common to all apprehensions, nothing is distinguished from anything else. But as soon as I perceive, or assume in advance, that in this succession there is a relation to the preceding state, from which the representation follows according to a rule, something presents itself as an event, or as something that is happening; ... (Kant 1781/87, B 243, tr. Kemp Smith, modified)

Kant thus says that whenever we bring a series of representations under a rule that determines the order of its parts, the object of this series presents itself as an event of a certain kind, or as a certain kind of happening. To bring a series

of representations under a rule is to thus identify its object as an instance of a certain generally specifiable kind of events or processes.

In the corresponding wide sense of sense of “law,” to bring an event under a law is to see it as an instance of a general type of events, about which certain general claims are true. We do this, for instance, when we describe an event as “falling over,” “knocking something down,” or “gathering food.” Falling over, knocking down, and gathering food are types of events about which one may have general knowledge. That these events conform to laws in this wide sense does not mean that they are governed by specific physical laws. This is of course also true, but to bring an event under the type “falling over” is not the same as bringing it under a specific physical law. It is rather to associate it with a general and familiar pattern.

Anyway, if “-nomic” refers to a law in this wide sense, then all descriptions of an event as an instance of a type of events turn out to be teleonomic. Allport might not have realized this. When he speaks of teleonomic description, he seems to think of descriptions that refer to an end, aim, or purpose in a more specific way. The ends that he has in mind are ends that are pursued by agents in their actions. Still, to identify an event as “something falling over,” for instance, is also to describe it by reference to an end state, namely by reference to the state of having fallen over and lying on the ground. As long as something is actually falling over, this end state must still lie in the future, and yet what is happening is properly identified and described by reference to this state. Therefore, “falling over” is a teleonomic description.

Seen in this light, Allport only points out the obvious: Like every other kind of event, the behavior of an agent must be identified and described in terms of what it leads to. One might try to imagine a purely physical description of a person’s behavior, where only the movements of particles are described. Such a description might seem to be entirely non-teleonomic. But there is in fact no such contrast between teleonomic and entirely non-teleonomic descriptions of processes. Rather, a description is either teleonomic or it is not a description of a process at all. For there is a trade off between precision and intelligibility. A purely physical description of an everyday event may allow for more precise and reliable predictions, but it does not bring the event under any of the types of events that usually interest us. The complicated pattern of movements that happens when someone knocks over a glass of ink may never be repeated in this exact form, and if we are interested in preventing further instances of its kind, we had better stick to some plain teleonomic description of it (rather than a description of the exact physical movements that this one instance involves). More importantly, even the most basic movements of elementary particles must be described as directed at some end point, if they are indeed described as movements. If something is not going anywhere, it is not an ongoing movement, and if it is going somewhere, it is directed at some end point that it has not yet reached.

In any case, all the words we usually use in order to describe the behavior of a person refer to some aim of this person, so that they are all teleonomic. This aim can be very simple. We may not know what a man aims at by waving his arm, but at least we know that when he does so, he aims at waving his arm. There may be many aims of the man that we do not know, but there are always also

aims of his that we do know. As Anscombe points out, “if you want to say at least some true things about a man’s intentions, you will have a strong chance of success if you mention what he actually did or is doing” (1963, 8). That is, usually, the description of what an agent does is a description of something the agent aims at. When Allport recommends the teleonomic method, he only tells us to consciously do more of what we usually do and can hardly avoid: to describe the behavior of an agent in terms of her aims and intentions.

Note in passing that this also applies to the notion of a trait. It is not actually clear what the difference is between a description of behavior as an expression of a trait and a description of the same behavior in terms of a “teleonomic trend.” We usually describe traits in terms of general aims and behavior trends. For instance, when Aristotle describes the trait, courage, in the *Nicomachean Ethics*, he describes nothing other than what courageous persons generally do. He writes things such as the following:

The observance of the mean in fear and confidence is courage. (II,vii,2, 1107b1) [...] The courageous man then is he that endures or fears the right things and for the right purpose and in the right manner and at the right time, and who shows confidence in a similar way. (III,vii,5, 1115b18–19, tr. Rackham)

Courage is here clearly described not as a cause of behavior but rather as a general *kind* of behavior, or in Allport’s words: a teleonomic trend. Further, even authors who do take traits to be efficient causes of behavior must describe and individuate them in terms of teleonomic trends. That is, even if courage is thought to be some purely physical disposition, this disposition is still most properly described as something that reliably produces courageous behavior. It is difficult to imagine a completely non-teleonomic description of the exact same kind of thing. There seems to be some physical disposition wherever there is a trait, but this disposition can only be identified as such by reference to what it produces. The notion of a trait should therefore be reformed, not replaced. Instead of replacing references to traits by teleonomic descriptions, we need to realize that there is really no opposition between the two. Traits really are teleonomic trends.

