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Kant on Evolution: A Re-evaluation

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6.1 Introduction

Kant's notorious remark about the impossibility of there ever being a Newton of a blade of grass has often been interpreted as a misguided pre-emptive strike against Darwin and evolutionary theories in general:¹

It would be absurd for humans even to make such an attempt or to hope that there may yet arise a Newton who could make comprehensible even the generation of a blade of grass according to natural laws that no intention has ordered; rather, we must absolutely deny this insight to human beings. (CPJ 5:400)

My aim in this chapter is to re-evaluate this claim in the context of Kant's account of organic generation and argue that, contrary to what is usually thought, it does leave room for the possibility of evolution. After spelling out the constraints Kant identifies for any scientific study of the history of living beings, I examine his theory of generation and draw its implications for biological heredity, species diversity, and the role played by environmental factors in organic development. On this basis, I conclude that first, evolution is a possible albeit far-fetched hypothesis for Kant; second, Darwin's theory of natural selection would have turned a far-fetched possibility into a plausible candidate; and third, it would not have disposed of the need for teleology. This is why, I argue, Darwin could never have been a Newton of a blade of grass.

6.2 The distinction between history of nature, system of nature, and natural history

Kant begins his account of the scientific study of the natural world and its changes by noting the necessity of dissipating the equivocation of the notion of 'history of

¹ See, for instance, Lovejoy (1968), Cornell (1986), Ruse (2006), and O'Shea (2012).

nature.² To this effect, he distinguishes between different kinds of histories, depending on their object of study and their methodology. Some are truly historical in the sense that they approach the natural world diachronically (e.g. natural history (*Naturgeschichte*) and the system of nature (*Systeme der Natur*)); others approach it synchronically, by examining the state of the natural world at a given point (e.g. the description of nature (*Naturbeschreibung*)). While these scientific projects differ significantly, they are not only intrinsically related but depend upon each other for their possibility. For there is a sense in which the description of nature is the basis of any diachronic study of it:

[N]atural history would only consist 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. (TP 8:161–2)

It is only from the current state of the natural world, which we can experience, that we can hope to discover its previous states and the causal connections at work between those states, which have made its current state possible. The description of nature, the least ambitious project perhaps, grounds them all in the sense that it is their epistemic condition of possibility:

[W]hich came first, history or geography? The latter is a prerequisite for the former, because events necessarily take place with reference to something. History is a continuous progression, but things, too, change, and give an entirely different geography at particular times. Geography is thus the foundation [of history].

(PG 9:163)

Despite the epistemic contribution of geography, Kant underlines the limitations of historical studies of nature. As such, they have not reached the status of a proper science: ‘while one (the description of nature) appears as a science with all the splendour of a great system, the other (natural history) can only point to fragments or shaky hypotheses’ (TP 8:162). It is difficult to know with certainty nature’s history in remote times: ‘it has to be guessed, more through experiments than by accurate testimony’ (PG 9:162). One type of ‘guesswork’ is the analogical study of the shapes of natural beings. Through comparative anatomy, it aims to group them into various classes, obtained by trial, and thereby form a system of nature. On the basis of the resemblance between different kinds of natural objects, it organizes them into a logical system by recording ‘[t]he agreement of so many

² ‘I demand nothing new thereby but merely the careful separation of one business from the other, since they are entirely heterogeneous’ (TP 8:162).

genera of animals in a certain common schema, which seems to lie at the basis not only of their skeletal structure but also of the arrangement of their other parts' (CPJ 5:418). However, insofar as this classification is based on the mere 'similarity of form' between natural beings (PG 9:160), it has the appearance of a system but it does not really unify its parts within a common natural whole. Yet it is only by showing the real filiation between natural beings that we can bring unity to their apparent diversity and thereby hope to ground a true historical study of nature:

The school division concerns *classes*, which divide the animals according to *resemblances*, the natural division concerns phyla, which divide the animals according to *relationships* in terms of generation. 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. (ODR 2:429)

The classes of a school division such as Linnaeus' do not track a real continuity between living beings belonging to the same class. They do not tell us anything more about the nature of things than logical continuity, that is to say the conceptual relations of similarity and difference.³ Such a system of nature does not inform us about the real possibility of things, only their conceivability. There is in this sense an artificial character to the system of nature that the history of nature does not share:

