Kant on the Special Sciences

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ABSTRACT

While Kant was arguably as deeply engaged with the emerging special sciences of his time as he was with Newtonian physics, there is a deep tension in his treatment of these disciplines. On the one hand, Kant endorses a reductionist approach in natural science. On the other hand, Kant is committed to a variety of anti-reductionist positions in empirical psychology, chemistry, and the emerging biological sciences. This chapter examines the precise form that Kant’s anti-reductionism takes in each of these domains and the corresponding set of questions about the extent to which each of these constitutes a genuine science for Kant.

KEYWORDS: psychology, chemistry, biology, reduction, science, proper science

1. Introduction

Kant’s deep engagement with Newtonian physics, which he considered to be the model of natural science, is well-known. So, too, is the fact that one of Kant’s principal philosophical aims was to provide the metaphysical foundations for Newtonian science. In the *Critique of Pure Reason*, Kant provides what he calls the ‘transcendental part’ of the metaphysics of nature (MFNS 4: 470), which concerns the most general laws of pure natural science, e.g., that every event has a cause and that substance is permanent. In the *Metaphysical Foundations of Natural Science*, Kant supplements this with a special metaphysics of nature that grounds the general laws that govern matter as such, which, for Kant, are laws of motion.

In the Preface to the *Metaphysical Foundations*, Kant outlines the conditions that a discipline must meet to count as a science properly so-called, and he argues that only mathematical physics meets these conditions. Kant describes chemistry as a science only ‘improperly so-called’ and claims that ‘the empirical doctrine of the soul’ is even further removed from the ranks of proper science (MFNS 4:470-2). It is tempting to conclude from these remarks that Kant was dismissive of what we might call the ‘special sciences’—disciplines such as psychology, chemistry, and biology. Or that Kant believed that these disciplines could only become genuine sciences if they radically reformed themselves to accord with the demand that ‘every doctrine of nature must finally lead to natural science’, i.e., to physics (MFNS 4:469). It is tempting to conclude, in other words, that Kant thought these disciplines could only become genuine sciences if their subject matter could be reducible, in some sense, to the small number of powers and forces of matter as such.

Kant’s views on the special sciences are, however, considerably more complex than this. In fact, Kant was deeply engaged with the latest developments in these disciplines (especially chemistry and what would soon become biology) and endorsed approaches in these disciplines that were not the ones that would be most conducive thoroughgoing reductionism. Thus, alongside Kant’s commitment to physics as the paradigm of natural science, an anti-reductionist thread runs through Kant’s treatment of empirical psychology, chemistry, and biology, although this anti-reductionism takes a different form in each of these disciplines.

In this chapter, I examine the sense in which Kant is an anti-reductionist with respect to each of these disciplines, along with further questions this raises about the possibility for these disciplines to become sciences, either properly or improperly so-called. An initial goal of the chapter is to suggest that Kant did not limit genuine science to what he calls science ‘properly so-called’. In the words of Robert Butts, Kant has a conception of ‘science, not as a finished system, but as a research program’ (1990: 1). A further goal is to suggest that although Kant considered reduction to be an ultimate goal within chemistry and biology (though not psychology), he did not think that this goal would necessarily be met, nor that it should be pursued at the expense of anti-reductionist research programs that have proven more successful in discovering empirical laws of nature.

1. Kant on Proper Science and Reduction

I want to begin by briefly looking at Kant’s remarks on natural science in the Preface to the *Metaphysical Foundations of Natural Science* (MFNS), where Kant is often taken to deny that disciplines such as psychology and chemistry could become genuine sciences. Although Kant sometimes uses the term ‘science’ (*Wissenschaft*) in a loose sense to refer to any discipline that contains a systematic body of cognition, including history, the study of antiquities and classics, anthropology, empirical psychology, natural description and natural history,[[1]](#footnote-1) in the Preface to the MFNS, Kant outlines the conditions that a discipline must meet to be a natural science ‘properly so-called’ (henceforth: proper science) and argues that only physics meets these conditions.

To be a proper science, a discipline must (1) be systematic; (2) involve an interconnection of grounds and consequences (in this case, causal laws), and (3) contain fundamental laws that are apodictically certain (MFNS 4:468).[[2]](#footnote-2) To meet condition (1), a discipline must be organized by a guiding principle (empirical or rational) that demarcates its subject matter and which allows us to form a ‘whole’ of cognitions, in which more specific concepts and laws can be derived from more general concepts and laws (A832/B861). To meet condition (2), a discipline needs to contain not merely an organized collection of observations, but specifically a system of causal laws through which observed phenomena can be explained. We establish empirical causal laws through experience (B263), by which Kant means experiments and controlled observations that are guided by hypotheses (Bxiii). Merely empirical laws, however, are not apodictically certain. Indeed, although Kant refers to merely empirical laws as laws, he also insists that, strictly-speaking, laws are *necessary* rules, and merely empirical laws lack necessity (A91/B124). Knowledge of necessity, for Kant, can only be a priori. Thus, to meet condition (3), the doctrine must contain ‘a priori cognition of natural things’ (MFNS 4:470), which in turn requires the application of mathematics.

Kant’s argument for the mathematization requirement is as follows:

P1: ‘To cognize something *a priori* means to cognize it from its mere possibility’;

P2: ‘the possibility of determinate natural things cannot be cognized from their mere concepts’;

P3: ‘Hence, in order to cognize the possibility of determinate natural things…the *intuition* corresponding to the concept [must] be given *a priori’*, that is, that the concept be constructed’

P3: ‘[R]ational cognition through the construction of concepts is mathematics’;

C: A ‘pure doctrine of nature concerning *determinate* natural things (a doctrine of body or doctrine of soul) is only possible by means of mathematics’ (MFNS 4: 470).

Importantly, this is not simply the requirement that a discipline make use of quantitative methods.[[3]](#footnote-3) It is the much stronger requirement that the fundamental concepts of the science be constructible a priori, which, in turn, allows for the formulation of universal and necessary laws.[[4]](#footnote-4) The object of study in physics is matter, and although the concept of matter is empirical, the fundamental determination of matter is motion, which allows for a priori construction.[[5]](#footnote-5) This, in turn, allows us to formulate mathematical laws of motion. For Kant, then, only physics, whose fundamental laws can be cognized a priori, meets the conditions for natural science properly so-called. ‘Natural science’ he writes, ‘is either a pure or applied doctrine of motion’ (MFNS 4:476-7).

If a doctrine contains empirical causal laws that lack an a priori foundation, it is a natural science only ‘improperly’ so-called (henceforth: improper science). It only meets conditions (1) and (2) above. And, a doctrine that only meets condition (1), that is, it contains systematically ordered information but not a system of causal laws, is merely a historical doctrine of nature. This includes natural description (i.e., systems of classification based on observed similarities of objects) and natural history.

