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Kant on Scientific Laws

This chapter explores Kant's analysis of systematic unity in relation to the question of whether there are any laws of nature and, if so, whether they can be known by us. The chapter begins by noting how Kant's theory of systematic unity has inspired different accounts of the laws of nature, and explores the relation between a necessitarian account of laws and a reflection based one. Focusing in particular on the *Critique of Pure Reason*, I suggest that Kant's analysis of systematic unity relies on a principle of purposiveness which is not based on the analogy with reason's practical causality, but on an assumption of natural purposiveness indebted to Kant's earlier theory of germs and dispositions. The difficulty of reconciling his pre-critical views on natural purposiveness with the analysis of scientific laws put forward in the first *Critique* is, I suggest, what leads Kant to abandon the proto-necessitarian theory in favour of an alternative, reflection-based, account.

1. **Kant's contribution to the debate on the laws of nature**

In recent years there has been a surge of interest in Kant's arguments on the systematic unity of knowledge to vindicate an account of scientific explanation centred on the unifying power of laws (for a recent state of the art see Massimi and Breitenbach 2017). At the heart of this enterprise is an attempt to reflect on the importance of systematicity for understanding the character of laws as regularities reduced to a limited set of patterns balancing explanatory strength and simplicity. While traditionally associated to a rigid defence of *a priori* statements in tension with the fallibilistic commitments of modern scientific theories, more charitable readings have paved the way to a different interpretation of Kant's reflections on scientific

method (see Gava and Stern 2015) Kant's argument about systematic unity has been invoked in different contemporary accounts of the laws of nature.

These can be divided in four groups of theories. First there is an account of laws of nature understood as "best systems" for the classification of regular empirical occurrences where laws are seen as regularities in a system of empirical generalisation subject to a requirement of specificity of intervening connections (Kitcher 1986; Kitcher 1996: 412). On this "best systems" version, a scientific theory is understood as a "a projected order of nature", whereby methodological directives such as the directive to obtain "systematic unity in our knowledge" act as heuristic devices enabling us to evaluate scientific proposals even before these are tested (Kitcher 1992: 213). Then there is an account of laws of nature understood as "derivations" from a priori laws. On this second family of interpretations, only those particular empirical generalisations that can be connected to a priori laws have necessary status and therefore count as genuine laws. (Buchdahl 1992, Friedmann 1992). Thirdly, Kant's theory is often invoked in the context of a "necessitarian" account of laws whereby the necessity of the laws of nature is grounded in the "essential nature" of things and independently of human cognition (Kreines 2009, Messina 2017, Kreines 2017). Finally, there is a "reflection" account, according to which the necessary character of laws is derived from a priori principles combined with an ideal of unity that orients our efforts of comparing and contrasting particulars so as to arrive at lawlike generalisations (Breitenbach 2018).

Common to all these interpretations is an attempt to capture adequate relations of dependency amongst natural phenomena while vindicating the distinctiveness and necessary character of laws vis-à-vis contingent regularities (for a view that objects to this framework see Watkins 2014). The difficulty, for all of them, is how to account for the relation between two interconnected claims that we find throughout Kant's contribution to the question of unification of the laws of nature. The first is an epistemic claim about the heuristic role of systematic unity for the purpose of constructing stringent generalisations with causal explanatory power and that satisfy criteria of necessity. The second claim is a more controversial, ontological, claim about the character of the regularities that laws are supposed to capture, and whether such regularities can be seen as inherent to nature. For, as one author puts it, "how could we be *justified* in adopting explanatory patterns from considerations of unification, if unity of causes, laws and powers was not intrinsic to nature"? Without a further, ontological commitment, the logical demand would seem driven by "an obsessive phantasy that might in no way match the order of natural phenomena" (Kitcher, 1994, p. 262).

While some authors consider the ontological claim unnecessary to the epistemic one (Guyer 2005), others take seriously its implications for a Kantian contribution to our understanding of the necessity of laws (Kreines 2009). For how can one account for the necessity of the laws of nature while being agnostic or even denying that nature really does exhibit the necessary regularities that our explanations capture? "An explanation", we are told "must provide information about an underlying condition on which an explanandum really depends" (Kreines 2009: 531). Yet, the problem, from a widely shared Kantian perspective, is that while we can *postulate* the necessity of the regularities of nature, we cannot *know* that the regularities we postulate *are* necessarily *laws* of nature, regardless of our postulating them as such. The identification of patterns of regularity depends on our own methodological directives not on the way things are. We are therefore left with a dilemma: either the laws of nature are not laws *in a strict sense* after all (i.e. we don't know if they capture *necessary* relations in nature) or we grant that there are laws of nature but that our a priori principles are (at best) only contingently related to them.

One way out of this dilemma is to develop a "reflection" account of the laws of nature, grounded on a principle of purposiveness orienting our scientific enquiry (Breitenbach 2018; Ginsborg 2017). Like the necessitation account, the reflection account, finds laws of nature by presupposing an ideal of systematic unity based on natural purposiveness and which orients empirical investigation. Like derivation accounts, that enquiry is also rooted in a priori laws. And like best system theories it is open to the rectification of previous errors through new empirical observations: where lawlike generalisations sustain further scrutiny, they can be called laws. Knowledge of the laws of nature is, on the reflection account, neither entirely inaccessible (as with necessitation theories) nor entirely given to us (as with derivation accounts) nor knowledge of laws with reduced modal force (as with best system theories). It is progressively acquired with the help of the assumption of the purposive unity of nature and evidence of our own observations.