Natural history, which we still lack almost entirely, would teach us about the changes in the shape of the earth, likewise that of its creatures (plants and animals) that they have undergone through natural migrations and the resultant subspecies from the prototype of the phyletic species. It would presumably trace a great many of seemingly different kinds to races of the same species and would transform the school system of the description of nature, which is now so extensive, into a physical system for the understanding. (ODR 2:434)

The difference between natural history and school system of nature is a difference between the conceptual and the real, a conceived unity and a natural unity. What is at stake is thus a different sense of 'connection' between living beings. One is logical: it is based on the principle of resemblance. The other is natural: it is based on filiation, which, in the case of living beings, is defined by the common law of natural reproduction:

³ 'Division of knowledge according to concepts is *logical* [...] we obtain a *system of nature* (*systema naturae*), as for example that of *Linnaeus*' (PG 9:159–60).

The natural division into species and kinds in the animal kingdom is grounded on the common law of propagation, and the unity of the species is nothing other than the unity of the generative power that is universally valid for a certain manifoldness of animals. For this reason, *Buffon's* rule, that animals which produce fertile young with one another (whatever difference in shape there may be) still belong to one and the same physical species must properly be regarded only as the definition of a natural species of animals in general in contrast to all school species of the latter. (ODR 2:429)

By defining species in terms of the capacity to reproduce and have fertile offspring, Kant can account for organic unity within a species. Species-groupings thereby acquire a historical reality that logical classes lack. However, to make sense of this notion of species, we need to turn to Kant's account of organic generation. For to understand the possibility of a biological line of descent, he needs to explain organic development in a way that secures the inheritance of biological characteristics within the same species.

6.3 Kant's epigenetic account of natural predispositions

On my reading, Kant's position on organic generation is a middle ground between preformation and epigenesis, by which I mean that it has both an epigenetic and a preformationist component.⁴ The epigenetic dimension of Kant's account consists in, negatively, leaving aside the question of life's beginnings, and limiting itself to the claim that an organism can only be conceived as the product of another organism: it 'begins all physical explanation of these formations with organized matter' (CPJ 5:424) and does not try to account for the possibility of an original form of organization.⁵ Positively, it characterizes nature as something that is productive and has a teleological element (*Bildungstrieb*, 'formative impulse'). In this sense, the decisive contribution of epigenesis to the debates on organic generation is to acknowledge a primitive organization and, accordingly, subordinate mechanical principles to teleological principles: 'our judging of them must always be subordinated to a teleological principle as well' (CPJ 5:417). Kant's endorsement of epigenesis is supplemented with a strong preformationist component, as appears most clearly in this passage:

⁴ Kant's position is what I have called an 'epigenesis of natural predispositions' (Cohen (2006)). It is unique since, as Sloan notes, most forms of preformationist theories were opposed to the thesis of epigenesis (Sloan (2002): 233). For an account of the scientific context of the time and the debates on generation in particular, see Lenoir (1982), Sloan (2002), Zammito (2002), and Lagier (2004).

⁵ As Kant notes, Blumenbach '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's relationship with Blumenbach has been the subject of numerous divergent interpretations. See, for instance, Lenoir (1982), Sloan (2002, Section 3), and Zammito (2003).

[T]he productive capacity of the progenitor is still preformed in accordance with the internally purposive predispositions that were imparted to its stock, and thus the specific form was preformed virtualiter. (CPJ 5:423)

Kant restricts epigenesis by positing the existence of natural predispositions that are dynamic and purposive ordering principles inherent in the species' original stock. By playing the role of structures that limit the evolution of the species, they account for the fact that it cannot transform and its characteristics are predetermined.⁶

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 [*ursprünglichen Anlagen*], which were to be found in the organization of its phylum. (TP 8:179)

There are structuring powers, acting upon specific pre-existent germs (*Anlagen*), that underlie all developments in a given species: an organized being 'incorporate[s] nothing into its generative power that does not belong to one of the undeveloped original predispositions of such a system of ends' (CPJ 5:420).⁷ In other words, crucially, these predispositions predetermine the development of natural species by providing intrinsic purposive structures that guide their organic development. Thus, at variance with purely epigenetic theories of generation, Kant's theory entails that biological inheritance can only be caused by natural predispositions present in the original stock: 'outer things can well be occasioning causes but not producing ones of what is inherited necessarily and regenerates' (ODR 2:435).⁸ The seeds of all organic changes had to be present from the start since their transmission is the only way of securing the inheritance of species-characteristics.

