

KANT'S ESSENTIALIST ACCOUNT OF THE LAWS OF NATURE

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Abstract. Kant claims (a) that the pure understanding is the legislator of nature: it dictates the universal laws of nature. Nevertheless, (b) particular laws of nature are only revealed in experience; they cannot be deduced from the a priori, universal laws. Still though, (c) to a priori and empirical laws *qua laws* pertains a necessity that is alien to mere empirical regularity. How do these theses cope together? Contrary to popular interpretations, the paper argues that, for Kant, particular laws of nature neither derive their necessity from a priori laws (M. Friedman) nor from their coherence with one another (Ph. Kitcher). Instead, Kant lays down a metaphysical conception of necessity: laws of nature are necessary because they rest on the nature or the essence of the relevant objects. The paper attempts to show (a) that Kant has a uniform account of all laws of nature, universal and particular, based on the “formal meaning” of the term “nature” (MAN, p. 467) and (b) how this account challenges stereotypical views of Kant’s philosophy.

Keywords: laws of nature; nomic necessity; logical and real essence; inner principles; form/matter.

1. INTRODUCTION

Kant’s account of the laws of nature has been a matter of considerable debate in recent Kant scholarship. The present paper argues that Kant has a uniform account of all laws of nature, universal and particular, on an essentialist basis: laws of nature are grounded in the nature or the essence of the relevant objects. The paper builds upon an earlier paper of the author, which has appeared in Greek¹.

2. NATURE AND ITS LAWS

In one of his first publications, at the age of twenty-two, in 1797, while Kant was still alive, Schelling attacks the orthodox Kantians and their view on the laws of nature:

¹ “Ο Καντ και οι νόμοι της φύσης” [Kant and the laws of nature], *Deucalion*, vol. 35, nr. 1–2, 2021, pp. 60–76.

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For them [the pupils of Kant], the world and the whole of reality is something that is originally alien to our spirit [...] Nevertheless, they dominate *such* a world, that is for them though *contingent* and that could just as well be different, with laws that - they don't know how and whence - are entrenched in their understanding. [...] And Kant is supposed to have taught that stuff? [...] There has never existed a system that would be more ludicrous or more picaresque. Nature has never been something different from its laws. [...] But because one can think of nature as some - I don't know which - speculative thing, to which one lends an existence independent of its laws, therefore one considers these laws as laws implanted to the world by a spirit outside it. Or, according to the newest system, as laws that our understanding first confers to nature as to something completely different from itself.²

Thus, according to the orthodox Kantians - Schelling seems to have in mind, among others, Friedrich Gottlob Born and Carl Christian Erhard Schmid -, our understanding imposes on nature some fundamental laws that are originally alien to it. In that way, our understanding dominates nature. Schelling denies that such was Kant's teaching. Kant could impossibly teach something as "[...] ludicrous or [...] picaresque". Nature is not "[...] something different from its laws".

Reinhold, Fichte, Schelling and others famously distinguished between the *letter* and the *spirit* of Kant's philosophy.³ They aimed to comply with the spirit of Kant, whereas the orthodox Kantians stuck to the letter. In the present case, however, in his quarrel with Kant's pupils, Schelling is right *according to the letter* of Kant. The question as to the spirit of Kant's position can be set aside for the time being. There is no doubt that Schelling developed Kant's philosophy in a direction, which implied a major revision of Kant's teachings on the thing in itself. Nevertheless, what Schelling states in the passage cited above, does indeed conform to the letter of Kant. For Kant himself, in fact, nature is nothing apart from its laws. Kant defines nature as the "lawfulness of appearances in space and time" (KrV, B 165), as an order according to laws. There is no 'nature in itself' in Kant; there can be no nature somehow before the laws or without the laws. Only some form of vulgar Kantianism, if the term is permissible, can accommodate such a notion.

For Kant, the concept of nature entails laws - nature and laws are inseparable concepts - and the concept of law entails necessity: "[...] the word nature already carries with it the concept of laws, and the latter carries with it the concept of the necessity of all determinations of a thing belonging to its existence" (MAN, p. 468). Yet, in

² Friedrich Wilhelm Joseph Schelling, *Allgemeine Übersicht der neuesten philosophischen Literatur (Abhandlungen zur Erläuterung des Idealismus der Wissenschaftslehre)* (1797-8), in *Schelling Werke (Historisch-kritische Ausgabe)*, vol. I.4, Stuttgart, Frommann-Holzboog, 1988, pp. 78-79. All translations are the author's, except in the case of Aristotle's *Physics* and of Kant's *Metaphysical Foundations of Natural Science* and the *Critique of Pure Reason*. The English editions used for translations from these works are listed in the reference list below.

³ Cf. the theoretical justification of the distinction in Johann Gottlieb Fichte, "Ueber Geist und Buchstab in der Philosophie. In einer Reihe von Briefen" (1794), in Fichte, *Werke*, edited by I.H. Fichte, Reprint: Berlin, de Gruyter, 1971, vol. 8, pp. 270-300.

which sense do laws imply the necessity of determinations? For Kant, the laws of nature do indeed govern the phenomena; they force them, so to say, to behave as they do. Causal laws refer to necessary relations of cause and effect: if A, then B follows by necessity. Such relations are no mere regularities that we happen to come across to in our experience. The Preface to the *Metaphysical Foundations of Natural Science* and the Introduction to the *Critique of Judgement* are very clear on that point: the concept of nature is inextricably linked to laws and to their necessity, i.e. the kind of necessity we would today call *nommic necessity* (cf. MAN, pp. 468–469; AA 5, p. 183).