One problem with the reflection account however is Kant's insistence that the principle of purposiveness at the basis of the systematic unity of nature, while being necessary from a logical perspective (i.e. to orient our empirical investigations) is also contingent from an ontological point of view (Ginsborg 2017). In other words, while we can postulate the systematic unity of nature according to purposes, we cannot be sure that nature really is so arranged. But if we cannot assume that, how can the reflection account vindicate the *necessity* of laws, as opposed to their contingent generality? What really distinguishes this account from

best-system theories? And how can it address the objections about weak modality that best-system theories usually attract?

Kant has two kinds of answers to the problem of what gives necessity to the laws of nature. They are related but in tension with each other. Both try to explain why the principle of purposiveness can help us discover *necessary* rather than merely contingent generalities in nature. Where they differ is in how they think about necessity. The more familiar answer, which is at the heart of reflection accounts, directs us to Kant's remarks on the empirical laws of nature in the *Critique of Judgement* where the transcendental status of the principle of purposiveness is clarified in connection to the constitution of organic beings and the analogy with human intentional action. It is reflection on the way reason sets and pursues practical purposes, we are told, that legitimises the use of purposive principles in our effort to systematise the laws of nature.

The other, less familiar answer, is the one I want to explore in this paper. It stems from an interpretation of Kant's remarks on systematicity at the very end of the first *Critique*, in the section devoted to the *Architectonic of Pure Reason*. Here too, Kant tries to explain why systematic unity is necessary, how reason achieves it, and in what relationship it stands to nature. Here too the analogy with organic beings is vital. Here too, the principle of purposiveness plays a key role in explaining what confers systematicity to laws, and why some of the regularities we establish following empirical observation are also necessary. Yet, as I try to show, Kant's answers in the first *Critique* vindicate a proto-necessitarian rather than a reflection account of laws of nature.

Kant's version of necessitarianism is different from contemporary necessitarian accounts, however. As we shall shortly see, Kant's reflections on systematic unity imply that there is inherent purposiveness in nature, that there are laws of nature that reflect necessary relations between kinds but also (and this is where his theory differs from contemporary necessitarian accounts) that they can in principle be accessed by us. The reason they can be accessed by us is that the constitution of reason mirrors the constitution of nature: the same principle of purposiveness guides the relation between the whole and the parts in both. While in the reflection account, the systematic unity of nature is a projection of the systematic unity of reason based on the analogy with reason's disposition to pose practical ends, in the proto-necessitarian account that Kant holds prior to the third *Critique* the systematic unity of reason and the systematic unity of nature are connected through the use of the ideas of reason. This, as I try to show in what follows, is difficult to square with other core aspects of Kant's critical

work. It also explains Kant's later abandonment of necessitarianism in favour of the reflection account.

2. The metaphor of reason as an organism

The distinction between aggregative and systemic knowledge is at the heart of all rigorous scientific enquiry and crucial to an analysis of laws as universal regularities as opposed to merely contingent generalisations. Such a distinction is central to the section of the *Critique of pure reason* devoted to the *Architectonic of pure reason*, one of the lesser known parts of Kant's wider discussion of philosophical method and the only one to explicitly tackle the problem of the unity of the system (Ypi 2011; Manchester 2008). An aggregate of knowledge, we are told here, is like a rhapsody where accidental knowledge is amassed without a proper account of the relation between the parts, and of their distinctive function within the whole. A system, on the other hand, is an arrangement where cognitions fit together in an ordered way and where the parts and the whole mutually support each other acting as a condition of reciprocal development (Kant, [1786] 1998 A 832, B 860; 691).[1]

Kant's suggestion in the *Architectonic of Pure Reason* is that, in the case of a system, the necessary relation between the whole and the parts can be understood with reference to the purposive nature of our cognitive activities. Reason, he claims, contains essential purposes, purposes which structure its unifying efforts compatibly with an idea of the whole that stands in an organic relation to the development of the parts. Such an idea of the whole acts both as the basis for the development of the different parts of the system while at the same time representing its only "supreme and internal end" (Kant, [1786] 1998 A 833, B 861; 692).

Kant's analysis of systematic unification has two components. On the one hand systematisation consists in the effort to structure the relation between different parts of a system in such a way that new empirical findings can be coherently incorporated in a body of knowledge already available. On the other hand, Kant argues, that systematic unity must be presupposed if we strive toward the unification of disparate principles. The latest part is often interpreted as evidence of the dynamic character of methodological enquiry (even of Kant's affinities with a fallibilistic method of scientific enquiry) (Gava 2016). However, Kant's further

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[1] Following the convention amongst Kant scholars, before the page references in the Cambridge edition of the works of Kant, I have provided references to the page number of the Prussian Academy edition.

argument on how exactly to conceive this unifying effort and the particular remarks on purposiveness that we find in the *Architectonic* are perplexing. We are told, firstly, that the idea of a unitary system must be presupposed given the purposive nature of our cognitive activities and that this presupposition grounds our efforts to find a coherent relation between disparate principles and cognitions (*KrV*, [1786] 1998 A 832, B 860; 691). This is a logical requirement of unification and a rather straightforward one at that. But we are also told, much more problematically, that the idea of the whole of the system underpins the purposive structure of reason, and can be explained in analogy with the constitution of an organic body (Kant, [1786] 1998 A 833, B 861; 691). As Kant puts it, pure speculative reason contains "a truly articulated structure of members in which each thing is an organ". This means, Kant suggests, that "everything is for the sake of each member, and each individual member is for the sake of all, so that the least frailty whether it be a mistake (an error) or a lack, must inevitably betray itself in its use". (*KrV* [1786] 1998, B XXXVII-XXXVIII; 120).