If we combine Kant’s remark that only physics is a proper natural science with his claim that ‘every doctrine of nature must finally lead to natural science and conclude there, because this necessity of laws is inseparably attached to the concept of nature, and therefore makes claim to be thoroughly comprehended’, it looks like Kant advocates a reductionist program in the sciences (MFNS 4:469). Indeed, at the end of the Dynamics chapter, where Kant presents his dynamical theory of matter in terms of attractive and repulsive forces, Kant writes that ‘all natural philosophy consists…in the reduction of given apparently different forces to a smaller number of forces and powers that explain the actions of the former’ (MFNS 4:534). At the same time, however, Kant expresses skepticism about reduction in chemistry and denies that it will be possible in psychology and in the investigation of organisms.

In the remainder of this chapter, I examine the sense in which Kant is an anti-reductionist with respect to each of these disciplines, along with the further questions this raises about the possibility for these disciplines to become sciences, either proper or improper.

1. Kant on Psychology

The object of study in psychology is the mind or soul. Kant consistently rejects the

ontological reduction of the soul (i.e., materialism), although his position is subtle. An important result of Kant’s Critical philosophy is that we simply cannot have any knowledge of the ultimate nature of the soul (A383). For all we know, it is possible that the supersensible ground of both outer appearances (material bodies) and inner appearances (the soul or thinking nature) is the same kind of thing (B428). We can thus neither confirm nor deny ontological reduction at this level. However, Kant does reject ontological reduction within the domain of appearances.[[6]](#footnote-6) Consider the following passage from the MFNS:

*Life* is the faculty of a *substance* to determine itself to act from an *internal principle*… Now we know no other internal principle in a substance for changing its state except *desiring*, and no other inner activity at all except *thinking*, together with that which depends on it, the *feeling* of pleasure or displeasure, and *desire* or willing. But these actions and grounds of determination in no way belong to representations of the outer senses, and so neither [do they belong] to the determinations of matter as matter. Hence all matter, as such, is *lifeless*. (4:544)

Here we see that Kant is relying on the distinction between the two kinds of appearances to reject materialism about the mind.[[7]](#footnote-7) Material bodies are objects of outer sense, while mental states can only be objects of inner sense. Kant is keen both to secure the inertia or ‘lifelessness’ of matter and the independence of the thinking self from matter.

This independence, however, might come at the price of relinquishing causal laws in psychology. One reason for thinking that Kant denies that there can be psychological laws stems from his characterization of causal laws in terms of changes or alterations of substances. In the Second Analogy, Kant formulates the law of causality in terms of alterations—‘all alterations occur in accordance with the law of the connection of cause and effect’ (B232)—and he notes that ‘the concept of alteration presupposes one and the same subject as existing with two opposed determinations, and thus as persisting.’ (B233). But since we do not have an intuition of the soul, we cannot determine that there is a persistent substance underlying psychological changes.[[8]](#footnote-8) On this line of reasoning, Kenneth Westphal concludes that psychological changes are not subject to causal laws (2004: 232).

However, there is certainly considerable textual evidence that Kant thinks there are psychological laws. In the MFNS he explicitly refers to the ‘phenomena of inner sense *and their laws*’ (MFNS 4:471, italics added). He consistently refers to the laws of association as empirical psychological laws that determine inner appearances (A100, B152; Anth. 7:176, 220).[[9]](#footnote-9) And in his discussion of the Third Antinomy, Kant is clear that human actions, as appearances in nature, result from the empirical characters of human beings, and are subject to ‘constant natural laws, from which, as their condition, they could be derived’ (A539/B567). Inner appearances belong to nature just as much as outer appearances, and nature is governed by causal laws. (Prol*.* 4:295).

But how can we formulate these laws if we do not have an intuition of the underlying substance of psychological states? There are at least three possibilities for responding to this worry:

1. *We hypothetically assume an underlying substance of mental states even though we cannot further determine this substance.*

On this view, defended by Patrick Frierson, what is needed to formulate psychological laws is simply the assumption that there is ‘*some* substance that underlies the changes observed in inner sense’ (Frierson 2014: 26). This goes with a reading of the First Analogy according to which ‘the ascription of a substance as the subject of changes does not require that we actually know what that substance is’ (Frierson 2014: 25).[[10]](#footnote-10) In this case, although we do not have an intuition of the underlying substance of psychological changes, and thus cannot further determine this substance, our awareness of mental states and powers gives us a reason to assume it. Furthermore, according to Frierson, Kant consistently allows for the empirical use of the concept of a substantial soul (2014: 24).

1. *The Regulative Idea of the Soul serves as the Analogue of a Schema for the Category of Substance*

While the previous response allows for the empirical application of the category of substance, Katherina Kraus argues that we cannot apply the schematized category of substance to inner intuition. But rather than adopt Westphal’s conclusion, Kraus argues that the idea of the soul allows for a regulative employment of the category of substance that allows for the formulation of psychological laws (2019: 188).[[11]](#footnote-11) The soul provides an ‘analogue of a schema’ (A655/B693) for substance by allowing us to project a mental whole of which the mental states we cognize are considered as parts, even though we do not cognize this soul as a persistent substance in time.

1. *There are psychological causal laws*, *but we cannot cognize them.*

A third possibility, which accommodates both Kant’s insistence that there are psychological laws with his apparent denial that we can cognize the underlying substance of mental states, is to accept that there are psychological laws but take Kant to deny that we can ever have cognition of these laws.[[12]](#footnote-12)

While I do not have space here to defend response (1), there is certainly textual evidence that Kant allows for the empirical use of the concept of a soul as the substance underlying thinking nature (A342/B400; A379; Frierson 2014: 24). Furthermore, Kant suggests that the persistence of the soul ‘in life,’ where it is connected to the body, is uncontroversial (B415; Prol. 4:335). Importantly, however, even if Kant does allow for the empirical use of the concept of a soul, this does not necessarily mean that we will be able to discover *causal* laws in psychology. Indeed, Kant appears to rule out not only a proper science of psychology, but even an improper science of psychology.

Kant denies that psychology can be a proper science because it cannot meet the mathematization requirement. Mathematics, Kant claims, is not even ‘applicable to the phenomena of inner sense and their laws’ (MFNS 4:47). Even if we can to some extent apply quantitative methods to the phenomena of inner sense,[[13]](#footnote-13) the only aspect of our inner states that we can construct a priori as a magnitude is their temporality. This can give us *some* a priori knowledge about inner states, e.g., that because time is a continuous magnitude, the ‘flux of inner changes’ will be subject to the law of continuity.[[14]](#footnote-14) As Kant notes, however, this is hardly the extension of cognition that we expect from a proper science.