3. THE NECESSITY OF LAWS: UNIVERSAL AND PARTICULAR LAWS

One should distinguish, however, between the universal and the particular laws of nature. According to Kant's provocative formulation – his followers whom Schelling chastised in the passage cited above surely had this in mind – the pure understanding is the authority that “dictates” to nature its universal laws (KrV, B 160). Hence, these laws are cognized a priori, independently of experience. The universal laws are the transcendental *conditions of the possibility of experience*, which necessarily govern the objects of experience, the phenomena. They are the “principles of pure understanding” that Kant presents in the *Critique of Pure Reason* (KrV, A 148/B 187). Among those universal laws, we find the principle of causality, the Second Analogy of Experience: anything that happens follows from a cause, according to some necessary law (cf. KrV A 189/B 232 ff.). Yet such laws, a priori laws, are also the fundamental laws of physics, which Kant deduces in the *Metaphysical Foundations of Natural Science*. For example, Kant derives from the principle of causality the law of inertia, Newton's *lex prima* (cf. MAN, pp. 543–544).

On the other hand, the particular laws of nature cannot be deduced from the universal, a priori laws. The principle of causality demands some causal law; yet it leaves open which law that will be. According to a formulation from the First Introduction to the *Critique of Judgement*, nature, as long as its particular laws are concerned, is “free” with regard to the understanding's lawmaking (AA 20, p. 210; cf. KrV, B 165). Nature is not bound by that universal legislation. We do not dominate it in that respect, in order to recall the passage from Schelling. From the perspective of our cognitive capacity, particular laws are not compulsorily the ones they are, like the universal laws; instead, they could be different. In that sense, particular laws are not necessary, but contingent. We cognize them, of course, from experience and not a priori; they are *empirical* laws.

Particular, empirical laws *qua laws* must anyway have necessity in the sense explained above: *nommic necessity*. That is, they have to refer to necessary relations. On the other hand, for Kant, such necessity can never be known through experience. Empirically, we can never obtain the awareness of necessity. A relation derived by an inductive generalization does merely state a regularity; it cannot acquire the dignity of a law (cf. MAN, p. 468; KrV, B 3–4).

Hence, a difficulty does emerge with respect to *empirical laws*. Those laws must, on the one hand, be empirical and, on the other, proper laws. The two demands do not seem to cope well with one another. In research, three different interpretations have been proposed.

4. THREE INTERPRETATIONS FOR THE NATURE OF PARTICULAR LAWS

(a) For Michael Friedman, particular laws are not derived directly from a priori laws, yet they are, nevertheless, derived from the application of a priori laws on the matter of experience. Particular laws are determined partly a priori, but they also have an empirical component.⁴ Hence, empirical laws draw their necessity from a priori laws. Empirical laws have a derivative nomic necessity. Friedman's interpretation does certainly find its footing in Kant's texts: empirical laws of physics stand, according to Kant, under a priori principles, which they "apply" on the particular circumstances of experience (KrV, A 159/B 184). Any doctrine of nature must "finally" [zuletzt] aim at a priori principles in order to be properly scientific (MAN, p. 469). However, what about a discipline like chemistry, where there are, for Kant, no fundamental a priori laws, but merely empirical, "contingent laws" that do never fully satisfy reason (MAN, p. 469)? Are we actually not allowed to talk about laws in such a discipline? Does Kant just use the term imprecisely, without rigor? In general, for Friedman's approach, empirical laws seem to be necessary, *proper laws, yet not properly empirical*. Particular laws are laws insofar as they partake of a priori necessity.

(b) An alternative interpretation has been defended by Philip Kitcher among others⁵. According to this approach, particular laws do indeed arise as inductive generalizations. They acquire the dignity of a law by being incorporated into a systematic order, i.e. into a continuous hierarchical scheme of more general, intermediate, and more specific laws. An inductive generalization acquires "(some kind of) necessity"⁶, i.e. it turns to something more solid than a statement of mere empirical regularity – in other words, it transmutes into a law – insofar as it fits the best available such system. The relevant criteria are simplicity of the general patterns and fruitful differentiation

⁴ Cf. Michael Friedman, "Causal laws and the foundations of natural science", in Paul Guyer (ed.), *The Cambridge Companion to Kant*, Cambridge, Cambridge University Press, 1992, pp. 175–180, for the derivation of Newton's law of universal gravitation from the a priori laws of mechanics and the merely empirical laws of Kepler.

⁵ Philip Kitcher, "Projecting the Order of Nature", in Robert E. Butts (ed.), *Kant's Philosophy of Physical Science*, Dordrecht, Reidel, 1986, pp. 201–235. For discussions of Kitcher's account and of other attempts in the same direction see James Messina, "Kant's Necessitation Account of Laws and the Nature of Natures", in Michela Massini, Angela Breitenbach (eds.), *Kant and the Laws of Nature*, Cambridge, Cambridge University Press, 2017, pp. 135–136; James Kreines, "Kant on the Laws of Nature: Laws, Necessitation, and the Limitation of Our Knowledge", *European Journal of Philosophy* vol. 17, nr. 4, 2008, pp. 529–530, 546–551.