As a result, Kant's theory of the epigenesis of natural predispositions provides the biological ground for his account of the development of natural species by uniting the diversity of living beings organically and thus historically. Without a preformationist component that allows for natural predispositions to be

⁶ See also Sloan (2002: 246–7) and Zammito (2003: 88–93).

⁷ Kant offers a distinction between germs [*Keime*] and predispositions [*Anlagen*], although it is not particularly compelling: 'The grounds of a determinate unfolding which are lying in the nature of an organic body (plant or animal) are called *germs*, if this unfolding concerns particular parts; if, however, it concerns only the size or the relation of the parts to one another, then I call them *natural predispositions*' (ODR 2:434). In this paper, I treat them as equivalent since the distinction spelt out here is not directly relevant to my argument.

⁸ See also 'heredity, even only the contingent one, which does not always succeed, [can never] be the effect of another cause than that of the germs and predispositions lying in the species itself' (Det. 8:97). As Lovejoy notes, Kant is 'a vigorous opponent of the supposition that acquired characters can be inherited and an unqualified partisan of the doctrine of the continuity and unmodifiability of the germ-plasm' (Lovejoy, 1968: 183).

developed and then transmitted, permanent lineages within the various species cannot be secured. Yet without an epigenetic component that allows some seeds rather than others to be actualized, the diversity within these species cannot be accounted for.

However, there are different kinds of biological diversity within the same species, for some traits are invariably inherited and others are not. Thus, within each species, two types of differentiation can be made: one according to which the members of a species who possess characters that are invariably inherited belong to the same race; and another according to which the members of a species who possess characters that are only partially hereditary constitute varieties. Heredity is thus the key to the distinction between different kinds of biological groups, which Kant calls race, strain, variety, and sort (see Table 6.1):

Among the subspecies, i.e. the hereditary differences of the animals which belong to a single phylum, those which persistently preserve themselves in all transplantings (transpositions to other regions) over prolonged generations among themselves and which also always beget half-breed young in the mixing with other variations of the same phylum are called *races*. Those which persistently preserve the distinctive character of their variation in all transplantings and thus regenerate, but do not necessarily beget half-breeds in the mixing with others are called *strains*. Those which regenerate often but not persistently are called *varieties*. Conversely, that variation which produces with others half-breeds but which extinguishes gradually through transplantings is called a special *sort*. (Det. 2:430)

On my account, it is because of the preformationist component of Kant’s theory of generation that there must have been an original single stock containing the seeds of all races within the same species. This stock, in turn, guarantees that all races belong to the same species since the biological lineage is preserved by inheritance. On the other hand, it is because of the epigenetic component of his theory of generation that some seeds rather than others can be actualized depending on the environment, which explains racial and varietal diversity within the same species. Through the conjunction of species monogenesis and racial epigenesis,

Table 6.1 Different kinds of biological groupings

Biological groupings	Persistence of characters through transplanting	Persistence of characters through breeding
Race	unfailingly hereditary	unfailing half-breed
Strain	persistent characters	contingent half-breed
Variety	partially hereditary characters	contingent mix of breed
Sort	gradual extinction of characters	no half-breed

Kant's account of the history of living beings consists of generations of species confronting various kinds of environment and slowly producing a diversity of races from a unique strain in which an infinity of germs was originally located.