Kant also appears to rule out an improper, i.e., experimental, science of psychology on methodological grounds.[[15]](#footnote-15) There are three problems (MFNS 4:471): (1) the very nature of mental states precludes experimentation of the kind we perform in chemistry or experimental physics because ‘the manifold of inner observation cannot be held separate or recombined at will’; (2) other thinking subjects do not allow us to perform psychological experiments on them; and (3) observation (of ourselves or others) changes the state of the subject. Kant thus claims that psychology ‘can never become anything more than a historical doctrine of nature’. There is a close connection between improper science and observation and experiment because it is through the latter that we establish empirical causal laws. Thus, the methodological challenges faced by psychology with respect to observation and experiment would seem to preclude it becoming even an improper science.

Several interpreters suggest that the above concerns are specifically directed at the introspectionist psychology of Christian Wolff and Alexander Baumgarten.[[16]](#footnote-16) Wolff, who accords to empirical psychology the same status as experimental physics, holds that we can establish the ‘characteristics of the human soul’ on the basis of inner experience, that is, through attention to our own conscious states.[[17]](#footnote-17) Baumgarten similarly takes inner sense to be the source of knowledge in empirical psychology.[[18]](#footnote-18) In this context, then, Kant’s remarks can be taken, not as an indictment of scientific psychology *tout court*, but as a criticism of the introspectionist approach of Wolff and Baumgarten. Furthermore, interpreters suggest that Kant’s own response to methodological problems with introspection is to extend the data of psychology to include the data of outer sense, i.e., human behavior and action (Sturm 2001: 174; Cohen 2010: 57).[[19]](#footnote-19)

There are two points to make in response to this strategy. First, given the way that Kant demarcates disciplines, it is not clear that research that relies on the observation of human behavior would belong to what Kant considers to be psychology. In his discussion of the Third Antinomy, where Kant insists that, at the empirical level, human behavior is determined by natural laws, he refers to *anthropology* as the science that is tasked with discovering these laws (A550/B578). Furthermore, in the Doctrine of Method, Kant notes that a properly developed empirical psychology will belong to anthropology (A849/B877). What Kant considers psychology (as opposed to anthropology) appears to be limited to the data of inner sense. And, given the methodological challenges discussed above, Kant thinks that this doctrine can never be more that systematic description.[[20]](#footnote-20)

The second point to make here is that Kant does not limit his methodological concerns to introspectionist psychology but extends them to anthropology as well, noting that these concerns ‘make it difficult for anthropology to rise to the rank of a formal science’ (Anth. 7: 121). In other words, even if empirical psychology supplements the data of introspection with the observation of human behavior, this will not necessarily help it to become a science, even improperly so-called. But Kant is at least more optimistic about the future prospects of psychology cum anthropology. In the first Introduction to the *Critique of the Power of Judgment*, he claims that ‘the only true obligation of empirical psychology’ is to ‘make psychological observations…and thus to gather material for rules of experience that will be systematically connected in the future’ (CJ, 20:239).

1. Kant on Chemistry

In the Preface to the MFNS, Kant cites chemistry as an example of a natural science

‘improperly’ so-called. As Kant sees it, chemistry, which studies the forces of matter responsible for the processes of dissolution (i.e. chemical combination) and decomposition, ‘still’ lacks a concept of chemical actions that can be constructed a priori and thus ‘no law of the approach or withdrawal of the parts can be specified according to which…their motions and all the consequences thereof can be made intuitive and presented a priori in space’ (MFNS 4:470-1). Because chemistry cannot meet the mathematization requirement (a requirement that Kant thinks ‘will only be met with great difficulty’), it is a ‘systematic art or experimental doctrine’ but not a proper science (MFNS 4:471).

It is easy to read Kant as here dismissing the chemistry of his time in relation to rational mechanics. Indeed, some interpreters hold that because chemistry does not meet the mathematization requirement and is not a proper science it does not count as a science at all for Kant. Nayak and Sotnak claim that chemistry is not a ‘genuine science’ for Kant because it only contains empirical generalizations (1995: 148). Gaukroker claims that the ‘wholly empirical dimension’ of disciplines such as chemistry is, for Kant, ‘a failure’ (2016: 5).

However, there are two problems with this line of interpretation. First, and more generally, the identification of ‘genuine science’ with ‘proper science’ overlooks that Kant has a more empirically-minded conception of what constitutes scientific practice that is informed by the experimental tradition in natural philosophy and of which chemistry is a prime example even though it is only an improper science.[[21]](#footnote-21) Although Kant departs from some within this tradition (e.g. Bacon and Boyle) in emphasizing the role of reason in guiding empirical inquiry, Kant nevertheless acknowledges the importance of experiment and observation for establishing empirical laws of nature. As we have just seen, Kant’s main criticism of empirical psychology is not that it cannot formulate universal mathematical laws but that its subject matter is not amenable to the kind of observation and experiment that is at the heart of empirical inquiry.

Several other texts support attributing a more empirically minded account of scientific practice to Kant, which would challenge the identification of genuine science with only proper science. In the Preface to the B-Edition of the *Critique of Pure Reason*, Kant approvingly cites Stahl’s chemical experiments alongside the physical experiments of Galileo and Toricelli as setting natural science on a secure path (Bxii-xiii). Furthermore, as Kant remarks in the *Danziger Physik* (lecture notes from his Physics course in the summer of 1785), ‘only the smallest part of natural events can be mathematically demonstrated’ (DP 29:97; trans. from Friedman 2013: 245). Although we can explain ‘why snow falls to the earth’ in ‘accordance with mathematical principles’, we cannot explain ‘how vapours are transformed into drops or dissolved’ through such principles. Instead, ‘this must be explained from universal empirical laws of chemistry’ (29: 97-8). In other words, when Kant calls chemistry a ‘systematic art’ and an ‘experimental doctrine’, this is not to deny that it is a theoretical science that yields empirical laws.[[22]](#footnote-22)

Second, Kant’s remarks in the Preface to the MFNS should not be taken as dismissing chemistry because it fails to offer mathematical force laws of chemical corpuscles, as Nayak and Sotnak claim (1995: 148). Instead, Kant’s remarks should be understood as an endorsement of a Stahlian experimental approach to chemistry, especially in light of the failures of Newtonian chemists to deliver mathematical laws of chemical combinations.[[23]](#footnote-23) Some context will help us to appreciate this point.

Chemists working within a Newtonian framework hoped to explain chemical combinations in terms of attractive and repulsive forces that operate on the parts of the combining substances.[[24]](#footnote-24) Indeed, they often identified the tendency of certain substances to combine with each other (chemical affinity) with attraction.[[25]](#footnote-25) The problem, however, is that chemical attractions, unlike universal gravitation, do not act proportionally to the quantity of matter. To address this problem, Newtonians postulated ‘short range’ forces of attraction (and repulsion) to account for the selectiveness of chemical combinations, where the central thought was that these forces were affected at short distances (i.e. minute spaces between particles) by the properties (e.g. shape, size, density, texture) of the particles of matter in the combining substances. But the appeal to the unobservable properties of particles matter was not experimentally tractable.