⁶ Ph. Kitcher, "Projecting the Order of Nature", p. 210.

between the lawlike statements. Kant develops the idea of such a system of laws of nature mainly in the Appendix to the Transcendental Dialectic of the *Critique of Pure Reason* (see KrV, A 642/B 670 ff.). For this approach, in contrast to the preceding one, empirical laws seem to be *properly empirical, yet not proper laws*. Nothing guarantees that they really carry nomic necessity, that they do indeed govern the phenomena and not just our thought about them.

The common feature of both approaches discussed so far is that they start out from an *epistemic notion of necessity*. The fundamental sense in which laws are necessary is their being necessary with respect to our cognition. A priori laws are necessary, merely empirical laws are not. According to the first approach, a priori laws transmit their necessity to empirical laws, which would lack it if they would be merely empirical. According to the second approach, merely empirical generalizations require a further epistemic support, i.e. their coherence with one another, in order to become laws.

(c) The proponents of the third line of interpretation point out that, for Kant, laws of nature are necessary not in an epistemic, but in a metaphysical sense. Laws of nature are grounded in the *nature* or the *essence* of the objects they apply to; hence, they do inexorably apply to them. Thus, Kant adopts, one could say, an essentialist position. Earlier accounts in that direction – by Eric Watkins and James Kreines⁷ – argue that this is Kant's view with regard to particular laws: particular laws of nature are grounded in the particular nature of some natural kinds. More recent work – by James Messina, Nicholas Stang and the current author⁸ – goes one step further and attributes to Kant a uniform account of all laws of nature, universal and particular, on the basis of a metaphysical notion of necessity, or, in other words, on an essentialist basis. If laws of nature are grounded in the nature or the essence of the objects, then, of course, they inevitably govern those objects; the determinations of the objects are necessarily subject to the relations the laws dictate. Hence, for this approach, nomic necessity is ensured for all laws, both for those that are necessary in an epistemic sense, i.e. a priori, and for those that are not, i.e. for empirical laws.

5. LAWS OF NATURE AND THE NATURE OF THINGS

What is that uniform Kantian picture of all laws of nature, that is (a) transcendental laws, (b) the fundamental, a priori laws of the pure, rational part of physics, and, finally, (c) particular, empirical laws?

⁷ See Eric Watkins, *Kant and the Metaphysics of Causality*, Cambridge, Cambridge University Press, 2005, pp. 335–336, 400–408; J. Kreines, “Kant on the Laws of Nature”.

⁸ See J. Messina “Kant's Necessitation Account of Laws”; Nicholas F. Stang, *Kant's Modal Metaphysics*, Oxford, Oxford University Press, 2016, pp. 228–259; Jannis Pissis, “Kants Naturbegriff”, in Sarah Schmidt, Dimitris Karydas, Jure Zovko (eds.), *Begriff und Interpretation im Zeichen der Moderne*, Berlin/Boston, de Gruyter, 2015, pp. 51–62; Jannis Pissis, “The Concept of Nature in Kant's *Metaphysical Foundations of Natural Science*”, in Violetta Waibel, Margit Ruffing, David Wagner (eds.), *Natur und Freiheit: Akten des XII. Internationalen Kant-Kongresses*, Berlin/Boston, de Gruyter, 2018, pp. 1519–1526. These recent accounts converge in their results, although they have been developed independently of one another.

(a) Transcendental laws are grounded in “nature in general” [Natur überhaupt] (KrV, B 165; MAN, p. 469), i.e. the nature of a sensible object in general, the nature of an object of possible experience. How are we able to cognize that *nature in general*? How do we have access to it? “The conditions of the possibility of experience in general are at the same time conditions of the possibility of the objects of experience” (KrV, A 158/B 197), as Kant proclaims in a crucial passage of the First Critique, explaining the supreme principle of all synthetic judgements. The transcendental laws, as conditions of the possibility of experience, are at the same time conditions of the possibility of the objects themselves, the phenomena. The laws constitute the objects of possible experience; they constitute their nature. The pure understanding does of course dictate these laws. However, it does not dictate them arbitrarily, because it wishes so, neither do they follow from the way the human mind happens to be constructed. Transcendental laws are grounded in the “nature of the understanding” (AA 4, 308), in other words in “the essence of the faculty of thinking itself” (MAN, p. 472). For that reason, Kant holds that he needs to establish their systematic completeness and to prove their necessity. Thus, he presents in the First Critique a “system of all principles of pure understanding” (KrV, A 148/B 187) and for each such principle, i.e. fundamental law, he enunciates, he provides a proof that nothing can be an object of experience, in other words a thing of nature, unless it conforms to that fundamental law. The laws dictated by the understanding define a nature in general.

(b) Correspondingly, the laws of rational physics – which Kant presents in the *Metaphysical Foundations of Natural Science* – follow from the specification of the transcendental framework on possible *outer* experience. They emerge as the conditions of possibility of an object of outer experience, i.e. an object of outer senses, a material object, in abstraction from particular features of different kinds of matter. The a priori laws of physics define the *nature of matter in general* [Natur der Materie überhaupt] (see MAN, pp. 476–477). The systematic completeness of these laws rests on the systematic completeness of the transcendental concepts and principles of the understanding:

But the schema for completeness of a metaphysical system, whether it be of nature in general, or of corporeal nature in particular, is the table of categories. For there are no more pure concepts of the understanding which can be concerned with the nature of things. (MAN, pp. 473–474).

How do the laws of rational physics specify the transcendental laws on corporeal nature, i.e. on matter? For example, the principle of inertia – which Kant states in the form: “[e]very alteration of matter has an external cause” (MAN, p. 543) – is a specification of the principle of causality, according to which every alteration has a cause.