The metaphor of reason as an organic being is crucial to understand the kind of methodological principle on the basis of which the *Critique* seeks to bring the multiplicity of cognitions in one systematic whole. Systematic unity is essential, as we can see, to reason's ability to be internally self-correcting and for the adequate use of its more specific principles. As Kant also explains in the *Preface* to the *Prolegomena*, since pure reason is an isolated domain, "there is nothing outside of it that could correct our judgment within it, the validity and use of each part depends on the relation in which it stands to the others within reason itself, and, as with the structure of an organized body, the purpose of any member can be derived only from the complete concept of the whole" (*Prol*: 263; 59).

Scientific knowledge for Kant requires incorporating the "form of a whole, in so far as the conception determines a priori not only the limits of its content, but the place which each of its parts is to occupy". The very definition of a system as "the unity of various cognitions under one idea" (*KrV* A832/B860; 691) entails a rational redescription of the idea of the whole as both anticipating a priori the possibility of arranging the parts as parts of one system and analysing the system as the concrete unity to which the parts tend. As Kant emphasizes, the scientific "idea" of a system contains "the end and the form of the whole which is in accordance with that end" (KrV A832/B860; 691). That distinction, in turn, relies on an "idea of the whole" with regard to which it is possible to assume that the parts of the system belong together in dynamic relation to each other.

The unity of reason is therefore grounded on the idea of a dynamic whole which can contain a multiplicity of cognitions in their constant development, a development whose

possibility is in fact also presupposed. This way of articulating the idea of the whole is reminiscent of the Leibnizian conception of monads. For Leibniz the monad was conceived as a "primitive force" or "originary activity" which also contained the conditions of possibility for its own future development. By expanding and revisiting the Aristotelian concept of *entelecheia*, Leibniz sought to show how this primitive force was at the basis of his account of the development of organic bodies and their distinction from inanimate objects.[2]

Interestingly, like Leibniz, Kant mentions the similarity with the activity of organic beings to explain the characteristics of the idea of the whole on which the architectonic-systematic structure of reason is grounded.[3] The whole, he argues, is in this case

articulated (*articulatio*) and not heaped together (*coacervatio*); it can, to be sure, grow internally (*per intus susceptionem*) not externally (*per appositionem*), like an animal body, whose growth does not add a limb but rather makes each limb stronger and fitter for its end without any alteration of proportion (*KrV*, A 833, B 861; 691).

The analogy with an animal body and the explicit reference to the development of organic beings is very important to understand the principle of unity on which we rely to distinguish between systematic and aggregative knowledge. Most Kant scholars refer to Kant's *Critique of Judgment* and to the principle of purposiveness in nature to explain how the analysis of biological nature can help us understand the necessity of scientific laws more generally (Breitenbach 2009; 2018). However, in the third *Critique* the purposive analysis of organic beings is oriented by the causality according to purposes that reason displays in the practical domain. In the *Critique of pure reason*, Kant makes no reference to an autonomous domain of practical reason and to its distinctive, practical, causality in accordance to ends.

The contrast between the two is instructive. In *the Critique of the Power of Judgment*, Kant argues, everything is reciprocally means and end (*KU*, 376; 247-48). It is difficult to explain the development of organic beings by reference to mechanic causes, guaranteed by the application of the concepts of the understanding to objects of experience. What one needs to presuppose instead is a particular type of causality, "the idea of an effect as the very condition of possibility of that effect" (*KU*, 367; 239-240). Thus, organised beings ought to be analysed

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[2] On the relation between Leibniz's conception of monad and Kant's (and Hegel's) account of purposiveness, see Chiereghin, Franco, "Finalità e idea della vita. La recezione hegeliana della filosofia di Kant", in *Verifiche*, 19, 1990, 127-229.

[3] For two relevant discussions of the relation between reason and the activity of organic beings see Mensch, J. *Kant's Organicism: Epigenesis and the Development of Critical Philosophy*. Chicago: University of Chicago Press, 2013, and Ferrarin, A. *The Powers of Pure Reason: Kant and the Idea of Cosmic Philosophy*. Chicago: University of Chicago Press 2015.

as "ends of nature" (*Naturzwecke*) (*KU*, 372-374; 244-246). However, Kant insists that the expression is also inadequate since the source of that type of cause is the capacity for reflective judgment.