Stahlian chemists, by contrast, appealed to distinct species of matter to explain chemical phenomena. Stahl, working with the traditional chemistry of principles (which combined Aristotle’s fundamental elements of earth, air, water, and fire, with Paracelsus’ later principles of salt, sulphur, and mercury), was notable for appealing to a single principle to explain combustion and calcination, namely, phlogiston. He provided empirical support for his hypothesis that phlogiston was the bearer of inflammability through experiments in which he heated metals to produce metal calxes (oxides), thus ‘removing’ the phlogiston, but then reconstituted the metals by, in Kant’s words, ‘putting it back again’ (Bxiii), which he did by reheating the calxes with charcoal, a non-metallic substance thought to be rich in phlogiston. The additional principles of earth were salt (the principle of weight, solidity, and density) and mercury (the principle of metallic properties). Stahl classified water as a principle, but he considered fire and air as instruments that do not enter into chemical compounds but serve as either aids or retardants of chemical combinations.[[26]](#footnote-26)

By referring to chemistry as an ‘experimental doctrine’ Kant is indicating his support for the more experimentally tractable approach to the subject. That Kant broadly endorsed Stahlian phlogistic chemistry is clear from passages in the first *Critique* and the *Danziger Physik*. As we have seen, Kant praises Stahl’s experiments in the Preface to the B-Edition. In the *Danziger Physik*, he remarks that ‘Phlogiston or pure elementary fire has been first introduced in chemistry by Stahl, who proved it to be an element that is of the same kind in all combustibles’ (29:163; trans. from Carrier 2001: 217). And, as Martin Carrier (2001) observes, in the Appendix to the Dialectic in the first *Critique*, Kant’s reference to three chemical elements and two chemical instruments accords with Stahl’s theory.

Kant’s discussion of the Stahlian chemistry of principles in the Appendix to the Dialectic, however, raises several questions about how we should understand the role of ideas of reason in chemistry. In the Appendix, Kant presents Stahlian chemistry as an example of the proper use of ideas of reason to guide empirical inquiry. Kant notes that although we do not find pure earth, pure water, or pure air in nature,

concepts of them are required (though as far as their complete purity is concerned, have their origin only in reason) in order to appropriately determine the share that each of these natural causes has in appearance; thus one reduces all materials to earths (mere weight as it were), to salts and combustibles (as force), and finally to water and air as vehicles (machines, as it were, by means of which the aforementioned operate), in order to explain the chemical effects of materials in accordance with the idea of a mechanism. (A646/B674)

Although Kant identifies pure elements with ideas of reason in passage, it is not entirely clear how we should understand this identification. One suggestion is that Kant thinks of pure elements (e.g. pure earth) merely as idealizations that promote the systematic classification of natural substances (Okruhlik 1986: 312). Kant’s remark that ‘as far as their complete purity is concerned’ these elements ‘have their origin only in reason’ supports this suggestion. However,

Carrier (2001: 226) argues that it is because principles are postulated as that which explain the properties of ordinary substances that they cannot in turn be such substances. Here it helps to recall that on the traditional chemistry of principles, the principles are not to be identified with the ordinary substances that bear the same name.

Michael Bennett McNulty similarly argues that it is because elements or principles serve as ‘unconditioned causal grounds’ (2015: 5) that they must be identified with ideas of reason that transcend possible experience. On McNulty’s interpretation, we make a number of empirical observations in chemistry (e.g. that various metals can be calcined), but our search for systematicity leads us to postulate an underlying ground for the regularities we observe (e.g. Phlogiston, as the basis of calcinability and combustion). <Phlogiston> is not an empirical concept, but an idea of reason, which is thought as the *unconditioned* ground of certain chemical phenomena. Furthermore, McNulty takes the grounding of chemical laws in ideas of reason to confer necessity on these laws (on the assumption that necessity requires an a priori grounding and ideas of reason are a priori).

The main problem with this interpretation is that Kant insists that ideas of reason, although they have a legitimate role to play in empirical science, ‘cannot be used to ground the explanation of actual appearances through an hypothesis’ (A771/B799). Ideas of reason are merely regulative. They can guide us in our search for systematicity, but they cannot themselves figure in explanatory hypotheses. We must distinguish, then, between the principles as ideas of reason and the actual substances that are hypothesized by the chemist, even if this means that chemical laws lack necessity. But we can agree with McNulty that Stahlian chemistry, while still a part of physical science in the broad sense, is not reducible to rational mechanics, because it does not ground chemical phenomena in the motions of the particles of the interacting substances but in different species of matter (but again, where these must be understood in terms of actual substances and not corresponding ideas of reason).[[27]](#footnote-27)

What is still unclear is whether Kant’s endorsement of the Stahlian chemistry of principles reflects a merely temporary or a principled anti-reductionism. McNulty has recently argued that, for Kant, chemistry is *in principle* irreducible to physics. Chemical changes cannot be reduced to mathematical laws of motion because they involve ‘changes to the nature or inner constitution of matter’ (2017: 107). In particular, chemical dissolutions for Kant involve absolute penetration. Any part of the solution contains the combination of the substances in the same proportion as the whole. As McNulty notes, ‘chemical dissolutions are absolute, continuous, and without clots or molecules, of reagents’ (2017: 107). Mathematical physics explains the relative penetration of the space filled by a substance through compression, but compression cannot explain the absolute penetration of a substance by another (MFNS 4:501). Michael Friedman is more optimistic on this front. While Friedman acknowledges that Kant does not attempt to reduce chemical phenomena to mathematical physics, he does not take Kant to rule out the possibility of this reduction. As Friedman sees it, the ‘continuum model of matter’ that underlies Kant’s conception of chemical phenomena is ‘intended to describe the empirical behavior of matter as rigorously as possible without either endorsing or rejecting any deeper explanatory models that may or may not later be discovered’ (2013: 254).

Without settling the question of whether Kant thinks that chemistry will one day be reducible to physics, what is important for our present purposes is that although Kant clearly endorses reduction as a goal of scientific explanation, he is perfectly willing to endorse an anti-reductionist research program in chemistry if it is more experimentally tractable, even if this means that chemical laws lack necessity.

1. Kant on Biology

The term ‘biology’ is not used to describe the study of organisms until twelve years after the publication of the *Critique of the Power of Judgment*. For Kant, the disciplines that would soon belong to biology were considered part of natural history, which, as we have seen, he classifies as a historical doctrine of nature in the MFNS. Nevertheless, Kant’s account of the ineliminable role of teleological judgments in the investigation of organisms commits Kant to some form of anti-reduction in biology and has important implications for whether Kant thinks that there could be a genuine science of biology.