In any case, Allport’s notion of teleonomy is not only older than Pittendrigh’s but also much better worked out. Like Pittendrigh, he makes clear that teleonomy is about describing end-directed phenomena, as opposed to explaining them. Like Williams, he thinks of teleonomy not as a distinctive quality of things but as a method of dealing with them. Also, Allport offers a good rationale for the suffix “-nomy”: Teleonomy is the kind of description by which an item is brought under a certain kind of law. A further virtue of Allport’s account is that he draws his distinction in a field where teleological explanation is also legitimate, so that the difference is not simply one between end-directedness vs. end-directedness plus bad metaphysics.

Given this precedent, It is unfortunate that biologists have mostly looked at Pittendrigh for an account of teleonomy. It is perhaps even more unfortunate that many of them rely on the elaboration of Pittendrigh’s account provided by Ernst Mayr. I will now turn to Mayr’s version of the distinction between teleonomy and teleology.

5. Mayr

Mayr distinguishes between teleomatic, teleonomic, and teleological processes. All three kinds of processes are directed towards certain ends, but they are so for different reasons. Teleomatic processes are end-directed because they are “regulated by external forces and conditions” (Mayr 1976, 389). In contrast, teleonomic and teleological processes should presumably be end-directed because of internal forces and conditions. More specifically, teleonomic processes owe their end-directedness “to the operation of a program” (Mayr 1976, 389), where a program is taken to be “coded or prearranged information that controls a process (or behavior) leading it toward a given end” (Mayr 1976, 393–4). This does not tell us much about programs beyond what we already know: that teleonomic processes owe their end-directedness to them. But in the present context, vagueness may well be a virtue. Mayr is well advised not to presuppose a too substantial theory of what a program is.

Mayr does not provide an equally explicit definition of teleological processes. Judging from his discussion of possible objections to the use of teleological language, “teleological” is an umbrella term that includes several kinds of bad metaphysics that are excluded from mere teleomatics and teleonomy: the assumption of a cosmic purpose, of backwards causation, or of intelligent design in nature, and all kinds of anthropomorphism (Mayr 1976, 384–6).

There are several problems with Mayr’s account of the distinction between teleomatic, teleonomic and teleological processes. The first is that it does not seem to be exclusive. As Mayr admits, “[i]f ‘teleological’ means anything it means ‘goal-directed’” (1976, 387); but if this is what “teleological” means, teleonomic and teleomatic processes are also teleological. They are goal-directed. Further, a program that directs a process towards an end is not necessarily internal to this process. For instance, the genetic code that regulates the growth of bones may be internal to the organism and the bones, but there is no clear sense in which it is internal to the process of growth. This process is therefore caused to be end-directed by external forces and conditions, and thus not only teleonomic but also teleomatic. There is thus no clear distinction between teleonomic and teleomatic processes (cf. Nagel 1977, 271).

More importantly, Mayr draws the distinction between teleomatic, teleological and teleonomic processes in terms of causes of and explanations for end-directedness. The three kinds of process are end-directed all the same, but they are so for different reasons. Teleomatic processes are end-directed because of external forces, teleonomic processes are end-directed because of the operation of a program, and teleological processes are end-directed because of backward causation, conscious deliberation, or intelligent design. Mayr distinguishes between different kinds of end-directed processes merely by distinguishing between the reasons why they are end-directed.

Classifying phenomena in terms of reasons for them is not in general a bad thing. For instance, one may distinguish the functions of organs from those of artifacts by saying that organs are items that have functions for one kind of reason, whereas artifacts have functions for another kind of reason. However, this would

not be a distinction between two *kinds* of function. A real and an artificial heart have the exact same function, in the same sense of function, although they have it for different reasons. Mayr, however, seems to want to draw a distinction between different kinds of goal directedness by reference to different reasons for goal directedness. He thus seems to assume that if two things are goal directed for different reasons, they are therefore goal directed in different ways. It is not at all clear why this should be the case.