In the third *Critique*, Kant explains that the hypothesis of final causes cannot be formulated by invoking the principles of the understanding (*KU* 234; 35). The concept of an end must, on the contrary, be explained in relation to practical reason and the determination of the will in conformity with the moral law.[4] The causal relation established by the principles of the understanding, Kant argues, can only help us articulate the link between efficient causes (*nexus effectivus*) which relates causes to effects but not the other way around. Attempts to reflect on the causality of organic beings rely on a nexus established by analogy with a concept of reason (ends), which, as Kant says "if considered as a series, would carry with it descending as well as ascending dependency, in which the thing which is on the one hand designated as an effect nevertheless deserves, in ascent, the name of a cause of the same thing of which it is the effect" (*KU*, 372; 244). Such a nexus, he clarifies further, is established when: i) the parts are only possible due to their relation to the whole; ii) the parts are combined into the whole by being reciprocally both cause and effect of their form. Only then, Kant argues, can we say that the idea of the whole determines the form and combination of all the parts as "a ground for the cognition of the systematic unity of the form and the combination of all of the manifold that is contained in the given material for someone who judges it" (*KU*, 372; 245).

The principle that therefore helps to explain the development of organic beings is the principle of the "internal purposiveness of nature" (*innern Zweckmäßigkeit der Natur*) (*KU*, 376-378; 433-437; 247-249, 300-303), a principle that belongs to the capacity for reflective judgment, that is transcendental and regulative, that differs from all other regularities established with the help of the understanding and that is more similar to the concepts of reason. This principle in turn relies on an "idea", the idea of the whole of nature as a regulated system of ends (*die Idee der gesammten Natur aus eines System nach der Regel der Zwecke*) (*KU*, 379; 250-251). Yet this idea, Kant explains in the third *Critique*, does not expand knowledge beyond the limits of experience and we cannot infer from it anything on the existence of a

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[4] Indeed, in the first version of the introduction to the third *Critique* Kant uses the term *Zweckmäßigkeit* to explain both the specific principle of purposiveness at the basis of reflective judgment and the concept of practical conformity to ends explaining how the latter is a kind of "Zweckmäßigkeit, die zugleich Gesetz ist" a form of purposiveness that is at the same time also law (*EE*, 245, 133). The fact that Kant uses the same term for both suggests that it is hard to distinguish the concept of conformity to ends from the practical domain. Indeed, it is only in the second introduction to the third *Critique* that Kant distinguishes the term *Zweckmäßigkeit*, reserved to the capacity for reflective judgment from the *Gesetzmäßigkeit* of the understanding and the *Endzweck* of reason. See on the use of these terms in the first and second introductions, Francesca Menegoni, "Finalità e scopo finale nelle introduzioni alla kantiana 'Critica del Giudizio'", in *Verifiche*, 17, 1988, pp. 327-51.

potential "architect" of such system. The principle of purposiveness serves as a rule to the faculty of judgment in reflecting on the multiplicity of the laws of nature where it can no longer be assisted by the principles of the understanding.

Now, if we return to the *Critique of pure reason* in the light of Kant's remarks on purposive causes in the third *Critique*, we find that to analyse the laws of nature from a systematic perspective also requires the idea of purposive unity. We find, too, an explanation of purposive unity with reference to the analogy between a system and an organism where everything is reciprocally a means and an end. But in the third *Critique*, we can only ascribe purposes to organic beings if we rely on a principle of internal purposiveness, which in turn is grounded on an idea of nature as a system of ends, which is in turn based on the necessity of practical reason. Does this analogy work to also explain the nature of the systematic principle at the basis of the architectonic unity of reason in the first *Critique*? Should we also postulate an internal conformity to ends within the system of pure reason?

On the one hand, this seems plausible and indeed compatible with Kant's suggestions that the rational scientific concept of a system contains the "end and the form of the whole that is congruent with it"[5]. On the other hand, the way in which purposiveness is discussed in the first *Critique* is peculiar, since here practical reason has no domain in which its principles are legislative and no necessitation of its own. In the first *Critique* Kant cannot rely on the practical causality of reason to explain why projecting to nature a conformity to purposes is *necessary*. Here, the role that the principle of reflective judgment plays in the third *Critique* is played by the "ideas" of reason (*Vernunftbegriffe*) which connect the concept of the whole required to conceive of a unitary system with the concept of a purpose (*Zweck*) which explains the assumption of a purposeful internal coordination of the parts within it.[6] The unity of an end, Kant argues, "to which all parts are related and in the idea of which they also relate to each other, allows the absence of any part to be noticed in our knowledge of the rest" (*KrV*, A 832; B 860; 691).

In the third *Critique* then, the principle of purposiveness helps explain how we can postulate the systematic unity of the laws of nature guided by a postulate of purposive unity which helps construct ever more appropriate sequences of generalisations. When we ask the question of where the "necessity" of these generalisations come from, we can only go back to

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[5]"Der scientifische Vernunftbegriff enthält also den Zweck und die Form des Ganzen, das mit demselben congruirt".

[6] See on the importance of the idea of the whole for the Kantian system and for analysis of the issue also in the Architectonic of pure reason H. Driesch, *Kant und das Ganze*, "Kant Studien", 1924, vol. 29, pp. 365-376.

the analogy with the constitution of our faculties, in particular the nature of practical reason whose capacity to pose practical ends guides our postulate of the systematic unity of the laws of nature. This vindicates a reflection account of the laws of nature. But in the *Critique of Pure Reason*, Kant makes no mention of the distinctive causality of reason in the practical domain. Yet the analogy with organic beings persists and plays a major role in defending the necessity of postulating systematic unity in scientific enquiry. In the next section I explain the different way in which purposiveness is articulated in the first *Critique*, why it supports a proto-necessitarian account of laws, and why the systematic unity of reason mirrors the systematic unity of nature rather than the other way round (as is the case with Kant's later work).