Only if one were to describe the events of the whole of nature as it has been through all time, then and only then would one write a real so-called natural history. If, for example, one were to consider how the various breeds of dogs descended from one line, and what changes have befallen them through all time as a result of differences in country, climate, reproduction, etc., then this would constitute a natural history of dogs. Such a history could be compiled for every single part of nature, for instance, on plants and so forth. (PG 9:162)

To have a better understanding of Kant's account of the relationship between biological heredity and environmental conditions, let's examine the case of human races, which Kant defines as the result of the adaptation of the human species to various environments through the development of different skin colours.⁹

6.4 Heredity, diversity, and environmental conditions: the case of skin-colour

In line with Kant's preformationism, the seeds of all human races were present from the start in the species' original stock. And in line with his epigeneticism, the appropriate seeds were first actualized to serve a purpose that arose from environmental circumstances, and then transmitted to the offspring. Insofar as skin colour appears to be the only character that is invariably dependent on the two parents, Kant identifies it as the biological criterion for distinguishing between races. As he notes, traces of the colours of a 'Negro' and a 'white' who breed both unfailingly appear in the offspring, whereas the complexions of a brunette and a blonde who breed do not.¹⁰ On this basis, his classification distinguishes between 'the whites, the yellow Indians, the Negroes, and the copper-red Americans' (Det. 8:93).¹¹ However, the choice of skin colour as the criterion for

⁹ As is now well known, Kant's discussions of human races are full of stereotyping, prejudice, and bigotry. In this section, I am solely concerned with their biological definition. For a nuanced and insightful analysis of the relationship between his views on race and the rest of his philosophy, see Frierson (2013: 104–7). See also Eze (1995) and Larrimore (1999).

¹⁰ '[B]londes and brunettes are not different races of whites, because a blond man can have entirely blond children with a brunette woman, even though each of these subspecies is preserved throughout extended generations in all transplantings. For this reason, they are strains of whites' (ODR 2:430)].

¹¹ As Kant writes, 'I think one is only compelled to assume four races of the human species in order to be able to derive from these all the easily distinguishable and self-perpetuating differences. They are 1) the race of the whites, 2) the Negro race, 3) the Hunnish (Mongolian or Kalmuckian) race, 4) the Hindu or Hundustani race' (ODR 2:432)]. For an account of the incongruity between Kant's two definitions of the four races, see Zammito (2006: 41–3).

distinguishing between races is only partly based on the fact that it appears to be the only character that is invariably inherited from both parents. It is also based on what Kant believes to be its essential feature, namely its purposiveness:

The reason why this character [skin colour] is an appropriate basis for a class distinction [...] is that the expulsion of wastes by means of sweating is the most important bit of concern exercised by nature insofar as the creature—which is affected quite differently by exposure to all sorts of different climates—is supposed to be preserved with the least amount of recourse to artificial means.

(PG 8:93)

Skin colour fulfils a crucial function in the survival of the human species: it allows its adaptation to different climates and different environmental conditions by regulating the constitution of the blood and allowing the expulsion of waste through sweating.¹² In this sense, skin colours are purposive: they are pre-adapted to a specific type of climatic environment, and they are all present, latently, as seeds, in the original human stock.

[T]hose of their descendants [of the first human couple] in which the entire original predisposition for all future subspecies was still unseparated were fit for all climates (*in potentia*), such that the germ that would make them suitable to the region of the earth in which they or their early descendants were to find themselves could develop in that place. (TP 8:173)

It is not that the human species has to adjust itself to fit the environment in which it lives; rather, the human species can adjust to different environments because it possesses a variety of seeds pre-adapted to all environments. Certain seeds contained in the original stock are actualized in accordance with the requirements of the environment human beings find themselves in, and the actualization of these seeds is precisely what constitutes a race. The racial characters thereby produced are then transmitted to the offspring, thus guaranteeing permanent racial lineages.

¹² This appears most clearly in Kant's speculations about the physical basis of blackness, where he appeals to iron particles in 1777 and to phlogiston in 1785. For instance, 'Now with respect to the peculiarity of a race, this purposive character can be demonstrated nowhere so clearly as in the Negro race; yet the example taken from the latter alone also entitles us at least to conjecture the same of the remaining ones, according to the analogy. For one knows now that the human blood becomes black (as can be seen at the underside of a blood cake) merely by being overloaded with phlogiston. Now already the strong odor of the Negroes, which cannot be helped through any cleanliness, gives cause for conjecturing that their skin removes much phlogiston from the blood and that nature must have organized this skin so that the blood could dephlogistize itself in them through the skin in a far greater measure than happens in us, where that is for the most part the task of the lungs' (Det. 8:103); see also ODR 2:440.