Up to that point, the metaphysical and the epistemic dimension go hand in hand. The conditions of knowledge are also conditions of possibility of the objects. The concept of the thing corresponds to its real essence [Realwesen], in order to use a term Kant occasionally employs (see AA 28, p. 553): The concept of nature in general corresponds to nature in general; the concept of matter in general corresponds to the nature of matter in general.

Yet, what guarantees that the general concept of matter does indeed capture its nature or essence? In order to understand that, one should carefully examine the method Kant follows in the *Metaphysical Foundations of Natural Science*. Pace Hegel⁹, that method does not consist in a mere analysis of the concept of matter. Rather, Kant follows a peculiar method, which he describes in the Preface to the work as “metaphysical construction” (MAN, p. 473) in contradistinction to the mathematical construction of concepts in pure intuition. Kant does not start out from a proper definition of matter, but from the basic determination of something movable in space. That determination is gradually enriched in reference to each of the four classes of categories and principles of the understanding (quantity, quality, relation, modality): the further determinations of filling a space (quality) and of the communication of motion (relation) are added to it. Hence, each of the four parts of the *Metaphysical Foundations of Natural Science* (phoronomy, dynamics, mechanics, phenomenology) starts with a determinate concept of matter. Then, it generates all additional predicates, which are required in order for thus determined matter to be possible as an object of outer experience, even if those predicates are not analytically contained in the concept of thus determined matter. Thus, in the second part of the work, space filling leads to the assumption of a fundamental repulsive force. This requires the assumption of an equally fundamental attractive force, because matter would otherwise expand in infinite space and annul itself. Both repulsive and attractive force belong for Kant “to the essence of matter”, to its “inner possibility” (MAN, p. 511)¹⁰.

(c) When we step on to particular laws, to further specification, the link between the metaphysical and the epistemic dimension is disrupted. With the concept we form for a particular kind of matter, we have not necessarily grasped the nature or the essence of that kind. In any case, the concept does not exhaust the essence; the logical essence – i.e. the ground of all that is contained in the concept of the thing – does not coincide with the real essence – i.e. with the ground of all determinations of the thing (cf. AA 28, 553). We explore particular laws in experience. We seek to detect the nature of some kind; we do not possess it. We do not constitute or construct it a priori.

However, particular laws – whether we cognize them or not – are grounded in the particular nature of the relevant kind of matter: e.g., in the particular nature of fluids or solids. According to Kant, “[...] there can be as many different natural sciences as there are specifically different things [spezifisch verschiedene Dinge]”, each of which

⁹ See Georg Wilhelm Friedrich Hegel, *Wissenschaft der Logik I: Die objektive Logik. 1: Die Lehre vom Sein* (1832), in Georg Wilhelm Friedrich Hegel, *Gesammelte Werke*, vol. 21, Hamburg, Meiner, 1986, p. 167.

¹⁰ For the method Kant follows in the *Metaphysical Foundations of Natural Science* see J. Pissis, “Kants Naturbegriff”, pp. 57–59; J. Pissis, “The concept of nature”, pp. 1575–1577 and in more extent Janis Pissis “Kants radikal dynamische Theorie der Materie im Blick auf Newton und Leibniz”, *Giornale di Metafisica*, vol. 37, 2015, pp. 54–58. For a discussion of how Kant's essentialist account of the laws of nature can concur with the constructivist approach Kant follows with regard to the derivation of universal a priori laws in the *Metaphysical Foundations of Natural Science* see also N.F. Stang, *Kant's Modal Metaphysics*, pp. 244–252.

has its own peculiar nature (MAN, p. 467). Thus, to each kind corresponds a particular natural science or a branch of physics: e.g., “hydrostatics” and “hydrodynamics” (MAN, p. 528) or the branch we call today solid-state physics (see MAN, p. 526–529). The Kantian idea is that particular branches also “finally” rest on the a priori foundations of physics. What does that mean? A fundamental repulsive and a fundamental attractive force, Newtonian gravity, necessarily constitute, as we saw, matter in general. These forces are conditions of the possibility of matter. In order to explain the divergence between fluids and solids, we will correspondingly turn to specific attractive forces of cohesion. Those forces have to account for the different constitution of each kind and are finally traced back to the fundamental attractive force. The laws that govern those forces are a matter of empirical research. The idea is that the a priori framework opens up the path in order for us to cognize particular natures, in order to come to know the material world in its diverseness and multiformity, in order to approach the things’ own peculiar nature¹¹.

Yet, what about sciences like chemistry, which, in Kant’s view, are not based on a priori principles, but are solely concerned with empirical laws (see MAN, pp. 468–469)? In that case, too, Kant can accept the same concept of laws and of their necessity: The laws – that we eventually do not know or do not know yet – are grounded in the nature of chemical substances. Just that in that case it is difficult for us to acquire knowledge, since we merely depend on experience. We do not have any access into the nature of chemical phenomena via a priori conditions of the possibility of chemistry¹².

According to the preceding discussion, when Kant talks of laws of nature, ‘nature’ does principally mean the nature of things, the *natura rerum*. The meaning Kant gives to the term ‘nature’ is probably surprising and must certainly be explained.