4. <u>Germs and dispositions</u>

Nobody, Kant argues in the first *Critique*, "attempts to establish a science without grounding it on an idea" (*KrV*, [1786] A 834, B 862; 692). Although this argument might at first appear like a dry formalistic and by now outdated remark in favour of the methodological unity of sciences, its relevance becomes obvious once we turn to its implications for the kind of enquiry that the *Critique of Pure Reason* seeks to advance: systematic enquiry based on laws rather than aggregative enquiry based on contingent generalisations. For Kant, philosophy is not a discipline that operates in isolation from other sciences. It is a rigorous science that ought to integrate the findings of all others and complement them with a reflection on the proper use of their tools, their respective methods of enquiry and their relation to our cognitive faculties and practical attitudes. But philosophy can aspire at all this only because it relies on reason alone, without appeal to external authorities and refining its own methodological criteria in dialogue with other sciences. It is impossible to prove the validity of its tools *more geometrico*, by presupposing certain premises and definitions and by equating its method to that of physics or mathematics (as Descartes or Spinoza maintained). The legitimacy and appropriate use of every principle depends on its organic relation with others and on the ability of all of them to help understand the conditions of possibility of experience in its complexity. Therefore philosophy, like every other science, needs to be conceived with reference not to "the description given to it by its founder" but "rather in accordance with the idea, grounded in reason itself, of the natural unity of the parts that have been brought together" (*KrV*, [1786] A 834, B 862; 692).

This presupposition of the unity of parts rests on a purposive relation of the whole and the parts which has both a logical/heuristic and an ontological component. Kant argues that the

unity of scientific knowledge and the purposive character of the idea of the whole that lies at its basis provides the cornerstone for the "scientificity of knowledge in general". The assumption of systematic unity is an important logical presupposition required for building stringent generalisations. Yet to have genuine necessity it must, for Kant, also reflect the way things are, the way nature is intrinsically organised. To explain where this necessity comes from we need to turn to the purposive structure of reason and explain in what relation it stands to the purposive structure of nature.

To explain how reason and nature support each other, Kant invokes an idea of purposiveness which helps us bring together reason's multiple cognitions and which confers a character of necessity to its systematic unifying attempts. On the one hand, such an idea is introduced in the *Architectonic of pure reason* as the principle of possibility of systematic experience, the foundation of our logical assumptions for the unity of lawlike empirical generalisations. On the other hand, Kant also emphasises that such an idea is already given to us in the (schematic) representation of the whole of knowledge before its complete execution. The relationship is here a functional one: the emerging idea of the sum total of cognitions already presupposes and determines the order of the parts in the present.[7] This does not mean that the correspondence is flawless, indeed, the full "definition of science", Kant argues, only rarely corresponds fully to its idea from the beginning. Yet such an idea of the whole is already contained in reason "like a seed, all of whose parts still lie very involuted and are hardly recognizable even under microscopic observation" (*KrV*, [1786] 1998, A 834, B 862; 692).

The clarification of the nature of ideas provided here appeals to an analogy between organism and system that is crucial to understanding why the generalisations of reason reflect necessary relations in nature. Just like a system is in previous pages of the *Architectonic* compared to a living being, so the idea of unity that lies at its basis is compared to a "germ" in accordance with which the organism develops. Systems, Kant clarifies here, appear to be formed "like maggots" by a "generatio equivoca from the mere confluence of aggregated concepts, garbled at first but complete in time, although they all had their schema, as the original germ (*ursprünglichen Keim*) in the mere self-development of reason" (KrV, [1786] 1998, A 834, B 862; 692).

One might argue that Kant's insistence on the capacity of reason for self-correction suggests here a best-system or reflection theory of the development of scientific knowledge.

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[7] See for more on this functional explanation of Kantian teleology Breitenbach, A. (2009). "Teleology in Biology: A Kantian Perspective." Kant Yearbook **1**(1): 31-56..

But such an interpretation would be difficult to square with the use of the term "*ursprünglichen Keim*" (original germ) to clarify the conditions of development of the idea of the system and to explain why Kant insists that such an idea is always already present in us. To explain the reference to germs and their origins requires going back to the reflections on the nature of organisms that surround the *Critique of Pure Reason* and on which Kant's conception of systematic unity relies.

Kant's reflections on these issues must be situated in the context of a familiar eighteenth-century debate about the unity of the species and the modality of transmission of character traits from one generation of organisms to the next. To better understand their relevance to the idea of natural purposiveness one should focus on the trilogy of essays in which the natural history of human beings is explicitly discussed: *Of the different races of human beings* (1775), *Determination of the concept of a human race* (1785) and *On the use of teleological principles in philosophy* (1788). In all these essays, reflecting on the reasons for the origin of different races, Kant offers a very similar explanation to the one quoted below:

the grounds of a determinate unfolding which are lying in the nature of an organic body (plant or animal) are called *germs* (*Keime*), if this unfolding concerns particular parts; if however it concerns only the size or the relation of parts to one another, then I call them *natural predispositions*. [. . .] This care of Nature to equip her creature through hidden inner provisions for all kinds of future circumstances, so that it may preserve itself and be suited to the difference of the climate or the soil, is admirable. [. . .] Chance or the universal mechanical laws could not produce such agreements. Therefore, we must consider such occasional unfoldings as *preformed* (BRM, (1775) 2007,89-90; 2: 435).

