

A CRITICAL METHOD FOR NATURAL HISTORY: THE DEVELOPMENT OF KANT'S TELEOLOGICAL PRINCIPLE

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INTRODUCTION

In recent years Kant's pre-critical work on natural history has gained significant attention. Scholars have recognised that Kant's nebular hypothesis of the formation of the solar system, his identification of the Milky Way as a rotating galaxy, and his reproductive account of heredity make innovative contributions to key debates in eighteenth century natural history.² Of course, none of these ideas are especially novel. Kant borrowed his nebular hypothesis from Thomas Wright of Durham,³ his theory of vortices develops Herman Boerhaave and Stephen Hales' speculative reading of Newton's *Opticks*,⁴ and his account of heredity draws directly from Georges Buffon's *Histoire Naturelle*.⁵ What is significant about Kant's work on natural history is that it helped to legitimise several marginal views by transforming the descriptive practice of natural history into an explanatory science that accounts for the present organisation of matter according to laws.

Despite increasing scholarly interest in Kant's pre-critical natural history, it is widely held that the critical Kant shifted his scientific ideal from speculative natural history to mathematically demonstrable physics. As Martin Schönfeld explains, Kant's pre-critical natural history ended 'in a grandiose failure' as Kant came to the conclusion that only what can be constituted can be known.⁶ For the critical Kant, the present organisation of matter is utterly contingent on the laws of experience, which are impervious to the arrangement of matter. Thus the use of rational categories to explain things that cannot be experienced is a spurious and unverifiable form of metaphysics. As Kant elaborates in *Metaphysische Anfangsgründe der Naturwissenschaften*, a proper science must be 'systematic', constitute an

‘interconnection of grounds and consequences’, and provide ‘apodictic’ certainty (MAN, AA 04: 468). Only mathematics and physics reach this high theoretical standard, for only they can bear ‘consciousness of their *necessity*’. The ‘improper’ or ‘figurative sciences’ (*uneigentliche Wissenschaften*), on the other hand, work to discover laws that are contingent on experience. The problem for such sciences is that the *a priori* principles of the understanding provide no guarantee that experience is anything more than a ‘labyrinth of the multiplicity of possible empirical laws’ (EEKU, AA 20: 214). Because the understanding has no grounds to expect that nature, as the sum of appearances in thoroughgoing interconnection, hangs together as a system, the best *a posteriori* sciences can hope for are ‘shaky hypotheses’.

While the critical turn is often interpreted as a re-evaluation of natural science under the constitutive ideal of physics, several scholars have drawn attention to Kant’s renewed engagement with methodological questions in the practice of natural history in his third *Critique*, *Kritik der Urteilkraft*. Peter McLaughlin explores Part 2, Critique of the Teleological Power of Judgment, as a ‘reflection on philosophical, in particular, methodological problems that arose through the constitution of an independent science of life.’⁷ For John Zammito it is ‘the culmination of Kant’s biological reflections.’⁸ That Kant would return to matters of a *science* of life raises several pressing questions for our understanding of Kant’s development. If the critical turn separates speculative natural history from proper physics, and denies the scientific status of the former, what *scientific* role could natural history play in Kant’s mature philosophy? If critical philosophy denies *a posteriori* sciences any explanatory power, why does Kant return to questions of method in natural history in a third critique?

In this paper I argue that Kant’s critical turn does not so much break from his pre-critical natural history as transform it, issuing a new understanding of experimental science as a research programme. To do so I examine Kant’s extensive reflections on natural history’s teleological method throughout the 1770s and 1780s, giving particular focus to debates with interlocutors Johann Georg Forster and Johann Gottfried Herder in the mid-1780s. This analysis will show that Kant not only remained concerned with developments in the field of natural history throughout the critical period but also that his critique of leading research programmes provided the conceptual work for the teleological principle that grounds his third *Critique*. Kant’s engagement with Herder and Forster moved him to reconcile his theory of organised matter with the critical philosophy. The result is a teleological method for the practice of natural history that does not provide knowledge of historical development but guides the empirical investigation of objects whose form cannot be understood apart from temporal variation.⁹

1. PRE-CRITICAL NATURAL HISTORY

1.1 *Natural history before Kant*

Before turning to Kant’s writings on natural history during the critical period I begin by identifying the teleological method Kant pursued in his pre-critical work. Natural history in the Baconian tradition was not directly concerned with teleology. It consisted rather in the

description of nature's actual or present arrangement. Bacon's original vision for natural history in *Advancement of Learning* (1605) operated as a pre-philosophical descriptive endeavour aimed at providing the 'primary matter' for natural philosophy. Against speculative philosophies that accounted for natural events according to non-physical causes, Bacon proposed that natural philosophy, 'the general into the inquiry of causes and productions of effects',¹⁰ takes place in and as a part of natural history. With the primary matter of natural history in hand, natural philosophy takes two modes of explanation to account for what has been found: physic, which describes the 'variable or respective causes' (the efficient and material causes), and metaphysic, which describes the 'fixed and constant causes' (the formal and final causes).¹¹ This is to say that that physic 'should handle that which supposeth in nature only a being and moving', while metaphysic 'should handle that which supposeth further in nature a reason, understanding, and platform.'¹² Teleology is thus a part of metaphysic, for it accounts for the arrangement of matter according to ends. While it features as the highest mode of leaning in Bacon's pyramid of knowledge, it is highly restricted, pertaining only to those items that cannot be explained according to movement. Bacon was highly critical of the use of metaphysic to explain physical events, for 'men (which is the root of all error) have made too untimely a departure [from physic], and too remote a recess from particulars.'¹³

Bacon's attempt to ground natural philosophy on a descriptive, factual basis had a marked influence on the practice of natural philosophy in both the British and French traditions of natural philosophy. By the 1670s an 'experimental' form of natural history featured as the prevailing methodological approach in the Royal Society.¹⁴ The earliest members of the Royal Society, including Robert Boyle, Robert Hooke, Robert Plot, and John Woodward, followed Bacon's the wholehearted rejection of speculative system building and sought to construct a new experimental paradigm in its place. By the early-eighteenth century key members of *l'Académie Royale des Sciences* also employed an experimental research program. French natural historians built on the method and findings of the British experimental scientists to overcome the philosophical tendency to trivialize the significance of matter, thereby contributing to the growing divide between experimental and speculative philosophy.¹⁵