6. THE FORMAL DEFINITION OF NATURE

In the Preface to the *Metaphysical Foundations of Natural Science*, Kant defines nature, in the “formal meaning” of the term, as the “first inner principle of all that be-

¹¹ The general laws that constitute matter in general belong a fortiori to the nature of any particular material object. The “mechanical laws of impact, according to which a golden ball can be transformed into a golden plate” are not external to the nature of the metal, as Pollok thinks (see Konstantin Pollok, *Kants ‘Metaphysische Anfangsgründe der Naturwissenschaft’. Ein kritischer Kommentar*, Hamburg, Meiner, 2001, pp. 45–46). Just the shape of ball or plate is external to the nature of the metal and indifferent to it.

¹² According to James Messina, in branches like chemistry, which do not rest on a priori principles, one should accept that the conditions of possibility of phenomena are grounded in some corresponding noumenal natures, to which we have no epistemic access (J. Messina, “Kant’s Necessitation Account of Laws”, pp. 146–147). However, in the critical Kantian framework, such a link between the predicates of noumena and the properties of empirical objects, of phenomena, is rather problematic. – For the critical Kant, our knowledge is limited in the field of phenomena. Nevertheless, that does not mean there is some definite limit on our capacity to cognize the particular natures of empirical natural kinds (with regard to our capacity to penetrate into the “inner of nature” see KrV, A 278/B 334). In a branch not based on a priori principles, there can never be, of course, some a priori guarantee that our merely empirical knowledge is actually on the right path.

longs to the existence of a thing” (MAN, p. 467). In the *Critique of Pure Reason*, Kant gives a different formal definition of nature, the one we already encountered above, in the first section: nature considered formally – “natura formaliter spectata” – is defined there as the “lawfulness of appearances” (KrV, B 165). Nevertheless, there is no real tension between the two alternative formal definitions of nature, the one that mentions a first inner principle and the other, which mentions laws governing appearances. The two definitions tend towards the same meaning. The definitions are referring to the form of the appearances, which is nothing else than the laws governing them. According to the Preface to the *Metaphysical Foundations of Natural Science*, in line with the formal meaning of the term “nature”, we talk of the nature of this or that thing as its specific “constitution” [Beschaffenheit] (MAN, p. 467). Yet, at the same time, that formal meaning is the meaning, in line with which the concept of nature implies laws (see MAN, p. 468). Kant defines laws as “principles of the necessity of that which belongs to the existence of a thing” (MAN, p. 469)¹³.

What is, then, the relation between principles in the sense of laws and first principle? Nature as first principle is a fundamental determination, from which follow the other principles, the laws, which also belong to the nature of the thing. This is the way Kant employs the terms. Thus, in its formal meaning, “nature” means the nature of the thing or essence of the thing¹⁴ and, in consequence, the laws that characterize it, that necessarily govern its determinations. To the formal meaning Kant opposes the “material meaning” of the term ‘nature’ (MAN, p. 467; cf. KrV, A 419/B 446 n.). In this sense, “nature” means the sum total of appearances, the totality of sensible objects, the “sensible world” (MAN, p. 467). Thus, the material meaning is the meaning common to us, in line with which we do not speak of the nature of things, but “of the things of nature” (KrV, A 419/B 446 n.) as parts of a whole. Nevertheless, the formal meaning is for Kant the basic meaning of the term. Even in the material sense, we are in a position to actually talk of *nature*, and not just of a *world*, only insofar as the relevant totality is held together by laws (see KrV, A 418–419/B 446–447 n.).

¹³ In the *Prolegomena to any future metaphysics*, nature is defined formally in a way similar as in the Transcendental Analytic of the *Critique of Pure Reason*: as the “lawfulness of the determinations of the existence of things in general” (AA 4, p. 295) or as “the sum total of the rules” of the pure synthesis of appearances (AA 4, p. 318). However, a footnote to the Transcendental Dialectic of the *Critique of Pure Reason* contains an alternative formal definition of nature, which bridges the idea of lawfulness or conformity to law with the idea of the “nature of the thing” as an inner principle. There, Kant defines nature in the formal meaning of the term as “the connection of determinations of a thing in accordance with an inner principle of causality” and explains that in this sense “one speaks of the nature of fluid matter, of fire etc.” (A 418–419/B 446 n.). A passage that links the two alternative definitions can also be found in the preserved students’ notes from Kant’s lectures on physics: “Nature (formaliter) means the lawfulness of the determinations of a thing. Every thing has its nature [...] the way it is determined” (*Danziger Physik*, AA 29, p. 101).

¹⁴ In the Preface to the *Metaphysical foundations of natural science*, in a footnote to the formal definition of nature, Kant defines “essence” as the “first inner principle of all that belongs to the possibility of a thing” (MAN, p. 467). In this sense, geometrical figures do have an essence, a ground of their possibility and of all their properties, but no nature, since they are but constructions in the pure intuition of space, while the existence of a thing can only be given in an empirical intuition. In reference to natural things, Kant uses the terms “nature” and “essence” indistinctly.

In any case, the formal meaning is fundamental to Kant's project in the *Metaphysical foundations of natural science*¹⁵. The object of natural science is nature in its formal meaning. According to Kant's impressive statement in the Preface to the work, natural science, in order to refer to nature, not in order to satisfy some scientific ideal, demands necessary laws, the "[...] derivation of the manifold belonging to the existence of things from their inner principle". Hence, a genuine or proper natural science demands to be based on "a cognition through reason", i.e. it demands a priori laws, since only for such laws we can have "certainty", awareness of their necessity (MAN, p. 468).