The human being was destined for all climates and for every soil; consequently, various germs and natural predispositions had to lie ready in him to be on occasion either unfolded or restrained, so that he would become suited to his place in the world and over the course of the generations would appear to be as it were native to and made for that place. (ODR, 2:435)¹³

The human species adapts differently to different conditions, and the best adaptation for each type of environment survives and becomes dominant, thereby giving the impression that the race was designed for this place. Of course, it is not strictly speaking 'native' to this place since it is the result of an evolution of the species. But the appearance of design isn't just an impression on Kant's account since the fit between a particular race and its environment is due to the actualization of an original predisposition whose purpose was the survival of the species in these types of conditions.¹⁴ It is in this sense that Kant places teleology at the centre of his biological account of species development.

Now, as is now well-known, Kant is famously ambivalent with regards to the role of teleology in science.¹⁵ Without getting into the detail of his account here, I believe that two claims are relevant to my discussion.¹⁶ On the one hand, he believes that we should always think of organisms as being mechanically possible and go as far as possible in our mechanical explanation of them: 'It is thus rational, indeed meritorious, to pursue the mechanism of nature, for the sake of an explanation of the products of nature, as far as can plausibly be done' (CPJ 5:418). Kant is and remains committed to the claim that all objects of experience can be accounted for in mechanical terms.¹⁷ On the other hand, he notes that we cannot help but rely on teleology as a principle for reflective judgment when confronting organisms: 'it is merely a consequence of the particular constitution of our understanding that we represent products of nature as possible only in accordance with *another* kind of causality than that of the natural laws of matter' (CPJ 5:408). Due to their reflective nature, teleological judgments are hypothetical modes of explanation that cannot attain the level of objectivity required by natural science.¹⁸ But in spite of that, we cannot do without them. Organisms have a 'special character' (CPJ 5:369): they stand out in the natural world in virtue of their

¹³ See also Det. 8:98–9.

¹⁴ Beyond the case of human skin colour, Kant's model of organic generation is intended to account for the diversity of characteristics within the same animal species in different countries: 'what is peculiar to each country, e.g. the animals. The local ones need not be noted, however, unless they are different in other places. Thus the nightingales do not sing nearly so loudly in Italy as they do in northern regions. On desert islands, dogs do not bark at all' (PG 9:164–5). I focus on the human case since it is the clearest discussion of it in Kant's works.

¹⁵ Contrast, for instance, McLaughlin (1990) with Quarfood (2004), and Breitenbach (2008).

¹⁶ I have defended these claims in Cohen (2004) and (forthcoming).

¹⁷ Teufel (2013) is particularly enlightening on this point.

¹⁸ As Kant notes, 'positing ends of nature in its products provides no information at all about the origination and the inner possibility of these forms, although it is that with which theoretical natural science is properly concerned' (CPJ 5:417).

self-organization, and we cannot grasp this unique feature without using the concept of purposiveness.¹⁹ Thus, when talking about organisms *qua* self-organized beings, we cannot do without teleology, and this applies to talking about their evolution as well their functioning. As a result, no matter how far we are able to go back in our mechanical explanations of living beings and their natural history, we cannot do away with teleology.

6.5 Different kinds of evolutionary impossibilities

On the basis of Kant's account of evolution as I have interpreted it, I believe that we should distinguish between different kinds of evolutionary impossibilities for Kant (see Table 6.2). Accounting for 'the first origin of the plants and animals' is a 'science for gods' (TP 8:162). Whatever this origin consists in, human beings cannot possibly know it. This epistemic closure differs from the absurd hypothesis that explains 'the generation of an organized being through the mechanism of crude, unorganized matter'—what Kant calls '*generatio equivoca*' (CPJ:419). What is not absurd, however, although it is often misunderstood as such, is the idea that all creatures originally display less purposive forms that evolve to fit better with their environment. Kant actually changed his mind on this point, since he originally deemed these evolutionary theories 'so monstrous that reason recoils before them' (Rev. Herder 8:54, 1785). The thought that 'one species would have arisen from the other and all from a single original species or perhaps from a single procreative maternal womb' (Rev. Herder 8:54) eventually becomes a mere 'daring adventure of reason' in 1790 (CPJ 5:419, 1790).²⁰ This shift is crucial for