Further, by defining teleonomy in terms of specific causes and explanations for end-directedness, Mayr misses the main point of Pittendrigh's distinction (Thompson 1987, 267–8). Pittendrigh and Allport propose using the term “teleonomy” in order to clearly separate the description and recognition of end-directed processes from their explanation. According to Pittendrigh, teleonomy should have nothing to do with the reasons for end-directedness, but only with the fact of end-directedness itself. Mayr, however, associates teleonomy with a certain kind of explanation for end-directedness.

There is, to be sure, a distinction between what Mayr does and what Pittendrigh wants to avoid. It is one thing to define teleonomic processes by reference to the way in which their end-directedness is explained and a quite different thing to explain a process by referring to its end. In the first case, end-directedness is the explanandum. In the second, the end is the explanans. Mayr does not define teleonomic processes as processes whose occurrence can be explained by reference to an end, but only as processes whose end-directedness admits of a certain kind of causal explanation.

Still, if the point of Pittendrigh's distinction is to clearly separate description from explanation, Mayr misses this point inasmuch as he builds a reference to a specific kind of explanation into the term that Pittendrigh wants to use merely descriptively. This is a bad idea for the reason mentioned above. To recall only one of them, if an explanation for a phenomenon is already built into its description, this explanation cannot later be given up without changing the topic. If teleonomic processes are defined as processes whose end-directedness is due to the execution of a program, the claim that these processes are end-directed for this reason cannot be challenged. It can only be replaced by a different claim about something else that is identified in another way.

6. Hennig

Mayr associates teleonomy with one kind of explanation for end-directedness and teleology with another. Among more recent authors, this is not uncommon. William H. Gilbert, for instance, distinguishes between teleological and teleonomic explanation and writes that a teleonomic explanation of an adaptive trait is one that refers to natural selection (1978, 304). Abdulrazaq A. Imam thinks that “[t]eleonomy refers to functional explanations based on consequences” (1989, 82). And Hayne W. Reese writes, very much in line with Mayr, that the concept of teleonomy has no use in behavioral studies because it only applies to activities that are determined by a genetic program (1994, 88).

Nicholas Thompson concludes from this that “none of the biological interpreters of teleonomy, perhaps even including Pittendrigh himself, was concerned about the distinction between description and explanation” (1987, 271). He proposes what he “fondly hope[s] will be the last definition of teleonomy to be offered in the literature”:

Teleonomy is the descriptive study of organizational properties of processes and structures without reference to any particular explanatory system. (Thompson 1987, 273)

This definition has the virtue of emphasizing Pittendrigh’s main point: That in certain areas it is legitimate to describe processes as end-directed regardless of how they and their end-directedness are to be explained. Unfortunately, Thompson’s definition cannot be the last to be offered, since it fails to do anything other than emphasizing this point. Teleonomy can hardly be the same as the descriptive study of organizational properties of processes and structures, because organizational properties and structures may well be described without any reference to ends, goals, purposes, or aims.³ If there is no reference to an end, however, it makes no sense to speak of teleonomy.

Let me therefore advance my own account of the distinction between teleonomy and teleology. Any satisfactory account of the distinction between teleology and teleonomy must satisfy the following conditions.

First, the distinction between teleonomy and teleology should not be taken to be one between different kinds of end-directed things. There is nothing wrong with calling things and processes teleological, if this is taken to mean that they can be described or explained by reference to ends. But the distinction between teleology and teleonomy is not a distinction between different kinds of things or processes. It is a distinction between different ways of thinking and talking about things and processes.

Second, the terms “teleology” and “teleological” should be understood to refer to any discourse concerning ends, and to all proper objects of such discourse. Teleonomy should be taken to be a special kind of this discourse. Teleology in the restricted sense that Ghiselin, Pittendrigh and others have in mind should be referred to by a specific term, such as “cosmic” or “intentional teleology.” If this condition is observed, it does not any longer appear possible to replace all teleological discourse by teleonomic descriptions.