Kant's formal definition of nature, as *first inner principle* of the determinations of a thing, seems, at first sight, out of place. It seems to point to Aristotle¹⁶ and to a pre-modern intellectual setting. What specific meaning does Kant give to the term "first inner principle"?

A *first principle* signifies, according to the above, the ground of all those principles that govern the object under consideration. With regard to matter in general, that ground is possible experience and, more specifically, possible outer experience. The universal laws of nature are derived as conditions of possibility of experience or of outer experience.

Principles signify, for Kant, first of all forces – i.e. a principle has the meaning of a cause (cf. MAN, p. 544) – and consequently the laws that govern the exertion of those forces. Kant thinks of forces in the sense of physics: moving forces, by virtue of which a body can set other bodies in motion, by virtue of which a body is causally efficacious in space¹⁷. The action of such forces is, for Kant, the only way we can come to perceive a material substance, an object of our outer senses (see KrV, A 265/B 321).

¹⁵ In research, however, the importance of the formal definition of nature is often played down, and the material meaning of nature is held to be solely relevant to Kant's project (see among others Michael Friedman, *Kant's Construction of Nature. A Reading of the Metaphysical Foundations of Natural Science*, Cambridge, Cambridge University Press, 2013, pp. 5–6; K. Pollok, *Kants 'Metaphysische Anfangsgründe der Naturwissenschaft'*, pp. 45–53). In a significant early contribution, Peter Plaaß has pointed to the fundamental importance of the formal definition of nature for Kant's project in the *Metaphysical foundations of natural science* (see Peter Plaaß, *Kants Theorie der Naturwissenschaft. Eine Untersuchung zur Vorrede von Kants 'Metaphysischen Anfangsgründen der Naturwissenschaft'*, Göttingen, Vandenhoeck & Ruprecht, 1965, pp. 24–34).

¹⁶ Cf. *Physics*, B 1, 192b, 20–23: "nature is a principle or cause of being moved and of being at rest in that to which it belongs primarily, in virtue of itself and not accidentally".

¹⁷ Kant understands force as the "cause of a motion" (MAN, p. 497), in the sense of an alteration in the state of motion, that is an alteration of direction or velocity (see KrV, A 207/B 252 n.). As to that, he adopts the Newtonian concept of force. However, in opposition to Newton and in accordance with Leibniz, Kant understands force in general as an inherent property of a body, as something that the body has and through which it is causally effective. For Kant, a moving body has, by virtue of its motion, "moving force", due to which it can mechanically communicate its motion to other bodies (MAN, pp. 536–537). For Kant's concept of force and for its relation to Newton, on the one hand, and Leibniz, on the other, see J. Pissis, "Kants radikal dynamische Theorie der Materie", p. 49; Marius Stan, "Kant's third law of mechanics: The long shadow of Leibniz", *Studies in History and Philosophy of Science*, vol. 44, nr. 3, 2013, p. 501; Eric Watkins, "Kant on extension and force: Critical appropriations of Leibniz and Newton", in Wolfgang Lefèvre (ed.), *Between Newton, Leibniz and Kant. Philosophy and Science in the Eighteenth Century*, Dordrecht/Boston/London, Kluwer, 2001, p. 123.

Erected on that basis, the project of Kant in the *Metaphysical foundations of natural science* is a radically dynamical theory of matter: matter is completely reduced to forces, “the material itself is transformed into fundamental forces” (MAN, p. 525). Kant rejects atomism and he in fact rejects it for being a flattening abstraction and a speculative hypothesis, which – in contrast to his own “dynamical natural philosophy” (MAN, p. 532) – does not leave any space for an empirical, experimental research program that would allow research to penetrate into the particular natures of things.

The atomism of Kant's time composed matter out of identical, absolutely impenetrable atoms and of empty intermediate spaces. Consequently, it explained the differences between particular matters, for example the different density, solely with reference to the different proportion of atoms and empty space. On the contrary, in the Kantian project, the different density of matters is traced to the different degree of the repulsive force, and further differences, as the difference between fluids and solids, have to be explained, as shown above, with reference to specific forces of cohesion and the particular laws governing them. Accordingly, in Kant's self-understanding, his dynamical theory was “much more appropriate and conducive to experimental philosophy” (MAN, p. 533), since, by stipulating specific forces and specific laws, it opened up a space for empirical research¹⁸.

Finally, *inner* principles do by no means stand for Aristotelian entelechies or any variant of them (cf. the radical rejection of that notion in AA 29, p. 106). Inner principles mean, for Kant, forces inherent to matter. For Kant, matter is not merely subject to “external moving forces”, as for a mechanistic conception, but instead has “moving forces of attraction and repulsion originally inherent in [it]” (MAN, p. 532), i.e. “inner forces” (AA 18, p. 418), by virtue of which matter is effective in space and can set other matter in motion. Gravitational attraction is, according to Kant, inherent to matter; it belongs to its essence (see MAN, p. 511), as Newton was not willing to admit¹⁹. Correspondingly, the laws governing the action of those inner forces should also be understood as inherent to matter, as inner principles pertaining to matter; not as laws imposed on some absolutely passive matter from outside. Further, the mechanical communication of motion occurs either by impact, by means of the repulsive forces, or it occurs by gravitational attraction. “Thus all mechanical laws presuppose dynamical

¹⁸ For Kant's radically dynamical theory of matter and for its relation to Newton, on the one hand, and Leibniz, on the other, see J. Pissis, “Kants radikal dynamische Theorie der Materie”. For the opposition between the atomists' “mathematical-mechanical explanation” (MAN, p. 524) and Kant's own “metaphysical-dynamical” (MAN, p. 525) theory, see in particular J. Pissis, “Kants radikal dynamische Theorie der Materie”, pp. 58-60. See also M. Friedman, *Kant's Construction of Nature*, pp. 234-258, who – based on the passage MAN, pp. 530-532 – relates Kant's dynamical project to a perspective that would allow chemistry to become a proper science too.