Table 6.2 Different kinds of evolutionary impossibilities

Evolutionary hypothesis	Epistemic status
First origin of the organic	Science for gods
From inert matter to life (<i>generatio equivoca</i>)	Absurd hypothesis
Common biological ancestry (<i>generatio heteronyma</i>)	Monstrous (1785) / Daring adventure of reason (1792)

¹⁹ See, for instance, Kant's claim that organisms 'first provide objective reality for the concept of an end that is not a practical end but an end of nature, and thereby provide natural science with the basis for a teleology' (CPJ 5:376). My treatment of this issue is of course far too brief, but I have defended this view in more detail in Cohen (forthcoming).

²⁰ As Lovejoy noted, Kant 'no longer condemns transformism on a priori grounds' (Lovejoy, 1968: 203–4). See also Huneman (2006: 15–6) for a description of Kant's shift.

the purpose of my argument, since the evolutionary ‘adventure’ of ‘*generatio heteronyma*’ is now a possibility for Kant:

... [I]nsofar as something organic would be generated out of something else that is also organic, even though there would be a specific difference between these kinds of beings, e.g., as when certain aquatic animals are gradually transformed into amphibians and these, after some generations, into land animals. *A priori*, in the judgment of mere reason, there is no contradiction in this.

(CPJ 5:419 - note)

Thus, it is not contrary to reason to think that some species could transform into other species.²¹ Instead of adopting a transformationist hypothesis however, Kant endorses what he calls ‘*generatio homonyma*’, i.e. the theory that species only produce organisms of the same kind.²² If I am correct that *generatio heteronyma*, the hypothesis of species transformation, is compatible with his general account of organic generation, what stops Kant from adopting it? I believe that it is the lack of evidence of its occurrence. For as he writes, ‘*generatio heteronyma*, so far as our experiential knowledge of nature goes, is nowhere to be found... experience gives no example of it’ (CPJ 5:420). It is on this basis that it remains a far-fetched albeit possible hypothesis rather than a conceptual monstrosity for Kant. As he notes, what experience does give numerous examples of, however, is the production of an organism by another organism of the same species (rather than either from another species, as per *generatio heteronyma*, or from inert matter, as per *generatio equivocata*). Thus the conjunction of *generatio univoca* and *generatio homonyma* seems more plausible to him. But as I will show in the next section, the empirical evidence that there have been different varieties of the same species that have evolved into different species (e.g. extinct species and varieties as descendants of these species, as shown by the evidence that supports Darwin’s theory of natural selection) would have turned a far-fetched possibility into a plausible candidate. To support this claim, I will confront Kant’s account with the basic tenets of Darwinian evolution to determine whether a Kantian account of evolution is possible. I will focus on the two issues that seem to me essential: adaptation, and natural selection.²³

²¹ Recall that, in Section 6.5, I have shown in what sense Kant’s original account in 1775 (*Of the Different Races of Human Beings*) and 1785 (*Determination of the Concept of a Human Race*) can be interpreted as circumscribing the supposed contradiction intrinsic to the idea of *generatio heteronyma*.

²² ‘all generation that we know is *generatio homonyma* [...] and produces a product that is in its organization itself homogeneous with that which has generated it’ (CPJ: 5:420).

²³ Other issues, such as the inheritance of acquired characteristics or the formation of new species, are not directly relevant to my discussion. While they are important for the consistency of Darwin’s account, they are less so in the context of its contrast with Kant’s.