Third, teleonomy should differ from teleology by being more closely associated with the identification and description of end-directed items, rather than with explanations by reference to their ends or explanations of their end-directedness. In general, the teleonomic description of a phenomenon should involve references only to what may be directly observed (in the sense in which one can directly observe what an agent is doing). It should not refer to intentions other than

³ I have argued above that in order to describe something as an ongoing movement, one must describe it as directed at an end. Otherwise, it will not be described as a movement at all. Organizational structures and properties, in contrast, may be studied descriptively without mentioning that they have anything to do with organization. They need not be studied *as organizational* structures and properties, but rather simply as some kind of complex structures and properties.

those that are manifest in actions, nor to purely mental states or events, divine or human, or genetic codes and other kinds of mechanisms and programs. As Allport writes:

Our point here [...] is that such end-effects have their place merely in describing the kind of behavior now before us; we do not regard them as a goal toward which that behavior is driven by some internal force or purpose. The goal has no place for us, methodologically, except in the act itself. (Allport 1937, 206)

The distinction between teleology and teleonomy thus hangs on the distinction between such ends of an end-directed process that are “in the act itself” and other ends that are not. This latter distinction may be explained as follows. In many cases, we can answer the question what an agent is doing simply by saying what she is aiming at. If someone is swinging an axe in order to chop wood she is chopping wood, and if she is chopping wood in order to make firewood she is making firewood, all of this by chopping wood and swinging the axe. We can directly observe her swinging the axe, chopping the wood, and making the firewood. Further, we may ask why she is swinging the axe and, upon receiving the answer that she is chopping wood, go on asking why she is chopping wood, and so on. However, as Elizabeth Anscombe puts it, “there is a break in the series of answers that one may get to such a question” (1963, p. 38). For instance, a person who is chopping wood in order to make a fire is not already making the fire by chopping wood. Making a fire is not an end “in the act itself,” that is, the action in question cannot be properly described as an act of making a fire. Therefore, we cannot simply go on and ask why the person is making the fire – for she is not in fact making the fire yet. Rather, the appropriate question to ask would be: “Why does she *intend* to make the fire?” This is a rather different question. It does not any longer concern an end that is “in the act itself.” Instead, it is a question about an intention that is not yet manifest in an observable action, and this is the kind of thing that Allport and Pittendrigh wanted to leave out of teleonomy. The aim of making a fire does not any longer belong to any teleonomic description of the act of chopping wood.

<i>internal ends</i>	<i>external end</i>
swinging the axe	
chopping wood	making a fire
making firewood	

Therefore, in order to distinguish between teleonomy and teleology, we need to get a firm grip on Anscombe’s “break in the series.” Let us call an end “internal to a process” if the process may as well be *described* in terms of these ends. Further, let an end be “external to a process” if the process can at best be *explained* by reference to these ends, but not described in terms of it. The distinction between internal and external ends should not be confused with the distinction between proximate and remote ends, or specific and general ends. Consider, for instance, the following example given by Floyd Allport and Ray Musgrave (1941, 327):

Woman picks up dish from floor

Woman picks up milk bottle

Woman pours milk into dish from bottle

Woman sets dish on floor

Woman speaks to dog: all right, you may have your breakfast now

Allport and Musgrave call this a “telic series.” Each of the actions listed is described in terms of a proximate and specific end, but they also all serve the more remote and general end of feeding the dog. Note, however, that this remote end is still *internal* to many of the listed actions. While the woman is performing them, one may often describe what she is doing as feeding the dog. For instance, she is not only pouring milk into the dish in order to feed the dog, she is also feeding the dog by pouring milk into the dish. In contrast, whereas she is picking up the milk bottle in order to pour milk into the dish, she is not pouring milk into the dish by picking it up. Pouring milk into the dish is an external end of picking up the bottle, but it is not a more general end. Further, although she picks up the dish and the bottle in order to feed the dog, she neither picks up the dish by picking up the bottle nor does she pick up the dish in order to pick up the bottle. Here, both acts are directed at the same end, but none of them is an end of the other.

Once the distinction between internal and external ends is clear, teleonomy may be defined as the kind of teleological discourse that is limited to the description and explanation of phenomena in terms of their internal ends, as opposed to their external ends. Note that thus explained, both teleology and teleonomy may involve explanations. For, as Michael Thompson points out, we often explain an action by simply giving it a more general teleonomic description:

[...] the explanation of action as it appears most frequently in human thought and speech is *the explanation of one action in terms of another*:

“Why are you pulling that cord?” says one

– “I’m starting the engine,” says the other; ... (Thompson 2008, 85).