Before we turn to these issues, it will help to first explain why Kant thinks that biology necessarily involves teleological judgments. To begin, certain natural objects have forms that display an apparent necessity in their organization, but which are contingent with respect to the mechanical laws of nature. Take Kant’s example of the structure of a bird. We understand the arrangement of its parts, for example, ‘the hollowness of its bones, the placement of its wings for movement and of its tail for steering’ as in some sense necessary. But, as Kant notes, this structure is contingent from the perspective of the mechanical laws of nature: ‘nature, considered as a mere mechanism, could have formed itself in a thousand different ways without hitting precisely upon this unity in accordance with such a rule’ (CPJ 5:360). We can only understand the structure of an organism as necessary by relating it to a rule that would determine its form, that is, by viewing it as a purpose, where a purpose is ‘the object of a concept insofar as the latter is regarded as the cause of the former’ (CPJ 5:220). We thus explain the organization of the parts of an organism in the way that we explain the organization of the parts of an artefact such as a watch or a house. Mere mechanical laws of nature—that is, laws that govern matter as such, even if we include chemical laws—do not explain the organization of a watch.[[28]](#footnote-28) To explain this organization, we appeal to the concept that guides the construction of this object (and thus the end for which it was created).

But the analogy between organisms and artefacts only goes so far. While artefacts are products of human agency—it is the watchmaker, after all, who organizes the parts of the watch—organisms are not products of external agency. As strange as it may sound, Kant describes organisms as being both causes and effects of themselves. Using the example of a tree, Kant cites three different ways in which an organism is cause and effect of itself (and thus self-organizing or self-producing): (1) reproduction; (2) nutrition and growth; and (3) preservation. A tree is the effect of previous trees of the same species but in reproducing becomes the cause of itself as species. In growth, an individual tree transforms nutrients it receives from the environment to grow and maintain itself. Finally, the parts of the tree are mutually dependent for their preservation; the leaves are effects (products) of the tree itself yet are causes of the continued existence of the tree. The fact that organisms are self-producing in these ways make them quite unlike artefacts, even though, like artefacts, we understand them as purposes.

In understanding organisms as *purposes*, we understand the organization of their parts in terms of the ‘idea of the whole’, but in understanding them as *natural* purposes, we take it that ‘the parts [are] combined into a whole by being reciprocally the cause and effect of their form’ (CPJ 5:373). Thus, to make sense of the structure of an organism (i.e. the parts that it has and the way that they are arranged) and the organic processes (e.g. nutrition and growth) that we observe, we must appeal to teleology. We judge that its parts are organs that serve some purpose in relation to each other and to the whole organism and we judge that processes such as nutrition and growth are goal-directed. The teleological principle that guides our investigation of the structure of organisms is that ‘an organized product of nature is that in which everything is an end and reciprocally a means as well’ (CPJ 5:376). And for Kant, we cannot view organisms in functional terms without at the same time assuming that they are ultimately products of an intentionally acting cause (CPJ 5:398).

Kant insists, however, that we must remain agnostic about the source of organized matter with its self-organizing powers. In his discussion of the Antinomy of Reflective Judgment, he claims that we cannot make any determinate claim about the origin of organisms, even if we must reflectively judge that they are only possible as ends. We can neither determine that ‘All generation of material things is possible in accordance with merely mechanical laws’ nor that ‘Some generation of such things is not possible in accordance with merely mechanical laws’ (CPJ 5:387). Thus, the starting point of biological investigation is matter insofar as it is already organized, and we must simply bracket questions about the ultimate origin of organized matter.

To determine the extent of Kant’s anti-reductionism in biology, it will help to distinguish between different kinds of reductionism:

1. Ontological reduction: the view that everything in nature can be *described* in terms of the properties and forces of matter as such.
2. Explanatory reduction: the view that we can fully *explain* natural phenomena in terms of the fundamental properties and forces that belong to matter as such.
3. Methodological reduction: the view that we should *investigate* nature using only mechanical principles.[[29]](#footnote-29)

Some scholars emphasize that Kant does not rule out the ontological reduction of organisms (Zumbach 1984: 87). While this is true, we must note that Kant also does not rule out the alternative: ontological anti-reduction. Although Kant rejects vitalism and hylozoism (which would involve a commitment to ontological anti-reduction), he also praises Blumenbach who ‘rightly declares it to be contrary to reason that raw matter should originally have formed itself in accordance with mechanical laws’ (CPJ 5:424). Kant is sympathetic to ontological anti-reduction, even if strictly-speaking, he thinks we must remain agnostic on this question.

What is clear is that Kant does not think we can fully explain the ability of organisms to produce themselves mechanically. As Kant puts it, organisms have a ‘self-propagating formative power, which cannot be explained through the capacity of movement alone (that is, mechanism)’ (CPJ 5: 374). If we set aside Kant’s agnosticism about ontological reduction, there is a further question of whether his appeal to teleological judgments in biological investigation involves merely methodological or also explanatory anti-reduction.

Some commentators read Kant as primarily a methodological anti-reductionist.[[30]](#footnote-30) On this interpretation, teleology plays an indispensable but nevertheless merely heuristic role in the discovery of physico-mechanical explanations, which are the only kind of scientific explanation that Kant would endorse. This gives us the following picture of biological investigation. The scientist adopts a teleological perspective in reflecting on the structure of plants and animals when they assume that each part of these organisms serves some purpose (and thus that the parts are *organs*) (CPJ 5:376). Identifying a purpose in turn leads the investigator to ask how the organ performs its function. But the actual explanation of how it functions is physico-mechanical. For example, the physiologist reflects on an eye as designed for sight in order to investigate the laws that govern the operation of its parts, but the actual explanation of how the various parts of the eye form an image on the retina is in terms of mechanical laws, i.e. Snell’s law of refraction (Richards 2000: 32). Similarly, one would approach organic processes such as nutrition and growth as goal-directed, but then explain these processes in terms of physico-mechanical (including chemical) laws (Van den Berg, 2011: 215-219).[[31]](#footnote-31)

There are certainly passages that support this interpretation. Kant writes that the teleological principle is ‘a heuristic principle for researching the particular laws of nature, even granted that we would want to make no use of it for explaining nature itself’ (CPJ 5:411) and that ‘where ends are conceived as grounds of the possibility of certain things, there one must also assume means the laws of the operation of which do not **of themselves** need anything that presupposes an end’ (CPJ 5:414). Furthermore, Kant claims that we have ‘an obligation to give a mechanical explanation of all products and events in nature, even the most purposive, as far as it is in our capacity to do so (the limits of which within this sort of investigation we cannot determine)’ (CPJ 5:415).