Kant's remarks on germs and predispositions are here situated in the context of a longstanding eighteenth-century scientific debate between defenders of epigenetic theories of natural development and preformist accounts (see for different discussions Huneman, 2007). The former, revived in the eighteenth century in the defence of "mechanistic" epigenesis, offered by G. L. L. Buffon's *Histoire naturelle générale et particulière* that appeared in 1749, explained organic development by referring to the action of a *moule intérieure*, a kind of vital force understood in analogy with Newtonian microforces, which organized the interaction of the various *molécules organiques* of which living matter was composed. Here, the generation of new organisms was illustrated with reference to a capacity inherent in matter to transform itself and generate new organic forms. Preformist accounts, on the other hand, developed in a climate of scepticism about epigenetic theories. They gained particular prominence in Germany through the work of Albrecht von Haller, later also reinforced by the analysis and microscopic

observations of the Swiss naturalist Charles Bonnet. Both Haller and Bonnet refined existing accounts of preformation drawing on Malebranche and Leibniz by referring to the existence of preformed germs, which were thought to be present in all natural beings, and which contained the seeds for their future development. Germs therefore pre-existed the fully formed organism, not in the sense that all the properties of a fully formed organism could be interpreted as already developed in the germs, but as seeds which required an ordering cause to facilitate their growth. Preformist theorists like Haller and Bonnet could thus respond to both biological and theological disputes about the relation of God to living matter, reconciling the natural development of organic parts with the defence of a purposeful intervention in the way natural forces with innate teleological direction could organize and develop.

As many interpreters have pointed out, Kant's general position towards epigenesis is complex (Zammito 2007). Although in the first *Critique* he went as far as calling the entire system "an epigenesis of pure reason" (Kant, [1786] A 3, B 167; 265) his commitment to a version of preformation is consistently clear in his early writings, and particularly in his essays on race. What makes this debate particularly interesting for our purposes is Kant's assumption of purposiveness as intrinsic to nature, not a projection of the practical causality of reason. In the writings on race, Kant notes that germs and dispositions should be understood as purposive conditions for the development of natural beings that specify their capacity to adapt and survive in particular environmental and atmospheric conditions. They represent innate structures, independent of mechanical causes, which precede the empirical development of organisms yet contain the seeds for their future growth and allow them to adapt in different environments (BRM (1775) 2007, 89-90; 2:435). Faced with the usual difficulties of invoking mechanical laws to analyse the unity of a species and explain how the characteristics of a particular organism could be preserved and transmitted to the next generation, a version of "preformist" theories is endorsed to account for the evolution of human traits that are already contained in it as germs and predispositions. Yet, while predispositions refer to certain conditions of development with regard to the size and relation of parts (organs) in a living being, germs are conditions for the development of new features. This then allows Kant to explain the unity and the diversity of the human species as well as its capacity to adapt to different external circumstances.

The implications of this theory are crucial for understanding Kant's analysis of the historical development of the human species and the role of reason in this development (see also Ypi 2014 for more discussion of this point). Kant explains how germs account for the different characteristics inherited by every race within the same human species, but also

emphasizes how the influence of a particular environment, the character of the soil, or certain atmospheric conditions establish differences in human traits. But the larger point that matters for our purposes is that, as Kant puts it, "the purposive character" of an organism is the general reason (*allgemeine Grund*) from which we can infer "a preparation that is originally placed in the nature of a creature with this intent" and from which we conclude to innate germs (BRM (1785) 2007, 102-103; 156)

The *Critique of Pure Reason* does not contain an explicit analysis of the principle of purposiveness. What Kant has to say here is not different from his views in the earlier anthropological writings on the concept of human race. Kant's biological theory of germs is essential to explain the status of the idea of purposiveness in the first *Critique*: it is only with reference to natural purposiveness that we can explain why the logical postulate of the systematic unity of the laws of nature is grounded on an ontological assumption of necessary relations between natural phenomena, as necessitarian theories emphasise. But the kind of proto-necessitarian theory that Kant embraces in the first *Critique* is problematic. Kant's theory of germs and predispositions seeks to solve the difficult problem of the relationship between logical and ontological purposiveness by introducing the idea of natural conditions for development able to account for both immutability and change in the course of human history.

On the one hand the postulate of purposive unity is logically necessary to understand the development of scientific theories as the progressive revealing through philosophical reflection of specific patterns linked to each other in a non-accidental way: this is also what the reflection account of the laws of nature maintains. But Kant adds more, he adds that the unity of purpose that reason displays is a reflection of a unity of purposes inherent to nature. This is where his theory is much closer to necessitarian account of the laws. But why assume that the contingent development of reason and the purposive arrangement of nature are connected in this way? Even if we say that the purposiveness of reason mirrors the purposiveness of nature, what guarantee is there that the regularities reason identifies and the patterns that nature exhibits overlap? What is the relation between the logical and the ontological assumption of systematic unity of empirical knowledge?