In such cases, we answer the question “Why” by re-describing the action in question. Starting the engine is an internal end of pulling the cord. Allport and Pittendrigh would probably say that it is “in the act itself” and can be discerned “fully by direct observation.” Once we know what is happening, we can literally see the agent start the engine, as much as we can see her pull the cord. These kinds of explanations are therefore not yet teleological, they are still teleonomic. They are explanations in terms of internal ends, not by reference to purposes that lie outside the action to be explained.

This does not invalidate Pittendrigh’s point that teleonomy is concerned with description rather than explanation. The distinction between description and explanation is not exclusive, since many descriptions of end-directed processes may also serve as explanations. Still, it plays an important role in distinguishing between teleonomy and teleology. Teleonomy is the kind of discourse about end-directed phenomena that involves internal ends only, and the internal end of an item is one in terms of which the item may be described as well as explained.

Other kinds of teleology involve ends in terms of which phenomena may only be explained but not described. Pittendrigh seems to assume that teleonomic systems can only be described and not explained by reference to ends, and that teleological systems may be described as well as explained in terms of ends. In fact, it is the other way around: Teleonomy is concerned with ends that may be descriptive as well as explanatory, whereas other kinds of teleological discourse are concerned with the ends of phenomena that can only figure in their explanation but not in their description.

Note further that according to the present account, there is no sharp boundary between teleonomy and teleology. To be sure, there are clear cases of teleonomy, where one does not explain but describe a phenomenon in terms of an end, and there are clear cases of the opposite, where one explains a phenomenon by reference to an end that cannot be used in order to describe the explained process. In between, however, there is a grey area – it may be controversial whether a phenomenon can be described in terms of an end or not (cf. Anscombe 1963, §23, 40). For some purposes it might be obvious that an animal is eating, for others we might only count as obvious that it is chewing and explain this by saying that it chews in order to eat. In still other cases, it might not even be obvious that an animal is chewing, and we might want to say that it moves its jaws in order to chew. It depends on the context and on our background knowledge whether we take a reference to an end to be teleonomic or not.

This, then, is how the distinction between internal and external ends works with regard to intentional actions. A teleonomic description of an intentional action is one in terms of ends that may serve to both describe and explain this action. A (non-teleonomic) teleological explanation of an action is one in terms of ends that may only serve to explain it, but not to describe it.

The external ends of a phenomenon are not directly observable in this phenomenon, since it may not be described and identified as such in terms of these ends. This does not mean that external ends must always involve conscious representations or other intentional states of an agent or designer, which cannot be directly observed. Rather, the external end of an end-directed movement may be any kind of end that is typically achieved by movements of this kind. It may well be directly observable, even though it is not directly observable *in* the movement that it explains. It may be the directly observable end of a larger movement of which the movement that is explained by it is only a part. If this is so, the larger movement may be teleonomically described in terms of an end in terms of which its part may only be explained but not described.

Therefore, the distinction between internal and external ends may as well be applied to phenomena that do not involve intentional agency. When a bird arranges sticks to build a nest, we may describe what it does in terms of its end: We may say that by arranging the sticks, it is building a nest. Building the nest is thus an internal end of what the bird is doing. In contrast, laying eggs is an external end of both arranging the sticks and building the nest. We may say that the bird is building the nest in order to lay eggs, but it would be wrong to say that by building the nest, it is already laying the eggs. The same is true for movements that are even more remote from intentional actions. The movements of an

animal's heart may be described and identified as pumping blood, but they also serve other ends by reference to which they may be explained, without it being appropriate to identify and describe them in terms of these ends. For instance, they contribute to cellular respiration, but they cannot be described or identified as instances of cellular respiration. The heart pumps in order that cellular respiration takes place, but it does not engage in cellular respiration by pumping. Still, cellular respiration is as directly observable as the movements of the heart.

The difference between teleonomic descriptions and teleological explanations rests on the one between internal and external ends, which does not in turn involve the assumption of backwards causation, conscious design, or intentional agency. It turns out that both kinds of teleological discourse are useful and legitimate in biology. Although biologists are well advised to clearly distinguish between teleonomy and other forms of teleology, they should not attempt to replace one by the other.

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