Yet, Kant *does* determine limits on how far mechanical explanations will reach. As we have already seen, Kant places the question of the generation of organisms—of how matter came to be organized in such a way that it has formative powers—beyond the scope of scientific inquiry (CPJ 5:382). As he puts it, ‘there can be no investigation in physics about the origin of organization itself’ (TP 8:179). In addition to this etiological question, Kant also suggests that we cannot fully explain organic processes such as nutrition, growth, and reproduction in purely mechanical terms. In his description of the growth of a tree, Kant writes:

This plant first prepares the matter that it adds to itself with a quality peculiar to its species which could not be provided by the mechanism of nature outside of it…. although as far as the components that it receives from nature outside it are concerned, it must be regarded only as an educt, nevertheless in the separation and new composition of this raw material there is to be found an originality of the capacity for separation and formation in this sort of natural being that remains infinitely remote from all art when it attempts to reconstitute such a product of the vegetable kingdom from the elements it obtains by its decomposition or from the material that nature provides for its nourishment. (CPJ 5:371)

Although we can explain some of what the tree does in terms of chemical and mechanical laws (e.g. breaking down the nutrients it receives from the environment), Kant suggests that the capacity of the tree to endow inorganic matter with its own ‘peculiar quality’ is beyond mechanical explanation. He makes a similar claim with respect to the growth and development of an animal:

It might always be possible that in, e.g., an animal body, many parts could be conceived as consequences of merely mechanical laws (such as skin, hair, and bones). Yet the cause that provides the appropriate material, modifies it, forms it, and deposits it in its appropriate place must always be judged teleologically, so that everything in it must be considered as organized, and everything is also, in a certain relation to thing itself, an organ in turn.’ (CPJ 5:377)

Again, certain aspects of growth and development can be explained mechanically, but not the cause that directs the organism to develop particular parts in their precise arrangement. As Kant puts it, although the ‘**authorization to seek** for a merely mechanical explanation of all natural products is in itself entirely unrestricted’, it is in fact quite limited with respect to organisms, ‘since by a principle of judgment that follows the first procedure alone nothing at all can be accomplished toward the *explanation* of such products, and hence our judgment of them must always be subordinated to teleological principles’ (CPJ 5:417).

We can see this ‘subordination’ at work in Kant’s own preferred theory of embryonic development in the third *Critique*: generic preformation. This view combines elements of the two rival theories of generation in the eighteenth century: preformation and epigenesis.[[32]](#footnote-32) According to the preformationist, embryonic development is the quantitative growth of a preformed organism (parts are not generated, they unfold). For the epigenesist, by contrast, embryonic development involves the formation of an organism (i.e. the actual generation of its parts) out of unorganized seminal material. Preformationists could explain the *organization* of organisms, but only by removing its source from the natural world (God is the source of the preformed organisms). Epigenesists took the development of organized matter to be a natural process, yet they struggled to explain whythe embryonic matter develops in the way that it does, for example, always forming certain parts (a heart, lungs, eyes, limbs) and in the same relation to each other. Mere laws of motion do not explain this. Kant agrees with the epigenesist that individual organisms are not preformed. However, he thinks that the *capacity* of organisms to generate more of their kind must be pre-formed. So, individuals develop from unorganized seminal material, but this material has been endowed with organizing principles (the origin of which is, however, beyond scientific explanation).

Kant approvingly cites the epigenetic theory of Blumenbach, who, as we have seen, rejects the idea that organization arises from raw matter, but who:

leaves natural mechanism an indeterminable but at the same time also unmistakeable role under this inscrutable **principle** of an original **organization,** on account of which he calls the faculty in the matter in an organized body (in distinction from the merely mechanical **formative power** that is present in all matter) a **formative drive** (standing, as it were, under the guidance and direction of that former principle) (CPJ 5:424).

Blumenbach, who defended an epigenetic theory of generation, appeals to ‘a formative drive’ (the *Bildungstrieb*) which directs embryonic development and guides the processes of nourishment and regeneration. In other words, a teleological force directs the mechanical processes through which the organism develops and maintains itself.[[33]](#footnote-33)

In his theory of race, developed in a series of essays, Kant likewise employs teleological principles to account for the unity of the species as well as variation in hereditary traits. As Kant sees it, germs (*Keime*) that determine species fixity and predispositions (*Anlage*) that allow for subsequent variations in response to environmental factors are present in the original phylum of the human race (DHR 8:99-103;TP 8:179; DR 2:434). If we combine Kant’s own theory of race with his remarks on Blumenbach, it looks like Kant is not just a methodological anti-reductionist in biology but also an explanatory anti-reductionist: our explanations of organic processes such as reproduction and growth (and explanations of species fixity and adaptation) invoke teleological forces and thus cannot be reduced to physical-mechanical explanation.[[34]](#footnote-34) Thus, if we only consider examples such as the eye, where the scientist invokes the fact that the eye needs to bend its lens in order to find the straightforwardly non-teleological, purely mechanical, explanations that Kant surely preferred, we might conclude that Kant is merely a methodological anti-reductionist. But if we consider more dynamical organic processes, such as plant growth or the adaptation of species over time, we must appeal to teleologically-specified mechanisms (e.g. the formative drive) that are not present in the former case.

The problem, of course, is that Kant appears to claim both that we must appeal to teleology to explain organisms and denies that teleology is explanatory. Kant repeatedly claims that teleological concepts and principles are regulative principles for reflective judgment (CPJ 5:375). He writes:

[T]eleological judging is rightly drawn into our research in nature, at least problematically, but only in order to bring it under principles of observation and research in **analogy** with causality in accordance with ends, without presuming thereby to explain it. It thus belongs to the reflecting, not to the determining power of judgment. (CPJ 5:360)

In the same vein, Kant writes that the concept of a natural purpose is a ‘regulative concept for the reflecting power of judgment’, which can guide investigation but cannot be used ‘for the sake of knowledge of nature’ (CPJ 5:375).

Kant’s insistence that the question of the origin of organic life is beyond scientific inquiry along with his claim that we cannot fully explain organisms mechanically and must appeal to teleological concepts and principles that are merely regulative has led some scholars to claim that Kant denied that there could ever be a genuine science of biology.[[35]](#footnote-35)

Here, however, we should distinguish between two kinds of teleological concepts in Kant’s account and the corresponding levels of explanation at which they operate. The concept of an intentionally acting cause of organized matter is an idea of reason that has a merely regulative use. Although such a concept is explanatory for reason, it cannot be used as an explanatory hypothesis for our actual cognition of nature.[[36]](#footnote-36) But Kant does allow for *other* teleological concepts to figure in explanatory hypotheses, such as his own appeal to germs and predispositions in his theory of race and Blumenbach’s appeal to the *Bildungstrieb*, and thus should be taken to allow for a genuine science of biology.[[37]](#footnote-37) The difference is that, in the latter case, these concepts, though they are clearly teleological, are neutral with respect to further ontological commitments concerning the origin of the properties and forces they describe.