In the mid-eighteenth century two rival programmes of natural history rose to prominence. In *Systema naturae*, first published in 1735, Swedish botanist Carl Linnaeus followed the Baconian experimental tradition to develop the binomial system of nomenclature and the hierarchy of seven main groups, the lowest of which are species and variety. The Linnaean classificatory system is based on the assumption that a static, 'progenitorial unity' exists outside of space and time as the result of 'some Omnipotent or Omniscient Being, namely God, whose work is called *Creation*.'¹⁶ From the assumption that the system we find in nature is the result of a direct creative act, Linnaeus derives three methodological principles: (1) 'there are no new species, (2) 'like always gives birth to like', (3) 'one in each species was at the beginning of the progeny'. The Linnaean God not only created matter at the origin of the cosmos, but also imbued it with systematic form. Building on these principles, Linnaeus' methodology classifies how objects appear to the observer in the present. A species is categorized by the shared possession of invariable or fixed heritable characteristics (following Aristotle, physiology and anatomy were the primary candidates). A variety is categorized according to accidental

alterations within a given species (size, colour, shape etc.). Despite the appearance of variation, Linnaeus maintains the perfection of God's original creation by assuming the immutability of species. The apparent change in species is simply the variation of accidental characteristics.

Against the hierarchical and abstract nature of the Linnaean system, French natural historian Georges Buffon developed an alternative programme for natural history.¹⁷ In the Preliminary Discourse (1749) to *Histoire Naturelle*, Buffon attacks Bacon's natural history/natural philosophy distinction, which separates experimentation from the investigation of causes. He denigrates the 'abstract' truths of physics that derive generalizable principles in favour of 'physical' truths that are grounded on succession and repetition of events in time and space.¹⁸ By placing physical truths over the abstract, Buffon locates the system of nature *in* space and time. He posits the existence of teleological kind of causality in the form of interior moulding forces (*moule intérieur*), organising powers that are known only through the emergent physical relations between living beings. Buffon revives the speculative accounts of natural origins rejected by Bacon to explain for the historical development of nature's order across extremely long periods of time, going as far as to permit species degeneration and even extinction. He does not, however, accept the full mutability of species.¹⁹ Rather, the interior moulding force unique to each species expresses itself in various ways according to contingent environmental conditions, and passes these variations on to the following generations.²⁰ Thus to discover the unity of a species the natural historian should not look for actual, physiological affinities but rather for the potential for fertile reproduction between apparently different kinds. Buffon's classificatory programme is grounded on the empirical criterion of generation: organisms are classified as the same species, no matter how great the variation, based on their capacity to produce fertile young.

1.2 Kant's universal natural history

In 'Allgemeine Naturgeschichte und Theorie des Himmels' (1755) Kant sides with Buffon's vision for natural history. In the attempt to build a genuinely historical astronomical system Kant extends the established programme of celestial mechanics into an evolutionary cosmology that accounts for the present organisation of matter as the achievement of an extended period of time:

Creation is not the work of one moment. After it has made a beginning with the production of an infinity of substances and matter, it is effective throughout the entire sequence of eternity with ever increasing degrees of fruitfulness. Millions and whole mountain ranges of millions of centuries will pass within which ever new worlds and world-orders will form and attain perfection ... Creation is never complete. It is true that it began once, but it will never stop. (NTH, AA 01: 314)

Kant's idea of cosmological development builds on the insights of Thomas Wright's 'An Original Theory or New Hypothesis of the Universe' (1750), a report of which appeared in German in the Hamburg journal *Freye Urtheile und Nachrichten* in January 1751. Kant explains that Wright's ideas were the original source that gave him 'cause to regard the fixed stars not as a scattered milling mass without any visible order' but rather as a 'a systematic

constitution' (NTH, AA 01: 231). The clue for Wright was the shape of the Milky Way, which guides a thought experiment about the role of attractive and repulsive force in the formation of vortices. The Cartesian theory of vortices speculates that celestial movement can follow stratified bands of secondary or primary matter left over from the fracture of larger elements.²¹ With the help of Wright, Kant's model avoids such speculation by using attraction to explain the condensation of the galactic cloud and repulsion to set it spinning (NTH, AA 01: 250). Systematic order, in Kant's pre-critical view, can emerge from mechanical principles alone, provided one begins with the right theory of matter.

The integration of continuous alteration into the static programme of eighteenth century celestial mechanics was a controversial venture, as the idea of development contains within it a contradiction. If the system of nature was ordained by God, then it must be perfect. Any change in this state would thus imply a departure from divine perfection.²² While Buffon was, at least in part, willing to accept the existence of degeneration, Wright and Kant aimed to show that development could be reconciled with the stability of the universal order. For Wright, at least in his 1750 essay,²³ this was a matter of recognizing the limits of natural philosophy: 'how the heavenly bodies were made, when they were made, and what they are made of, ... seems to our present sight not to be within the reach of human philosophy.'²⁴ *That* 'they do exist, have final causes, and were ordained for some wise end, is evident beyond doubt.' For Kant, the task of accounting for cosmological origins could be attempted, yet only by assuming an original organising power imbued within the basic particles of matter. To understand the present organisation of matter according to mechanical laws, one must assume a contingent, original organisation from which these laws follow. Anticipating the physical account of monads he develops in 'Physical Monadology' of the following year, Kant collapses Newton's distinction between the laws of 'existence' and the laws of 'creation' to account for everything from the elasticity of the atmosphere to the formation of Saturn's rings according to the activity of subtle particles of matter that were originally diffused across space. What appears as a starry chaos is in fact the reorganisation of the cosmic order by powers inherent to matter. Development is permitted so long as the *unity* of the system as a whole is preserved.