6.6 Kant vs. Darwin

Adaptation: Preformation vs. natural selection. Where Kant and Darwin seem to differ the most is that Kant believes that adaptation cannot be a result of chance:

Chance or the universal mechanical laws could not produce such agreements [between racial characteristics and their natural environment]. Therefore we must consider such occasional unfoldings as preformed. (ODR 2:435)

As shown in Section 3, due to his commitment to preformation, Kant cannot comprehend what mechanical process could lead to a fit between a particular race and its environment. On his account, the appearance of design isn't just an impression because it cannot be explained away; it can only be explained by the actualization of an original predisposition whose very purpose was the adaptation of the species to its environment (i.e. by introducing a teleological element within the species). But first, as already hinted at, the subspecies' adaptation is itself the result of an evolution triggered by the specific features of the environment. Thus the end result of this evolution, the race, is not native to this particular place. Second, and more importantly for my purposes, Kant's account does not commit him to the claim that the fit cannot be accounted for in any other, non-teleological way. What he is missing is a mechanical principle that can explain the adaptation of the organism to its environment. Without it, he cannot dispose of the need for preformation in the form of natural predispositions. But crucially, his account is compatible with natural selection *à la* Darwin. For, as shown in Section 3, although Kant may not be able to explain how, or even that, it is possible, he is committed to the possibility of a mechanical explanation of nature in general, and of organic generation in particular; a possibility that Darwin fulfils with his account of adaptation as the result of natural selection.

Natural selection as a teleological explanation. On my interpretation of Kant's account, even Darwinian natural selection would not dispose of the need for teleology. For, when Kant talks about organisms' 'purposive predisposition to self-preservation' (CPJ 5:420), he means that the actualization of a biological trait is explained by the fact that it favours the survival of the organism and thus the species. What this suggests is that the very concept of survival defines organisms and their evolution in teleological terms, as natural purposes. Thus, insofar as our explanations of nature cannot but rely on teleology in this way, even if this reliance is reflective or heuristic rather than constitutive, they cannot be purely mechanical. If this claim is correct, crucially, it also applies to Darwin's account, since the very form of explanation provided by natural selection is teleological in this way: it accounts for the selection of a trait by the overall function it fulfils in

the survival of the species.²⁴ In this sense, even Darwinian natural selection understood as a mechanical explanation of the possibility of evolution does not dispose of the need for teleology.

Of course, many believe that Darwin is the Newton of a blade of grass, for he makes comprehensible the evolution of species according to natural laws that no intention has ordered.²⁵ However, by contrast with this widely shared view, I believe that strictly speaking, Darwin isn't the Newton of evolution, and that, moreover, there can never be one on Kant's account.²⁶ For an authentic Newton of evolution would in effect be a physicist rather than a biologist. She would account for evolution at a molecular level, by providing entirely mechanical explanations of organisms and their evolution *qua* bundles of cells, just as she would of any other physical object. In this sense, she would collapse the distinction between organic and non-organic nature and thereby dissolve biology into a branch of physics. This is why strictly speaking:

It would be absurd for humans even to make such an attempt or to hope that there may yet arise a Newton who could make comprehensible even the generation of a blade of grass according to natural laws that no intention has ordered; rather, we must absolutely deny this insight to human beings. (CPJ 5:400)

However, while there can never be a Newton of a blade of grass for Kant, there can be archaeologists of nature (what we could call natural historians or modern evolutionary biologists) who study the evolution of organisms *qua* living beings by adopting teleology as an epistemic principle, albeit a heuristic one. On my account, Darwin is one of them.²⁷ For no matter how far his account of natural selection allows him to go back:

ultimately he [the archaeologist of nature] must attribute to this universal mother an organization purposively aimed at all these creatures, for otherwise the possibility of the purposive form of the products of the animal and vegetable kingdoms cannot be conceived at all. (CPJ 5:419–20)

Therefore, although evolution is a possible albeit far-fetched hypothesis for Kant, I have argued that first, Darwin's theory of natural selection would have turned it into a plausible candidate, and second, it would not have disposed of the need for teleology. This is why, on my interpretation of Kant, Darwin could never have been a Newton of a blade of grass.

²⁴ See, for instance, Lennox: 'Selection explanations are inherently teleological, in the sense that a value consequence (Darwin most often uses the term "advantage") of a trait explains its increase, or presence, in a population' (Lennox, 1993: 410).

²⁵ See, for instance, Shanahan (2004: 283–4).

²⁶ Contrast with Schuster (2011), esp. 9.

²⁷ For a slightly different take on this claim, see Cornell (1986: 408–9).