Consider the following passages:

in the case of the empirical laws of natural ends in organized beings, it is not merely permissible but is even unavoidable to use the teleological **way of judging** as the principle of the theory of nature with regard to a special class of its objects. Now in order to remain strictly within its own boundaries, physics abstracts entirely from the question of whether the ends of nature are **intentional** or **unintentional**… (CPJ 5:382).

I myself derive all organization from *organic beings* (through generation) and all later forms (of this kind of natural things) fromlaws of the gradual development of original predispositions, which were to be found in the organization of its phylum. Such development can often be seen in the transplantings of plants. How this phylum itself came about, this problem lies entirely beyond the limits of all physics possible to human beings. (TP 8:179)

Kant is careful to leave open the possibility that we will one day be able to provide non-teleological accounts of the forces responsible for organic process. However, teleological concepts such as the *Bildungstrieb* allow the naturalist to make progress in formulating empirical laws of these processes in the absence of fully mechanistic explanation. As in the case of chemistry, where Kant endorses the Stahlian approach over that of the Newtonian chemists, we can see that Kant is willing to endorse a research program in natural history that can make short term progress over its mechanistic rivals, even as he acknowledges that mechanistic reduction is the ultimate goal of science.

In sum: Kant allows the naturalist to invoke teleologically-oriented processes in the explanations of how trees grow and how species simultaneously remain fixed and adapt to their environments. But he emphatically does not allow the naturalist to speculate about why nature is the way it is, why it has objects that must be viewed as natural purposes in the first place. The naturalist can appeal to the fact that trees have growth as one of their ends to invoke a formative drive as an explanatory hypothesis. But the naturalist cannot ask, qua scientist, *why* there are things like this in nature that have ends that need to be satisfied.

1. Conclusion

For Kant, the special sciences comprise psychology, chemistry, and biology. Each of these pose their own interpretative challenges. In psychology, Kant is clearly an ontological anti-reductionist about thinking nature. But this gives rise to two problems. First, because the soul is not an object of outer sense, it is not clear that we can even formulate causal laws in psychology. Second, even if we allow for an empirical use of the concept of a substantial soul, it is not clear that we can perform the kind of observation and experimentation that would allow us to establish empirical psychological laws. In chemistry, unlike psychology, the object of study belongs to material nature, but there is still a question of anti-reduction because is not clear whether chemical forces can be reduced to the mechanical forces that characterize the nature of matter as such. To the extent that Kant endorses a Stahlian research program in chemistry, which appeals to different species of matter, he promotes an anti-reductionist approach to chemical phenomena. Yet, this is not the principled ontological anti-reductionism we find in psychology. In fact, Kant likely considers reduction an ultimate goal in chemistry. In biology, the precise form of Kant’s anti-reductionism is especially difficult to determine. While Kant both allows for the possibility that organic processes are ultimately mechanical (broadly construed to include chemical processes) and thinks that we should pursue mechanical explanations of biological phenomena, he also thinks that teleology plays an ineliminable role in biological investigation. It is not clear, however, whether this role is merely methodological, or whether Kant also allows for teleological concepts and principles to play an explanatory role. My own view is that Kant does allow for certain teleological concepts to play a role in biological explanation, while trying to limit, as far as possible, the ontological implications of these concepts.

Finally, I want to contrast two extremes when it comes to interpreting Kant’s views on the special sciences. On one extreme are those who would conclude that when Kant says that a discipline does not meet the conditions of proper science, it follows that Kant does not think it is a science at all. At the other extreme are those who would overlook the serious methodological challenges Kant identifies and struggles with in all the special sciences. We find both of these extremes in interpretations of Kant’s theory of biology, with some interpreters arguing that Kant did not think there could even be a genuine science of life, while still others have argued that Kant in fact provided the conceptual framework of subsequent German biology.[[1]](https://mail.google.com/mail/u/0/" \l "m_3093603133732348602__ftn1" \o ") We should avoid both of these extremes.