¹⁹ Gideon Freudenthal has convincingly argued that the reason Newton hesitated to consider universal gravitation as an inherent and essential property of matter was precisely that gravitation, unlike impenetrability and inertia, is inevitably a relational property. Cf. Gideon Freudenthal, *Atom und Individuum im Zeitalter Newtons. Zur Genese der mechanistischen Natur und Sozialphilosophie*, Frankfurt a. M., Suhrkamp, 1982, pp. 42-45; Isaac Newton, *Philosophiae Naturalis Principia Mathematica* (1726), edited by Alexandre Koyré and I. Bernard Cohen, Cambridge Mass., Harvard University Press, 1972, pp. 554-555.

laws” (MAN, pp. 536-537): the laws of classical mechanics, e.g. the principle of inertia, must also be inner, inherent determinations of matter.

In order to understand the term ‘inner principle’, it is helpful to focus on a crucial distinction Kant makes in the chapter on the “Amphiboly of the concepts of reflection” in the *Critique of pure reason*. It is the distinction between the “absolutely” [Schlechthin-] and the “comparatively internal” [Comparativ-Innerliches] in a thing (KrV, A 277/B 333; see A 265-266/B 321–322; A 274–275/B 330–331; A 277–278/B 333–334). Matter does only have comparatively inner determinations that are nothing but “outer relations” (KrV, A 277/B 333), first of all forces, by means of which matter is causally effective outside itself in space. To admit absolutely inner principles, by virtue of which matter could set itself in motion, would equal denying the principle of inertia and would lead to some form of “hylozoism” equivalent to the “death of all natural philosophy” (MAN, p. 544)²⁰.

For Kant, the basic meaning of the term “nature” is the formal or adjective (cf. KrV, A 418/B 446 n.) meaning of the term, in accordance with which we talk of the ‘nature of a thing’ as inner principle. Nevertheless, Kant’s formal definition of nature does not imply a metaphysical picture of the world as a collection of individual things, each endowed with some nature in the form of some intrinsic properties. On the contrary, the inner, essential properties of matter in Kant’s natural philosophy are entirely relational properties, nothing but “outer relations”: forces and laws governing those forces. Kant conceives of the purely relational character of material substance in line with the purely relational character of geometrical figures. The inner determinations of matter – forces acting under laws – are but relations to other matter in space, just like the inner determinations of a geometrical figure, e.g. the rectangularity of a triangle, are but relations of the space enclosed by the figure to the space outside it (cf. AA 4, p. 286). Hence, material substance is solely determined by comparatively inner, geometrical and dynamical, relational properties. The lawful relations that constitute a nexus of material things are the basic determinations of those things and first make them possible at all. The relations make up the ‘thinghood’ of material things; insofar they precede the individual material things as such. The priority of the formal over the material definition of nature in Kant’s account stands precisely for that priority of the lawful relations – which constitute the “nature of things” – over the ‘things of nature’.

²⁰ For the distinction between the absolutely and the comparatively internal in a thing in the chapter on the “Amphiboly of the concepts of reflection” of the *Critique of pure reason* as well as for its relevance to Kant’s theory of matter and laws of nature, see J. Pissis, “Kants Naturbegriff”, pp. 55–57; J. Pissis, “Kant’s concept of nature”, pp. 1573–1575. – Peter Plaaß fails to see the distinction between absolutely and comparatively inner in things. He distinguishes instead between the “inner of things” – “sealed to our knowledge” since we can never know the thing in itself – and some “inner of nature” that is accessible to us (P. Plaaß, *Kants Theorie der Naturwissenschaft*, pp. 27–28). For Kant, nevertheless, the thing in itself cannot even be determined as the inner of appearance. Otherwise, we would end up with Leibniz’s monads that have absolutely inner, intrinsic determinations, i.e. their own representations (cf. KrV, A 274/B 330). The comparatively internal in matter refers to forces and laws as inner principles; on the other hand, “the absolutely internal in matter [...] is a mere fancy [eine bloße Grille]” (KrV, A 277/B 333).

The preceding discussion on Kant's formal definition of nature suggests that it is rather misleading to point to the Aristotelian background or the Aristotelian connotations of that definition without qualification²¹. Nature as form in the Kantian definition does not refer to some inner principle of motion of the movable itself. On the other hand, Kant's definition does indeed indicate that the form of appearances is not superimposed to them, as an external or additional determination. Intellectual form and sensual matter of appearances – the determination and the determinable (see KrV, A 261/B 317) – do not stand for themselves, the one without the other: the form is but the form of the objects of experience and the objects are the objects they are by virtue of their form. The a priori form of matter, i.e. the system of the universal laws of nature, is internal or inherent in it, and it is the condition of matter's specific nature, i.e. of the particular laws. In that respect, there is in fact an affinity between the Kantian conception and Aristotelian hylomorphism.