Kant's account of natural history has received divergent interpretations in the literature. Some scholars argue that Kant's attempt to outline a purely mechanical cosmology signals a rejection of speculative mechanics and pre-modern teleology.²⁵ Yet this is only partly correct. Kant's aim is to use mechanical forces to explain the development of *perfection* from an original chaos. God has put a 'secret art' into natural forces, Kant claims, to bring about an evolution from chaos to a more perfect cosmic constitution (NTH, AA 01: 229). The material building blocks of nature are not inert particles but active centres of force driven by a striving to 'unfold' themselves (NTH, AA 01: 226). Noting Kant's active account of matter, other scholars have claimed that Kant's natural history is in fact a break from Newton's mechanical account of force, which, as Newton outlines in *Principia*, is simply the observed regularity of mechanical phenomena.²⁶ While it is true that Kant was busy trying to reconcile a Leibnizian account of monads with a physical influx theory of causation during the 1750s, this project was not entirely foreign to Newtonian science. As Robert Schofield has demonstrated, Newton's more speculative account of matter in the *Opticks* gave rise to a materialist Newtonianism in the

eighteenth century that identified the causes of all phenomena in a unique substance, the ether.²⁷ While Kant no longer refers to the ether as an explanatory device, as he did in his early essay ‘On Fire’, his notion of force as the inner essence of matter shows a continued influence from the speculative tradition of Newtonian experimentalism.²⁸

What is important to note for our present purposes is that Kant’s speculation about teleology is *direct*: the *telos* of nature is the visible striving toward perfection, which indicates that the purpose of nature is nature’s perfection (NTH, AA 01: 228, 262-3, 314). Final means and goal-states are immanent within nature as a system. In line with Buffon’s efforts to identify a genuinely historical dimension to the system of nature, the idea of ‘perfection’ for Kant does not entail a *telos* external to the cosmos but rather a union of the sensible and intelligible, the scientific and metaphysical, made possible through his dynamical account of basic particles.

While Kant is primarily concerned with celestial mechanics in NTH, he recognizes that organic structure poses an explanatory challenge to his natural system. The organised structure of even the simplest form of life, such as a worm, is far more complex than the mechanical structure of the cosmos (NTH, AA 01: 230). While Kant’s argument is that we can say, ‘Give me matter and I will build you a world out of it’, he raises the question,

Are we in a position to say: Give me matter and I will show you how a worm can be created? Don’t we get stuck at the first step due to ignorance about the true inner nature of the object and the complexity of the diversity contained within it? (NTH, AA 01: 230)

Kant concedes that his account of matter cannot explain organisation. However, his reference to ‘inner nature’ and ‘complexity’ suggests that the difficulty is not so much qualitative as quantitative. Later in the essay Kant speculates directly about organic structure, suggesting that the mechanical unfolding of the cosmos eventually leads to the evolution of life and rationality. His aspiration to unify science and metaphysics ultimately leads him to combine the quantitative and qualitative aspects of reality in a single domain.

1.3 Natural description and natural history

The development of living beings is an on-going theme in Kant’s lectures on anthropology and physical geography given throughout the 1760s and 70s. In an essay that accompanied the promotional material for the lectures in 1775 and 1777, ‘Von den verschiedenen Racen der Menschen’, Kant tackles the question of how the various forms of human life are related.²⁹ Is *Homo* a genus, to be broken down into distinct and invariable species? Or is the diversity of human form a contingent matter of variety stemming from *Homo* as a single species?

In the two versions of this essay Kant is not simply concerned with organic structure, as he was in NTH, but also with how such structure features within the explanations used by natural historians. In Kant’s view the Linnaean programme of natural history provided an arbitrary system of classification. In later editions of *Systema naturae* (1771) Linnaeus responded to the growing reports of human diversity with a revised classificatory schema that admitted four species in the genus *Homo*, each of which contained distinct varieties.³⁰ For Kant,

Linnaeus' proposal simply imposes an abstract system onto natural contingencies. In response, Kant searches for a new system that could generate species boundaries from experience itself. In contrast to preformationists such as Abraham Kästner and Victor Albrecht von Haller, who aimed to adapt the Linnaean programme to explain variation through time as the accidental change of non-hereditary characteristics through the effect of external forces (environment, climate, diet etc.), Kant follows Buffon, who classified species according to their reproductive capacities. He separates his own proposal from Linnaeus by identifying two research programmes within the field of natural history: the description of nature (*Naturbeschreibung*), which follows the Linnaean system, and natural history (*Naturgeschichte*), which follows the vital materialists such as Buffon. Natural description aims to classify the actual system of species based on the assumption that organisation is irreducible to matter and is the result of an original act of divine creativity. Natural history accounts for the present system on the assumption that form is an emergent property of matter that comes into being within space and time. Kant states that the 'former provides a school system for memory; the latter provides a natural system for the understanding. The first only aims at bringing creatures under titles; the second aims at bringing them under laws' (VvRM 02: 429, see PG AA 09: 161).

Kant's account of natural history has been described as 'explanatory' as opposed to 'descriptive', for it aims to account for the present order of nature according to laws.³¹ To show how natural history draws the manifold of organic form under laws for the understanding, Kant rejects Linnaeus' abstract category of 'variety' in favour of Buffon's physical concept of 'race'. In *Histoire Naturelle* Buffon advanced the notion of *rasse* to explain the presence of fertile half-breeds. Race denotes distinct varieties within a species that are passed on to the following generations. Fertility between these varieties indicates that they must share a common origin despite having different hereditary traits.³² Kant explains that while natural description is only capable of distinguishing varieties through the practice of 'logical division' that, for all intents and purposes, 'I make in my head' (dividing quadrupeds in terms of various modes of locomotion etc.), natural history identifies races genealogically, that is, through their 'physical division' governed by time and space (VvRM, AA 02: 435n). It traces 'a great many of seemingly different kinds to races of the same species', thereby transforming 'the school system of the description of nature, which is now so extensive, into a physical system of the understanding.' Natural history does not build an inventory of natural singularities from which to derive character resemblances but rather searches for the historical unity of a stem as evidenced through physical relationships (*Verwandschaften*) and generation (*Erzeugung*). To account for the variety of human races and the fertility of children borne from inter-racial union, Kant identifies a single generative stock (*Stamm*) that resembles Buffon's moulding forces, in which the germs (*Keime*) account for the specific characteristics of class and adaptive capacities (*Anlagen*) account for their specific combination. He cites 'Buffon's rule', which identifies species according to the ability to 'produce fertile young with one another (whatever differences in shape they may be)', to show that the 'natural division into species and kinds [*Gattungen und Arten*] in the animal kingdom is grounded in the common law of propagation, and the unity of the species is nothing other than the unity of the generative power [*zeugenden Kraft*] that is universally valid for a certain manifoldness of animals' (VvRM, AA 02: 429).

Kant's notion of a race is thus a 'subspecies' (*Abartung*), a hereditarily different kind that belongs to the same species and yet preserves its acquired characteristics over generations. He thereby admits change to the extent that he accepts Buffon's idea of degeneration, yet he preserves the perfection of the created order by maintaining the immutability of species.