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1. See CPJ 5:305; Anth. 7:119-120. [↑](#footnote-ref-1)
2. For further discussion of these conditions, see Nayak and Sotnak (1995) and Van den Berg (2011a: ch.2; 2011b). [↑](#footnote-ref-2)
3. For this claim with respect to chemistry, see Dussort (1956: 395) who argues that Kant’s later optimism about the status of chemistry in the *Opus Postumum* reflects his awareness of Lavoisier’s use of such precise measurements. For criticism, see McNulty (2016: 68-72). [↑](#footnote-ref-3)
4. See Nayak and Sotnak (1995). [↑](#footnote-ref-4)
5. See Friedman (2013: ch.1) for extensive discussion of how Kant understands the construction of motion as a magnitude. [↑](#footnote-ref-5)
6. However, Kant allows for a mechanical explanation of the physical states (of the brain) that underlie certain mental processes. In his comments on Samuel Thomas Soemmerring’s treatise *On the Organ of the Soul*, Kant appears to allow that empirical thinking, by which he means the combination of sensory representations by the imagination, is subject to mechanistic laws (here including chemical laws), because such laws govern the physical states of the brain that ‘underlie’ this thinking (12: 32-5). At the same time, Kant cautions against treating pure consciousness as subject to such reduction and maintains that it is the proper subject matter of metaphysics. In this sense, we might take Kant as placing certain mental operations as beyond the purview of natural science, while others—those that arise from the lower powers of the mind that we share with other animals and for which we can in principle identify physical correlates—are subject to investigation in accordance with mechanical principles. This investigation, however, belongs to physiology, not empirical psychology (12: 31-2). [↑](#footnote-ref-6)
7. See Ameriks (2000: 27-76) for an overview of Kant’s arguments against a variety of materialist positions. [↑](#footnote-ref-7)
8. Emundts (2007) argues that we cannot even take our mental states to be objects of experience. For criticism, see Kraus (2019). [↑](#footnote-ref-8)
9. It is worth noting that the law of association is Kant’s main example of a psychological law, but this does is not a *causal* law but an observed regularity. [↑](#footnote-ref-9)
10. In a different context, Andrew Chignell (2017) argues that although we do not have an intuition of an empirical self, we do cognize the self as the empirical substance in which changing representations inhere. Chignell, in apparent agreement with Frierson, claims that Kant’s ‘overall epistemology allows for the cognition of empirical substances in virtue of having sense-perception of their states’ (2017: 154). Since he does not consider this question in the context of laws of nature, it is not clear to what extent Chignell thinks the cognition of an empirical self would allow for the formulation of causal psychological laws. [↑](#footnote-ref-10)
11. See also Kraus (2018). A problem for Kraus’ proposal is that even if the idea of the soul enables us to project a mental whole for our own mental states, it is not clear how this helps us to formulate *causal* laws. To anticipate a point to which we will return in our discussion of chemistry and biology, Kant denies that regulative ideas can themselves serve as explanatory hypotheses, and causal laws should provide explanations of observed patterns rather than merely *describing* these patterns. [↑](#footnote-ref-11)
12. Although he is not concerned with psychology in particular, James Kreines (2009) argues for this kind of view with respect to empirical laws of nature in general for Kant on the assumption that Kant is a necessitarian about laws who also denies that we can have any cognition of the natures of the kinds that necessitate the empirical regularities that we observe. [↑](#footnote-ref-12)
13. See Kraus (2013) for a helpful discussion of the debate over the quantification of inner states and an argument that inner states can, to some extent, be quantified. [↑](#footnote-ref-13)
14. See Hatfield (1992: 220-2) for discussion. [↑](#footnote-ref-14)
15. In his defense of the possibility of a science of psychology, Frierson does not properly distinguish between a science in the sense of a systematic doctrine and what Kant calls science improperly so-called (which requires a system of causal laws that are established via observation and experiment). While Frierson is right that Kant allows for a science of psychology in the former sense, the more pressing question is whether he thinks that psychology could be an improper science that could systematically discover empirical causal laws. [↑](#footnote-ref-15)
16. Sturm (2001: 175-77); Sturm and Wunderlich (2010); Kraus (2016: 337). [↑](#footnote-ref-16)
17. Wolff (1732), translation from Richards (1980). [↑](#footnote-ref-17)
18. Baumgarten *Metaphysica* §505 (15:6); Sturm (2001: 176). [↑](#footnote-ref-18)
19. Kraus (2018: 84) holds that data of outer sense are needed to supplement introspection, but still maintains that introspection is the primary method of empirical psychology for Kant. [↑](#footnote-ref-19)
20. I agree with Kraus (2018) that Kant does not think that empirical psychology is simply transformed into pragmatic anthropology. It is a distinct ‘science’ by virtue of focusing only on appearances of inner sense. However, I am less sure of Kraus’s further claim that empirical psychology can become an improper science for Kant. Some of the passages she cites to support the claim that empirical psychology provides a system of laws (e.g., Anth. 7:202-220) are places where Kant is perhaps better described as providing systematic classifications. [↑](#footnote-ref-20)
21. For more on Kant’s relation to this tradition, see Vanzo (2012) and Cooper (2017). [↑](#footnote-ref-21)
22. See McNulty (2017: 100-102) for a detailed discussion of Kant’s characterization of chemistry as an ‘art’, and why this does not conflict with its status as a theoretical science. [↑](#footnote-ref-22)
23. This line of interpretation is suggested by Friedman (2013: 234-58). [↑](#footnote-ref-23)
24. See Thackray (1970), Carrier (1986; 2001). [↑](#footnote-ref-24)
25. See Duncan (1996: 96-104). [↑](#footnote-ref-25)
26. Carrier (2001: 218). [↑](#footnote-ref-26)
27. McNulty (2017: 105-106). [↑](#footnote-ref-27)
28. Here I am following Ginsborg (2015 [2001]), who takes Kant to understand mechanical explanation in the third *Critique* in terms of the laws that govern matter as such (for Ginsborg, this includes chemical laws). Peter McLaughlin suggests an alternative interpretation of mechanical explanation as ‘the reduction of a whole to the properties (faculties and forces) which the parts have…independently of the whole’ (1990: 153). As Ginsborg notes, however, Kant thinks that artifacts are also mechanically inexplicable, in the sense that we cannot explain how they have come to be organized merely on the basis of the properties and powers that belong to their parts, even if mechanical laws that govern their parts explain the properties of the whole once organized. [↑](#footnote-ref-28)
29. Zumbach distinguishes between these three forms of reduction in his discussion of Kant’s philosophy of biology (1984: 87-92). At first glance, the first two forms of reduction might appear to be the same. However, Zumbach distinguishes between two senses of explanation: (1) to offer a description; and (2) to provide full understanding. Thus, Zumbach thinks that even if we can describe a biological process in mechanical terms, this does not mean that we fully understand the process. For someone who rejects this distinction, this still leaves the distinction between ontological and methodological reductionism. [↑](#footnote-ref-29)
30. Proponents of this interpretation include McLaughlin (2000: 178-9), Zuckert (2007: 165-66), and Van den Berg (2011). [↑](#footnote-ref-30)
31. Van den Berg (2011) acknowledges that the mechanical explanation of these processes will only be partial. [↑](#footnote-ref-31)
32. For a helpful overview of this debate, see Roe (1981). [↑](#footnote-ref-32)
33. Richards (2000) claims that Kant’s appeal to Blumenbach rests on a misunderstanding, since, for Kant, the *Bildungstrieb* can only be a regulative idea, while for Blumenbach, it is an actual force in nature. Richards overlooks the fact Kant himself slides between a regulative and constitutive treatment of teleological concepts and principles. [↑](#footnote-ref-33)
34. For the interpretation of Kant as an explanatory anti-reductionist, see Zumbach (1984) and Fisher (2007). For Zumbach, teleological judgments explain the systematic unity of organic processes by ‘allow[ing] us to see how innumerable causal sequences are interrelated’ (1984: 125). Quarfood (2006) claims that for Kant, teleology plays a ‘quasi-explanatory role’ (2006: 737). We might also classify Ginsborg (2015 [2001]) as an explanatory anti-reductionist, as she thinks that we must appeal to normative laws (e.g. ‘acorns ought to develop into oak trees’) to explain why we privilege certain regularities over others (e.g. that even though acorns routinely rot, we privilege the observation that they routinely grow into oak trees). Breitenbach (2017) argues that Kant allows for specifically biological laws that contain biological concepts, such as that of the organism, that are not further reducible. However, Breitenbach insists that such concepts are fully naturalistic. [↑](#footnote-ref-34)
35. See Richards (2000; 2002), Sloan (2006), Zammito (1992; 2006; 2012), and Illetterati (2014).  [↑](#footnote-ref-35)
36. For the distinction between explanations that operate at the level of reason and those that operate at the level of the understanding, see McNulty (2015: 8-9). [↑](#footnote-ref-36)
37. See Breitenbach (2017) for an account of contemporary concepts in biology that are ‘naturalistic counterparts’ to the kinds of teleological concepts that we find in Kant, and which, according to Breitenbach, figure in the formulation of biological laws that are fully naturalistic but also further irreducible. [↑](#footnote-ref-37)