5.   The germ in the system

Kant tries to address this problem by assigning to *germs* a dual purposive function, a function crucial to understand the passage from the laws of nature to the patterns established by reason. Ideas of reason are to philosophy what germs are to anthropology. The history of reason is nothing else than a series of discovery of patterns

of explanation that are necessarily connected to each other if we ascribe nature an immanent end that provides unity to our understanding of natural phenomena. This immanent end is given in the purposive character of the ideas of reason, which schematise the purposive order of nature. But it is important to insist that there is a crucial difference in how the reflection account and the necessitarian account of laws explain this development. From the third *Critique* onwards, Kant's analysis of the laws of nature resembles the reflection account and is based on the discovery that order in nature is not immanent but projected with reference to human reason and the way it operates in the practical domain. In the first *Critique*, Kant's endorsement of the theory of germs and the analogy with ideas as subject to both natural and historical development contributes to a different theory of the laws of nature, one that is much closer to necessitarian theories.

Prior to the *Critique of Judgment*, and the identification of a specific principle of judgment that grounds the purposive analysis of nature on reason's capacity to set practical ends, Kant's answer to the problem of the laws of nature relies on nature's inherent purposiveness. The solution to the question of the conditions of possibility of systematic knowledge is contained in the theory of germs and dispositions and in the analogy with the purposive development of an innate idea of the whole which contains at the same time the condition of possibility of the development of the parts.

Both in the *Architectonic of Pure Reason* and in his essays on history, Kant emphasises the difference between an aggregative and a systematic account of knowledge and highlights the need for an organic connection of the whole and the parts. In both cases Kant also stresses how systematic unity can be defended in accordance with an idea which is already contained almost like a germ within human reason. Systems, Kant writes in the *Architectonic*, often appear formed "like maggots" by a "generatio equivoca" which all had their schema, as the original germ (*ursprünglichen Keim*) in the mere self-development of reason" (KrV, [1786] 1998 A 835, B 863; 692). The presence of a such a germ is not only observable if we turn our attention to particular systems and a given body of scientific work but to the development of philosophical enquiry as a complete discipline. It is not just that each body of work is articulated in accordance with an idea but all are rather in turn "purposively united with each other as members of a whole in a system of human cognition, and allow an architectonic to all human knowledge, which at the present time, since so much material has already been collected or can be taken from the ruins of collapsed older edifices, would not merely be possible but would not even be very difficult" (*KrV*, A 835, B 863; 692-3).

These passages confirm Kant's interest in a conception of philosophy articulated compatibly with the demands of the *Architectonic of pure reason* and perceived as a culmination of the demand for systematicity and classification in all the sciences. The requirement of systematicity cannot be considered fully satisfied already from the outset but develops in accordance with particular dispositions and follows the historical evolution of reason. Reason does not always contain what it needs to achieve the unity of the laws of nature but acquires it following a process of reflection and self-explication of its own purposes in an autonomous endeavour to shape the history of the different sciences. Philosophy as the discipline that embodies the highest form of systematic unity is here the "mere idea of a possible science", "nowhere given *in concreto,* but which one seeks to approach in various ways until the only footpath, much overgrown by sensibility, is discovered and the hitherto unsuccessful ectype, so far as it has been granted to humans, is made equal to the archetype" (KrV, [1786] 1998, A 838, B 866; 694).

Notice however that this mere idea of a possible science is not a chimera. The efforts of those involved with particular sciences to find their place within an ideal of complete knowledge are not risky attempts to achieve the kind of metaphysical insight prohibited by the critique of reason and required by its practical use. Whoever commits to doing philosophy, Kant argues also in the *Wiener Logik*, erects his building "on the ruins of another" (Kant, 1992, 799; 260) yet no work has ever reached a stage in which it can be considered stable in all of its parts. We do not know in advance what the common ground of all the laws of nature and of philosophy as a system of sciences looks like. The particular connection between different parts of the system must be identified dynamically and cannot be considered given already at the outset.

The history of scientific discovery consists of a series of efforts on the basis of which one can eventually come to see a path whose visibility is initially hindered to human knowledge. Reason begins by following this path in a way that is disoriented, without being prescribed any predefined or conclusive purposes. It proceeds chaotically at the start. But its construction finds more stability when the architectonic key to the systematic unity of all cognitions is discovered in the form of a principle of conformity to purposes which helps us explain the necessary connections between phenomena. In virtue of this principle, a researcher can organise scientific cognitions in a systematic way and see them as interconnected with each other while also allowing for plurality (Breitenbach and Choi 2017). Kant explains this point by arguing that it is "too bad that it is first possible for us to glimpse the idea in a clearer light and to outline a whole architectonically, in accordance with the ends of reason, only after we have long

collected relevant cognitions haphazardly like building materials and through them technically with only a hint from an idea lying hidden within us" (Kant [1786] 1998). Approaching the existent body of scientific knowledge from a historical perspective that enables us to observe how reason learns from its past mistakes is essential. But a purely historical outlook, we learn in the *Critique of Pure Reason*, is not enough. The process of identifying both reason's present limitations and its orientation to future purposes is assisted by a purposive arrangement of nature which contains the necessary relations between the different phenomena humans observe. That same purposive arrangement is at the core of the analysis of germs and dispositions with reference to which Kant explains the function of the ideas of reason. The strong, ontological, assumption of a purposive order in nature on which Kant's theory is grounded prior to the third *Critique*, brings his account of systematic unity much closer to necessitarian accounts. Once we discover the key to Kant's architectonic, lawlike regularities are both inherent in nature and accessible to us.