2. 'DETERMINATION OF THE CONCEPT OF A HUMAN RACE'

2.1 *The critical turn*

In *Kritik der Reinen Vernunft* (1781/7) Kant's concern shifts from the historical development of characteristics across time and space to the epistemic status of time and space as such. Time and space are neither real nor subordinate to objects and their relations, he argues, but the forms of human sensibility in which objects are experienced (see KrV, A 19-49/B 33-66). Things that lie outside the limits of possible experience, such as original stems, generative forces, or past adaptive modifications can be the items of speculation in our search for a unified system of nature, but they cannot be known.

The critical settlement cleaves an abyss between theoretical science and metaphysics. While Kant's pre-critical natural history operated on the theoretical assumption that the cosmos forms a systematic, self-replicating whole, the critical Kant transforms systematicity into a regulative ideal of knowledge that stands separate from nature (KrV, A 644/B 672).³³ Nature is simply 'the *existence* of things, insofar as that existence is determined according to universal laws' (Prol, AA 04: 294). The *system* of nature, the idea that this existence of things forms a law-governed arrangement, is an ideal of reason. This settlement raises a monumental problem for the practice of natural history: on what grounds might we apply rational concepts to empirical objects in order to bring the manifold of appearances into a law-governed order? In NTH Kant used the notion of dynamic particles endowed with a 'secret art' to explain how mechanical laws could bring about the perfect development of the cosmos. In VvRM he appealed to 'the unity of the generative power' and an 'original stem' to explain the capacity of a species to alter its form in response to adaptive pressures and pass these alterations on to the next generation. Yet the notions of dynamic particles and original stems are not *a priori* categories of the understanding constitutive of nature but concepts that the natural historian applies to nature as an already constituted manifold of appearances. In the Transcendental Dialectic of the first *Critique* Kant separates the constitutive principles of the understanding, the conditions of the possibility of the objects of experience, from the regulative principles of reason, rules that we give to ourselves concerning how we should order the already constituted objects of experience.³⁴ Kant's idea is that while the understanding presents the appearances in a causal sequence as determined in space and time, it leaves the form that arises from such a sequence radically underdetermined. To discover the laws responsible for the formal arrangement of matter we must go *looking* for order in nature.³⁵ Yet nothing in nature can confirm that appearances adhere to systematicity. Nature (as the sum of appearances) is radically separated from reason (as the ideal of systematicity). We cannot prescribe to nature that systematic unity *must* exist. The correspondence of nature to our need for order is instead a principle that governs our *reflection* on nature as a system.

2.2 The concept of race

Kant returns to the problem of explanation in natural history in his essay ‘Bestimmung des Begriffs einer Menschenrace’ published in the *Berlinische Monatsschrift* in November 1785. Here he defends the monogenetic account of the human species he began in the 1770s from critics who attacked his account of an original stock that subsequently developed into four races. His critics are misguided, Kant argues, for they mistake his speculative hypothesis for a theoretical account of origins. In response, Kant aims to show that natural history does not provide an objective narrative of events in history but rather yields a concept of race that, unlike the Linnaean system, can provide a law-governed account of how variable characteristics are nevertheless passed on without fail. Race is not an empirical concept based on description alone, he contends, for description is limited to a static conception of organisation that only permits the alteration of *non*-inheritable characteristics. Yet as he demonstrated in the first *Critique*, neither is race an *a priori* concept of the understanding that determines the unity of appearances. What then is the concept of race, if it is neither an *a posteriori*, empirical concept nor an *a priori* concept of the understanding?

Kant explains the concept of race according to a fundamental principle of natural history: ‘one finds in experience what one needs only if one knows in advance what to look for’ (BBM, AA 08: 91). Kant’s idea is that because bare experience does not contain systematic order, we can only discover the existence of physical relationships and generations if we go looking for them. The natural historian notices certain generalizations, such as the invariable inheritance of accidental characteristics (e.g. the paradigmatic example for Kant is skin colour). She then reasons that it is only possible to explain the *necessity* of this phenomenon if she assumes that such a potential lies ‘in the germs of the to us unknown original phylum of the human species’ (BBM, AA 08: 98). Of course, this original stock cannot appear as a product of experience. It features rather as a ‘must’ derived from her search for an explanatory system that can avoid speculation about organic form (what his critics thought he was doing) and the unnecessary recourse to divine action (what he felt that natural describers were doing). The only way to navigate between these two dangers, Kant reasons, is to examine the derivation of the variety of human form ‘from one single phylum, because without the latter the *necessity* of the heredity would not be comprehensible’ (BBM, AA 08: 99).

To reassure those who might be concerned that his natural history permits a theologically dangerous account of degeneration, Kant stresses that the notion of a single phylum in fact *defends* the principle of immutability: that ‘throughout all of organic nature in all changes of individual creatures their species is preserved unchanged’ (BBM, AA 08: 97). The notion of a single phylum allows us to exclude ‘any explanation which maintains that the transmission [of inheritable characters] – even that which is only accidental, which is not always successful – could ever be the effect of a cause other than that which lies in the germs and endowments of the species itself.’ No external force is responsible for transmission, whether divine intervention or environmental effects, for the agency of historical development must lie internal to the organic system.

Kant's argument in *BBM* shows a strained commitment to elements from both preformationism and epigenesis. On the one hand, Kant's attempt to explain the development of living beings according to the mechanical laws of nature leads him to accept the idea of pre-existing form. However, this pre-existing form is different to the standard view of preformationism, for it does not exist apart from matter as an external *telos* but rather within the phenomenal sphere of time and change. Thus Kant seems to require an active theory of matter, as he did in his pre-critical natural history, wherein a non-Newtonian power is constitutive of organic development. Yet such a power transgresses the limits of critical philosophy, which yields a concept of matter exhaustively determined by efficient causal connections blind to matters of form. In *NTH* Kant doubted the possibility of building a theory of matter that could account for the formation of a worm for the reason that organic structures are too complex. In the first *Critique* he destroys any chance of such an achievement by arguing that organic structures are discontinuous with nature as an already constituted sphere of appearances. Yet in *BBM* Kant presents race as a rational concept that is nevertheless derived from the necessary unfolding of germs and original dispositions, thereby requiring a formative law discontinuous with the laws of the understanding.