7. THE LETTER AND THE SPIRIT OF KANT'S APPROACH

We are, finally, in a position to address the question that was postponed in the first section, namely the question about the spirit of Kant's approach. In his early text, Schelling wrote that, according to a common conception, nature is an indeterminate something and some spirit, God, comes from outside and imposes laws on it. The orthodox view of Kant is, for Schelling, but a grotesque variation of that picture²². The traditional account of the laws being imposed on nature was given by Robert Boyle, but also by Newton. In early modern philosophy, this account was opposed by Spinoza and Leibniz, who held the laws to be immanent to nature, inherent in it²³. To the present day, Kant's conception is usually regarded as a variation of the imposition model²⁴. Schelling is already protesting this understanding of Kant. According to the above, he is right, not only in letter, but also in spirit. Kant insists on a notion of forces innate in matter, on a notion of the things'

²¹ As do N.F. Stang, *Kant's Modal Metaphysics*, p. 238; Friedrich Kaulbach, Entry "Natur (V. Neuzeit)", in Joachim Ritter, Karlfried Gründer (eds.), *Historisches Wörterbuch der Philosophie*, vol. 6, Basel/Stuttgart, Schwabe, 1984, p. 472. Kaulbach sets the Aristotelian-sounding definition of the *Metaphysical foundations of natural science* in contrast to the formal definition of nature as the lawfulness of appearances in the *Critique of pure reason*.

²² F.W.J. Schelling, *Allgemeine Übersicht*, p. 79.

²³ In his text *De ipsa natura*, Leibniz opposes the view expressed by Boyle and Johann Christoph Sturm, according to which the laws of nature are not grounded in the nature of things, but in the will of God. Leibniz thinks, on the contrary, that God legislates by implanting in things a nature of their own, forces and laws that are inherent to them. See Gottfried Wilhelm Leibniz *De ipsa natura sive de vi insita actionibusque creaturarum/Über die Natur an sich oder über die den erschaffenen Dingen innewohnende Kraft und Tätigkeit* (1698), in Gottfried Wilhelm Leibniz, *Philosophische Schriften*, vol. 4, edited and translated by Herbert Her-ring, Frankfurt a. M., Suhrkamp, 1996, pp. 280–283.

²⁴ For typical expressions of that view, see Michael Hampe, *Eine kleine Geschichte des Naturgesetzbegriffs*, Frankfurt a. M., Suhrkamp, 2007, pp. 71–80 (who cites the passage from Schelling's early writing, but sets the latter's conception in contrast to Kant's conception); F. Kaulbach, "Natur (V. Neuzeit)", p. 468.

own nature and of laws immanent in it. He does not adopt the model of the imposition of laws, simply replacing God with human understanding. His position is in line with the opposite model; he thinks of laws of nature as inherent in it.

The spirit of Kant's philosophy is not that the understanding's lawmaking is some imposition or projection on nature, that this lawmaking blocks the access to the things themselves, that we cognize nature the way we constitute it and not the way it really is²⁵. At the basis of modern natural science, Kant detects the following methodical prescription: "[...] what reason would not be able to know of itself and has to learn from nature, it has to seek in the latter (not merely ascribe to it) in accordance with what reason itself puts into nature" (KrV, B XIV). The Kantian idea is that – in proper disciplines, the ones that rest on a priori grounds – the understanding's lawmaking, "what reason itself puts into nature", opens for us the path to the particular aspects of nature, that it allows us to cognize the particular laws.

Today, we can hardly share the conviction that "what reason puts into nature" is invariant, that it consists in some immutable conditions of possibility of scientific or other experience. Can the Kantian idea be still attractive to us? Perhaps the simplistic Kantianism of his orthodox pupils might seem to be more adaptable. That is to say, perhaps it might seem favorable to think of nature as something essentially inaccessible, as a surface, on which we may project whatever scheme we deem convenient. On the other hand, one could admit that Kant was hasty to declare too much of "what reason puts into nature" as invariant and necessary (and as making up the essence of matter in general), but nevertheless discern in the change of scientific theories the persistence of some "last logical invariants" (Cassirer): of those minimal conceptual conditions that reason has to put into nature in order to cognize its laws, conditions that are indeed exempt from accidental subjectivity²⁶. Even apart from that, it could yet be rewarding to follow Kant in considering the object of natural science to be not the "things of nature" but the "nature of things" in terms of lawful relations. That approach would arguably serve an account that could do justice both to the cognitive success and to the limits of natural science, in the face of the change of scientific theories and of the variety of different conceptual constructions and models. Such considerations would certainly amount to a revision of the letter, but perhaps less of the spirit of Kant's philosophy.

²⁵ For a rather crude version of such an image of Kant, see Gernot Böhme, "Kant's Epistemology as a Theory of Alienated Knowledge", in R.E. Butts (ed.), *Kant's Philosophy of Physical Science*, pp. 333–348.

²⁶ Such a view has been developed by Ernst Cassirer. See Ernst Cassirer, *Substanzbegriff und Funktionsbegriff. Untersuchungen über die Grundfragen der Erkenntniskritik*, Berlin, Bruno Cassirer, 1910 (Reprint: Darmstadt, Wissenschaftliche Buchgesellschaft, 1976), pp. 355–358; Ernst Cassirer, *Zur Einsteinschen Relativitätstheorie. Erkenntnistheoretische Betrachtungen* (1921), in Ernst Cassirer, *Zur modernen Physik*, Darmstadt, Wissenschaftliche Buchgesellschaft, 1994, pp. 79–80.