6. Conclusion

Kant's contribution to contemporary debates on the systematic unity of the laws of nature is less straightforward than contemporary adaptations of Kant's thought make it sound. This is because it is difficult to isolate Kant's concern with the unity of empirical laws of nature from his more general concern with the unity of reason and the justification of the method of philosophy as a systematic discipline. For Kant every particular body of knowledge occupies a specific place in the history of philosophy. In the course of the development of the human species, a body of knowledge that was once considered coherent and plausible but became subsequently irrelevant is similar to an archeological repository from which one can learn about the past so as to better plan for the future. Kant thinks of his own critique as both a philosophical synthesis of the work of his predecessors but also as a tool for the discovery of a clearer and more comprehensive systematization of reason's cognitions, starting from an appropriate account of the relation of its different purposes and the justification of their connection to the unity of reason. This, he claims, can be achieved, because of the emergence "in a clearer light" of an idea that has guided reason at first haphazardly and almost in a hidden way and now finally discovered as the basis for its architectonic system.

Yet, as we have already emphasised, when taken seriously this account of the architectonic unity of knowledge also runs into peculiar difficulties. The historicisation of the idea of systematic unity at the basis of the entire philosophical system requires overcoming a

conception of the history of science as mere *cognitio ex datis* (*KrV*, A 836, B 864) and opens up to a philosophical account of it on the basis of an idea for a purposeful history of knowledge. But how can the postulate of coherence and classification under higher and higher principles remain a subjective postulate without any claim to objectivity in the phenomenal world? Is such an idea a mere illusion? And if not why not? Where does its necessity come from?

Kant's answer here, as we have seen, is to invoke the concept of purposiveness to explain how the idea of systematic unity is both subjective and necessary. On the one hand, the aspiration of systematic unity is a merely subjective ambition, an intellectual concern. Yet Kant also invites us to think of such an idea in analogy with an original "germ" always present in reason but that can only grow and develop further in appropriate circumstances of enquiry, sensitive to distinctive methodological constraints. This implies that the possibility of the harmonisation of particular systems into a whole that is purposefully oriented is in some ways always contained in the nature of reason even if the full development of such an idea depends on contingent scientific discoveries. Just like in the case of organic beings, environmental conditions are crucial to the full development of innate germs and dispositions, in the case of the idea of reason, historical circumstances play an analogous role. The evolution of the system is therefore a dynamic process through which reason disciplines and limits itself, seeking order and creating unity as it discards unnecessary elements found along the way. Each stage in the development of this process is a step towards the process of reaching further maturity.

But we should be cautious in reading Kant's methodological stance here a pragmatic-fallibilist one. The different elements that contribute to the unity of the system are not merely connected to each other but also to the idea of the whole that is at the basis of their development, an idea that Kant insists uncovers a unity that is already there. It is as if this idea of the whole always preceded the coming together of the unity of the parts; the whole is thought of as in some ways a determining cause of the parts. This account is much closer to Leibniz's proto-necessitarian account, the laws of nature are already there and already valid; human reason merely uncovers them, notwithstanding the mistakes made along the way. The principle of general purposefulness and order of nature that is at the basis of such an idea looks like a critical adaptation of the concept of unitary laws central to the old metaphysical tradition, whereby conformity to ends is an inherent characteristic of nature. Although Kant's explanation of the regulative role of ideas in the *Appendix to the Transcendental Dialectic* is supposed to have shown the implausibility of such interpretations, the return to the concept of germs and their status within Kant's philosophy of biology, as well as his remarks about the analogy between reason and organic beings suggest that by the end of the first *Critique* the possibility of jumping

from the logical use of ideas to an ontological view of nature as containing a purposeful arrangement of empirical laws cannot be discarded. In the *Critique of Pure Reason*, Kant proceeds much less carefully in reflecting on the link between the logical principle of systematic unity of experience and the ontological analysis of nature as inherently purposefully oriented. This later assumption is fully discarded only in later works, especially in the *Critique of Judgment*. But to see how and why the demand for unity grounded in the heuristic role of ideas progressively makes way to the concept of reflexive judgment as satisfying the same demand for systematic unity, we need to show how reason operates autonomously from the constraints of nature in the practical domain. It is only when Kant eventually succeeds in finding an autonomous domain where practical reason is legislative, and where the demand for unity in science is justified in the light of the demand for unity in moral action, that one is able to understand how the principle of conformity to purposes is both necessary *and* contingent. And it is only at that point that Kant abandons the proto-necessitarianism of his initial position for a reflection-based stance influenced by his theory of reason in practice.

Works of Kant cited and abbreviations used:

BBM   Bestimmung des Begriffs einer Menschenrasse, Ak 8 (1785), Determination of the concept of a human race

KrV   Kritik der reinen Vernunft (1781, 1787), *Critique of pure reason*

KU   Kritik der Urteilskraft, Ak 5 (1790), Critique of the Power of Judgment

Prol Prol Prolegomena zu einer jeden künftigen Metaphysik, Ak 4 (1783), Prolegomena to any future metaphysics that will be able to come forward as science

RM   Recension von Moscatis Schrift: Von dem körperlichen RezMoscati wesentlichen Unterschiede zwischen der Structur der Thiere und Menschen, Ak 2 (1771), Review of Moscati's work Of the corporeal essential differences between the structure of animals and humans

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