2.3 Kant's response to Herder

If Kant was not already aware of the problem that an active force posed to his critical system, it became apparent to him as he reviewed Herder's *Ideen zur Philosophie der Geschichte der Menschheit* (1784-85). In the introduction to *Ideen* Herder praises Kant's pre-critical *NTH*, and sets out, following the structure of Kant's early essay, to provide a developmental history of nature that begins with the formation of the earth as 'a star among stars' and culminates in the cultivation of human capacities.³⁶ However, rather than explaining the cosmological origins of life through entirely mechanical forces, as did Kant, Herder's aim is to identify an invisible, animating force responsible for the development of organic form. In Book III he attempts to identify this force as a single power behind the three organic powers (elasticity, irritability and sensibility) identified by Haller in the physiology of the animal body.³⁷ He speculates that 'infinite is the wisdom of God, which combined these powers with the different parts of the human body.'³⁸

In his 1785 review of *Ideen* Kant attacks Herder's 'hypothesis of invisible forces', which claims to identify an 'invisible universal nature' responsible for organisation. Herder's endeavour is futile, Kant claims, for it simply attempts to 'explain *what one does not comprehend* from *what one comprehends even less*' (RezHerder, AA 08: 54). That is, it attempts to explain the emergence of organised form by reference to a creative force derived from an analogy with our own form-creating powers. In Kant's view, not only does this explanation fail to elucidate nature's apparent vitality, for it calls on a placeholder as murky as that which it aims to elucidate, it also violates the mechanical properties of matter as constituted by the categories. While he 'fully concurs' with Herder on account of the need for a genetic force to explain the invariable transference of acquired traits, Kant remains committed to a form of preformationism that denies the emergence of order from bare matter. He returns to his account of germs, appealing

to a genetic force that ‘appropriately modifies *itself* internally in accordance with differences of the external circumstances’ (RezHerder, AA 08: 62). Kant qualifies Herder’s appeal to such a force as an ‘assumption’ rather than something objectively present for the natural historian:

One could call this natural vocation of the formative nature also ‘germs’ or ‘original dispositions,’ without thereby regarding the former as primordially implanted machines and buds that unfold themselves only when occasioned (as in the system of evolution [i.e. preformationism]), but merely as limitations, not further explicable, of a self-forming faculty, which latter we can just as little explain or make comprehensible. (RezHerder, AA 08: 62-63)

In contrast to Herder’s vital power, Kant claims that his theory of germs and dispositions does not give an objective account of organisation but simply regulates inquiry, allowing the natural historian to build a classificatory system by reference to organising principles that cannot be constituted. His point is that when it comes to species variation natural history cannot be grounded on an *a priori*, constitutive account of matter, for organisation is entirely contingent on experience. Natural history is rather a research programme that involves feedback between regulative principles and empirical findings in the process of building a system of nature.

3. ‘ON THE USE OF TELEOLOGICAL PRINCIPLES’

3.1 Forster’s critique

In his 1788 essay ‘Über den Gebrauch teleologischer Principien in der Philosophie’ Kant’s understanding of natural history had clearly developed in light of his review of Herder’s *Ideen*. The essay responds to a paper by the popular natural historian Johann Georg Forster entitled ‘Noch etwas über die Menschenrassen’, which appeared in the *Teutsche Merkur* in 1786. In this paper Forster defends the Linnaean classificatory programme against Kant’s separation of natural description from natural history, claiming that Kant requires the natural historian to project onto nature structural features that are far more arbitrary than the physiological categories established by Linnaeus.

Forster begins by attacking Kant’s guiding principle that ‘one finds in experience what one needs only if one knows in advance what to look for’ (BBM, AA 08: 91). This principle yields Kant’s notion of an original condition of the human species that produces ‘an invariably heritable difference’ that can be traced back to ‘one and the same line of decent’.³⁹ Forster’s claim is that far from leading the natural historian to the true conception of heredity, Kant’s principle is in fact guilty of ‘the most common of all illusions, namely, that we, in the appointed search for that which we need, often also believe that we have found it there, where it does not really exist.’⁴⁰ Against Kant’s hypothesis Forster defends the Linnaean principle that variable properties such as skin colour are accidental, and thus ‘not sufficient for the differentiation of species.’⁴¹ In opposition to Kant’s programme, which imagines some original state that led to the present constellation of the races, the Linnaean system differentiates a variety from a species ‘simply through the inconstancy of its characteristic features.’⁴² Gradations of skin colour are merely accidental changes according to environmental conditions, and thus cannot serve to determine the races.

To provide a Linnaean determination of race, Forster turns instead to a ‘physiological and anatomical basis’, which, in his view, yields the true invariably heritable characteristics.⁴³ This criterion identifies *two* races or lineages of descent, the Negro and the European: ‘the Negro possesses, both in consideration of outer as well as inner form, visibly far more that is consonant with the lineage of apes than with whites.’ While Forster is tentative to conclude that race maps on to species,⁴⁴ he concedes so in practice, claiming that the invariable inheritance of anatomy renders the two races fundamentally different by virtue of their lineage. His point is that Kant’s monogenetic account of species can only be ‘a science for gods and not for human beings’, for it requires theoretical *knowledge* of an original stock. ‘Who has the means of making known the ancestral tree of even a single variety up to its species’, Forster asks, ‘if that variety did not first come into being from another before our very own eyes?’⁴⁵ If the invariable differences characteristic of race ‘can no longer be traced historically back to their point of origination, then the least that we can do is regard the descent as underdetermined; and the distinction that Kant wants to make between the concepts of the description of nature and the knowledge of natural history must become altogether void.’⁴⁶

3.2 Defending the teleological principle

Kant’s aim in ÜGTP is to show that Forster’s objections to his account of race ‘derive only from the misunderstanding of the principle from which I start’ (ÜGTP, AA 08: 161). In Kant’s view, Forster had suspected him ‘for wanting to answer a question of the *physical* investigation of nature through documents of religion’ (ÜGTP, AA 08: 160), that is, for replacing natural history with theoretical pantheism. To prove Forster wrong, Kant seeks to clarify his notion of the starting principle for natural history in light of his critical epistemology. ‘Nature’, Kant states, ‘is the sum-total of all that exists as determined by laws’, while ‘world’ concerns the ‘supreme cause’ (ÜGTP, AA 08: 157). The first concerns physics and its practice is ‘theoretical’. The second concerns metaphysics and its practice is ‘teleological’. In ‘all examination of nature reason rightly calls for theory first’, Kant explains, which leads to the deduction of the categories and the fundamental categories of all objects of thought. Yet ‘where theory abandons us’ – where we find necessity in nature that is irreducible to mechanical causality – we ‘need to start from a teleological principle’ (ÜGTP, AA 08: 157). What Kant wants to show is that theoretical reason cannot yield a theory of invariable inheritance, for there is no reason *a priori* why we should attribute an organising principle to living beings. Forster is right to the extent that in terms of ‘nature’ as the sum total of appearances varieties are underdetermined (accidental). Without the assumption that variations result from a purposive causality they appear utterly contingent. However, Kant recognises that when ‘reason on the theoretical path of nature ... is not able to achieve its *entire* intention as wished,’ which is to develop a system of nature, we must pursue a teleological mode of inquiry. Forster took issue with this proposal, Kant explains, for he

finds it awkward to establish a *principle* in advance which is supposed to guide the investigator of nature even *in searching* and observing, and especially a principle that would orient observation toward a *natural history* to be furthered by this procedure, in contrast to a mere *description of nature*. (ÜGTP, AA 08: 161)

The problem with Forster's view, as it was with Linnaeus, is that it assumes that we can derive invariable characteristics from bare experience. Kant agrees with Forster that 'a *narrative* of events in nature [cannot] be reached by any human reason', for such would be, as Forster duly noted, a 'science of the gods'. Yet Kant nevertheless insists that 'nothing of a purposive nature could ever be found through mere empirical groping without a guiding principle of what to search for.' This is to say that 'only *methodologically* conducted experience can be called observing.'

Kant aims to demonstrate the superiority of his account of 'methodologically conducted experience' or 'observation' over Forster's descriptive approach by showing how the two programmes yield different results. He turns Forster's examination of variation in skin colour among native Americans. The Linnaean principle of variation leads Forster to attribute the variety of skin colour to external effects in the environment. Skin colour in Forster's view is an accidental, non-hereditary characteristic that could change back to its original state given the right environmental conditions. This conclusion raises an interpretive problem, however, for Forster's own example points to various gradations in skin colour within the same environmental system. To explain this anomaly, Forster had to 'assume two original phyla in order to explain these characters' (ÜGTP, AA 08: 169). Yet what are his grounds for differentiating the accidental variation of skin colour from the necessary inheritance (physiology and anatomy) of the original phyla? Forster's 'rash reasoning' simply 'follows the lead of *Linné's* principle of the persistence of the character' (ÜGTP, AA 08: 161). Kant's account, on the other hand, claims to follow a rational principle. The existence of various gradations of skin colour in the same climate confirms 'the conjection of an entirely consistent generative affinity though the unity of a phyletic origin, while simultaneously confirming the conjection of a *cause* of their classificatory difference residing in the human begins themselves, not merely in the climate' (ÜGTP, AA 08: 177). For Kant, 'it is possible and indeed more appropriate to the philosophical mode of explanation to view [the variation of characteristics] as the development of purposive predispositions planted in one phylum.' What Forster viewed as the '*degeneration* [*Ausartung*]' of an original stem is rather a '*subspecies* [*Abartung*]' (ÜGTP, AA 08: 163-4). By rejecting the distinction between natural description and natural history, Forster removes the natural researcher's capacity to distinguish between kinds and subspecies, and thus renders variation contingent in regard to natural laws.

Kant's account of observing presages the reflective operation of judgment he develops in *KU*. In the Transcendental Dialectic of the first *Critique*, the regulative principles that guide our reflection on nature as a system are already available in advance and are 'admitted as problematic only' (KrV, B 674). Observation, on the other hand, is 'methodologically conducted experience' (ÜGTP, AA 08: 161). It is not a form of reason but a form of judgment, the seat of experience. Yet judgment, as it is understood in the first *Critique*, is simply 'the faculty of subsuming under rules; that is, of distinguishing whether something does or does not stand under a given rule' (KrV, B 171). This determinative conception of judgment stands in contrast with observation, which involves the *search* for rules. The key to Kant's analysis is the sharp distinction between cognition and reflective observation, a distinction that is made possible by the critical philosophy. Natural history would be a 'science of the gods' only if the natural historian were to think that her research is constitutive of experience. Natural

history, for Kant, is far more epistemologically modest. Governed by the teleological principle, it consists only ‘in tracing back, as far as the analogy permits, the connection between certain present-day conditions of the things in nature and their causes in earlier times according to laws of efficient causality, which we do not make up but derive from the powers of nature as it presents itself to us now’ (ÜGTP, AA 08: 161-2).

Kant’s critical philosophy informs his separation of natural description from natural history in the following way. As he established in the first *Critique*, causality is the principle that ‘Everything that happens, that is, begins to be, presupposes something upon which it follows according to a rule’ (KrV, A 189/B 232). Yet causality, as a dynamical category of the understanding, concerns only the time ordered succession of objects of possible experience. As Kant states in ÜGTP, while we cannot ‘know a priori that there must be ends in nature’, we ‘can very well know a priori that there must be a connection of causes and effects in nature’ (ÜGTP, AA 08: 182). This entails that ‘the use of the teleological principle with respect to nature is always empirically conditioned’; the need to reflect on ends in nature arises because something in experience exceeds our understanding and invites reflection. When we inquire into the development of an item without our having perceived this developmental process, the categories cannot apply, for it lies outside the bounds of possible experience. By following the teleological principle we are able to project onto nature the expectation that a rule that accounts for its development can be found. This principle is teleological to the extent that it allows the natural historian to view the object as a ‘natural end’, as something that does not develop accidentally but according to an inner principle that is expressed in the arrangement of the parts (ÜGTP, AA 08: 162). Of course, the understanding knows that teleological inquiry is unable to yield knowledge of efficient causes. Thus, in contrast to physics, natural history ‘can only point to fragments or shaky hypotheses’ (ÜGTP, AA 08: 163). Such hypotheses are not mere guesswork, however, for ‘the *concept* [of race] is well grounded in the reason of each observer of nature who infers from a hereditary particularity of different interbreeding animals ... a common cause, namely a cause that lies originally in the phylum of the species’ (ÜGTP, AA 08: 163).

3.3 *Organic beings*

In Kant’s natural history, the concept of race is a rational principle that enables the natural historian to unify a multitude of phenomena into a system of laws. By categorising the subspecies within a general species, the natural historian identifies how ‘the greatest degree of manifoldness in the generation can be united by reason with the greatest unity of phyletic origin’ (ÜGTP, AA 08: 164). Kant does not try to unify theoretical science with metaphysics, as he did in his early essay NTH. He instead claims that the simplicity his theory of race brings to classification demonstrates the convergence of our rational anticipation of systematic order with nature as the totality of appearances. While observation makes ‘known the unity of the phyletic origin’, it is conditioned on the assumption that affinity exists: natural history ‘must be guided by a determinate principle merely in order to *observe*, i.e., to pay attention to that which could indicate the phyletic origin, not just the resemblance of characters, since in that

case we are dealing with a problem of natural history, not of the description of nature and of mere methodical nomenclature' (ÜGTP, AA 08: 164). We can only search for 'indications' of the phyletic origin, for it lies beyond the limits of theoretical science.

Kant observes that his idea of a phyletic origin entails the idea of an organic being, for it implies that there is 'some matter in which everything is mutually related to each other as end and means, which can only be thought as a *system of final causes*.' The possibility of a phyletic origin – as far as *human reason* is concerned – lies within a teleological rather than a physical-mechanical mode of explanation, meaning that 'there can be no investigation in physics about the origin of organisation itself.' Such an inquiry would lie 'outside of natural science *in metaphysics*.' Kant explains his position as follows:

I myself derive all organization from *organic beings* (through generation) and all later forms (of this kind of natural things) from laws 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 transplanting of plants. How this phylum itself *came about*, this problem lies entirely beyond the limits of all physics possible to human beings, within which I believed that I had to hold myself. (ÜGTP, AA 08: 179).

In Kant's view, both Herder and Forster, in one way or another, leave 'the fertile soil of investigation of nature to the desert of metaphysics' (ÜGTP, AA 08: 180). While Herder claims knowledge of original vitality, Forster claims that God's created order is disclosed in our descriptive practices. The 'true metaphysics', on the other hand, 'knows the boundaries of human reason,' its 'hereditary defect [*Erbfehler*]', namely, that 'it cannot and may not at all concoct a priori *basic powers* (for then it would devise nothing but empty concepts).' The natural researcher guided by true metaphysics can do 'nothing else than reduce the powers which experience teaches it (to the extent that the latter differ only in appearance but are basically identical) to the smallest possible number, and to look for the pertinent *basic power* in the *world*, if it is a matter of physics, or *outside the world*, if it is a matter of metaphysics' (ÜGTP, AA 08: 180). A phyletic origin exists outside the world of efficient causes to the extent that it can be both cause and effect of itself:

Now the concept of an organic being is this: that it is a material being which is possible only through the relation of everything contained in it to each other as end and means (and indeed every anatomist as well as every physiologist actually starts from this concept). (ÜGTP, AA 08: 181)

In an organic being, the whole accounts for the existence of the part, and the part contributes toward the whole.⁴⁷ This is to say that some kind of *subjective state* is causally efficacious, even if the very notion of a subjective state lies beyond the concept of matter that guides inquiry. In the case of an artefact – a watch, for example – the part might exist for the sake of the whole, but it does not exist *because of* the whole. The whole does not produce the part but rather an end external to the artefact, such as the idea in the mind of a designer. Thus it can be explained entirely in the realm of physics. In the case of an organic being, on the other hand, the part exists for the sake of *and* because of the whole. It is the cause of the whole and its effect. Kant reasons that for organic beings, 'a basic power that is effectuated through an

organization has to be thought as a cause effective according to *ends*, and this in such a manner that these ends have to be presupposed for the possibility of the effect' (ÜGTP, AA 08: 181). Yet returning to the limits of true metaphysics, Kant recognises that we can know of such powers 'in terms of their ground of determination only in ourselves, namely in our understanding and will, as a cause of the possibility of certain products that are arranged entirely according to ends, namely that of *works of art*.' To cause an artefact is simply a matter of the efficient causes studied by physics; I move my arm to spread paint on the canvas. To cause the *possibility* of an artwork, however, I require a rational power, 'a faculty to produce something according to an *idea* which is called end' (ÜGTP, AA 08: 181).

The theoretical puzzle of the teleological principle is that we must search for what we do not yet know to be there, and the only way that we can confirm its presence is by yielding systematic results on the assumption that it is there to be discovered. The natural describer, who does not have such a method, 'will have to search [for affinity] again; for what he needs in order to decide whether there is a real or merely a nominal affinity among the creatures will not present itself to him on its own.' Kant's point is that affinity is not a fact in nature to be discovered. The natural describer can search only for 'variety', the 'hereditary peculiarity that is not classificatory, since it is not propagated unfailingly' (ÜGTP, AA 08: 165). The historian of nature, on the other hand, classifies in terms of 'race', an 'unfailing *hereditary* peculiarity which justifies the division into classes but yet does not warrant the division into kinds.' This allows the natural historian to unify 'the greatest difference in shape' by a 'common phyletic origin' (ÜGTP, AA 08: 165).

CONCLUSION

In this paper I have argued that Kant's critical turn does not so much break from his pre-critical natural history as transform the teleological method from constitutive practice of accounting for the necessary development of nature as a system to a regulative practice of guiding our reflection on organisation *in* nature. In a letter to Reinhold in 1787 Kant gives us a clue to understanding how his critical examination of teleology in the third *Critique* emerged from this development. He apologises to Reinhold for not praising his *Letters on the Kantian Philosophy* in the *Teutsche Merkur*, and explains the reason for his neglect as follows:

However, an essay in that very journal, written by the younger Herr Forster and directed against some other ideas of mine, made it difficult to do this without taking on both projects together. As far as the latter is concerned, namely my argument with Herr F, I was prevented from publishing a clarification of my hypothesis. (Br, AA 10: 513)

In the course of responding to Forster's essay Kant discovered a new kind of *a priori* that allows judgment to do the regulative work he formerly ascribed to reason in KrV. For Forster, natural history aims to present the actual order of nature. Thus to come to nature with any prior determination is to find in nature what is simply not there. Kant responds by arguing that Forster's natural description can only yield an arbitrary differentiation between nominal degeneration and supposedly 'true' species boundaries, for it is impervious to historical development. In contrast to

Forster's methodology, Kant's account of observation turns on the regulative use of the teleological principle, enabling the natural historian to begin with experience and search for a rule capable of accounting for the contingent arrangement of objects. In this sense Kant expands his conception of science from the ideal of mathematics, a complete and static system, to include a research programme guided by the assumption that nature is amenable to our search for rules. Though means of observation the researcher is able to form concepts and derive laws to unify the manifold of appearances into the simplest system.⁴⁸ Kant begins his third *Critique* with this idea in the 'Erste Einleitung' (1789), stating that the 'principle of reflection on given objects of nature is that for all things in nature empirically determinate concepts can be found, which is to say the same as that in all of its products one can always presuppose a form that is possible for general laws cognizable by us' (EEKU, AA 20: 211). The need for such a principle for experimental science is paramount; if we could not presuppose it, 'then all reflection would become arbitrary and blind, and hence would be undertaken without any well-grounded expectation of its agreement with nature' (EEKU, AA 20: 212).

ABSTRACT: In recent years scholars have examined Kant's critical turn as a break from his earlier work on natural history. According to this view, Kant's pre-critical natural history attempted to explain the present organisation of matter through a law-governed historical development. The critical Kant, however, saw that organisation is contingent on experience. The outcome of Kant's 'turn' is thus that natural history is denied scientific status, for investigation that begins with experience cannot bear knowledge of its necessity. While I agree that Kant's critical turn alters the status of natural history, in contrast to recent scholarship I argue that it does not so much break from his pre-critical natural history as transform it. In response to the criticisms levelled against his work by Forster and Herder in the mid- to late-1780s Kant aimed to reconcile his theory of organised matter with the critical programme. The result is not a teleological account of natural origins but rather a teleological method that guides investigation of objects whose form cannot be understood apart from temporal variation.

KEYWORDS: natural history, teleology, Kant, Linnaeus, Buffon, Herder, Forster.

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NOTES

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2 For example, see Shea 1986, Schönfeld 2000, Watkins 2003, Sloan 2006.

3 Schaffer 1978.

4 Massimi 2001.

5 Adickes 1924.

6 Schönfeld 2000, 126.

7 McLaughlin 1990, 1. Others have gone a step further to claim that the critical turn itself was informed by theoretical questions arising in natural history during the mid-eighteenth century. Philip Sloan argues that late eighteenth-century biological thought 'illuminates the issue of the foundation and necessity of the categories and the status of the a priori' in *KrV* (Sloan 2002, 230). Jennifer Mensch claims that the epigenesist theory of organisation 'had a significant role to play for Kant's theory of cognition' (Mensch 2013, 2).

8 Zammito 1992, 214. See also Zumbach 1984.

9 The method I use draws from Imre Lakatos, who argues that 'the typical descriptive unit of great scientific achievements is not an isolated hypothesis but rather a research programme' (Lakatos 1978, 4). Lakatos shifts the historian's focus from specific hypotheses to a collection of experimental practices grounded on a hard core of theoretical assumptions, assumptions that cannot be abandoned without abandoning the programme altogether. When faced with anomalies, proponents of a research programme must build 'auxiliary hypotheses' to protect the hard core. Lakatos suggests that change in the history of science occurs when 'progressive research programmes replace degenerating ones' (Lakatos 1978, 6). While Karl Popper was critical of scientists who respond to anomalies with auxiliary hypotheses, Lakatos argues that a research programme can be *progressive* if recent changes to its auxiliary hypotheses have achieved greater explanatory or predictive power. When a research programme becomes *degenerative*, however, we find the need for a new progressive system of theories. In what follows I draw from Lakatos' methodology to suggest that Forster and Herder represent two responses to the growing awareness that the popular Linnaean tradition of natural history was in a degenerative period. While Forster remained committed to the theoretical assumptions of the established programme and thus saw the need for further auxiliary hypotheses, Herder searched for a new system of theoretical commitments. In response to both positions, Kant advocated instead for a change in status of how the theoretical assumptions of natural history operate in research practice in such a way that shifts the notion of science as a finished system in the direction of science as a research programme (see Butts 1986, 1990).

10 Bacon 1901, VII. 3.

11 Bacon 1901, VII. 5.

12 Bacon 1901, VII. 3.

13 Bacon 1901, VII. 5.

14 Anstey 2002, 65.

15 Anstey [in press], 13.

16 Linnaeus 1735, 18.

17 Sloan 1990, 304.

18 Buffon 1749, 53-54.

19 In volume XIII of *Histoire Naturelle* entitled *Dégénération des animaux* (1766) Buffon broadens the boundaries of the interior moulds. While he does not a full account of species mutability, he speaks of significant historical 'degenerations' in some species, allowing him to identify 'families' with several branches. For example, he places quadrupeds into a limited number of original stems.

20 Buffon 1749, 35.

21 See Descartes 1983, III 48-54.

22 Schaffer 1978, 180.

23 In his 1755 essay 'Second or singular thoughts upon the theory of the universe', Wright uses fire as the basis for God's action, which conserves while also transforming the cosmos.

24 Wright 1837, 12.

25 For example, see Schneider 1966, Shea 1986.

26 Schönfeld 2000, 111.

27 Schofield 1970.

28 Massimi 2011.

29 Kant has been rightly identified as one of the founding pillars of racism (see Bernasconi 2001, Mills 2005, Kleingeld 2007). While this debate lies beyond my present concern, if my argument has anything to bear on the assessment of Kant's theory of race it is simply to show that while his conception of natural history might have been necessary for the racist views advanced in his essays, it is by no means sufficient. Kant's account of natural history does nothing to resist his undoubtedly racist beliefs and yet it does not necessitate them.

30 See Sloan 1990, 307.

31 Fisher 2007.

32 McLaughlin 1990, 30.

33 See Friedman 1991.

34 Kant states that while the rules of systematicity 'seem to be transcendental', they 'can really be used in its elaboration as heuristic principles with good success, yet without one being able to accomplish a transcendental deduction of them' (KrV, A 664/B 692).

35 For example, Kant states that reason gives us the 'logical principle' of the unity of nature, which drives us to search for 'the hidden identity' that unites different phenomena under basic forces (KrV, B 677).

36 Herder 1800, 1.

37 Herder 1800, 48.

38 Herder 1800, 49.

39 Forster 2013, 153.

40 Forster 2013, 148.

41 Forster 2013, 153.

42 Forster 2013, 159.

43 Forster 2013, 155.

44 See Forster 2013, 156.

45 Forster 2013, 156.

46 Forster 2013, 164.

47 Kant's definition of an organic being bears similarities with what contemporary philosophers of biology call 'part-whole explanation': an explanation where the existence of a part is explained by its function in an organic system. See Winther 2011.

48 For a discussion of this method in *KU*, see Kitcher 1986.

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