

2 Filling out space—the ether and the dispositions of matter in Kant’s *Opus postumum*

Ansgar Lyssy

Published in: *Perspectives on Kant’s Opus postumum*, ed. by Giovanni Pietro Basile / Ansgar Lyssy, London: Routledge, 2022, 27-49

Introduction

What does it mean that a physical body *fills out* the space it is in? Descartes famously suggested that matter fills out space simply by means of inherent properties, namely, through extension and impenetrability. Leibniz then claimed that impenetrability needs to be understood as a force, as the causal ground for the resistance to movement, and hence needs to be of the same type as the causal ground of movement. He also argued that extension is a derivative concept, as it requires the simultaneous existence of similar things in different locations, and hence, it could not be a primordial property of matter. For the constitution of matter at a particular region in space, Leibniz argued, not only the notion of impenetrability (i.e., the resistance to motion) is necessary, but also the notion of inertia (resistance to acceleration). The spatial existence of a physical body is thus tied to its causal effectiveness and its extension arises from a concerted interaction of the forces inherent in the body with external moving forces. A merely geometrical object can be extended, but cannot fill out space, since it lacks the causal efficacy inherent in both impenetrability and inertia—two geometric bodies can be located at the same place, something that is impossible for material bodies.¹ But if matter is constituted from forces, where do these forces reside? According to Leibniz, they need to be grounded in simple immaterial substances, in monads.

These debates reverberate throughout Kant’s philosophy of nature. While initially drawn to a form of Leibnizian or Wolffian monadology, Kant argues in his critical philosophy that there cannot be any simple substances in space, as no parts of space are simple and as space cannot be understood as the condition of external appearances (*CPR*, A441/B469). In Kant’s natural philosophy of the critical period, space is filled by attractive and repulsive forces and the material bodies that are constituted thereof (e.g., *MF*, 4: 518). In the *Opus postumum* (*OP*), the question of the filling out of space is picked up, especially in a series of fourteen drafts concerning the proofs of the ether, most likely all written between May and August 1799. The *OP* and its conception of a transition

are designed to fill a systematic gap between a priori metaphysics and empirical science, as Kant strives to develop here an “a priori cognizable system of empirically given moving forces of matter” that serves “as filling of a gap by means of the regulative principle of synthetical cognition”² (*OP*, 22: 182; my translation). What is needed are “mediating concepts” (*Mittelbegriffe*, *OP*, 21: 475) that can be conceived entirely a priori, but have an empirical application as well. Herein, as I will discuss at length, the concept of force takes center stage, particularly the ether, which serves as both epistemic principle *and* actual object.

In the *OP*, Kant picks up the questions concerning the filling of space, which he discusses in conjunction with the proofs or ‘deduction’ of the ether. In these often rather fragmentary arguments, in which he departs from his earlier take on the ether as a merely hypothetical entity,³ Kant wants to show that the ether is not merely a hypothetical entity, but something whose existence we necessarily need to presuppose. To make a complicated matter short, we can distinguish several different, but entangled strands of arguments. In the first, Kant argues that without the ether as a unifying ground for experience, experience would be impossible (e.g., *OP*, 21: 217, 551). Since this is not the case, we *must* assume the existence of the ether. For this, there needs to be a singular subject of forces and a singular, obliquitous medium for all forces. Hence, as a condition of the possibility of experience, the concept of the ether is a hybrid notion that can be deduced a priori, but, unlike the ideas or postulates of pure reason, denotes an actual object. It is both an “intermediary object of perception” that provides ground for the unity of experience without being an object of experience itself; it is also “a real material” (*OP*, 21: 229), as it fills out space and allows for the constitution of matter and motion. Hence, the notion of the ether has a transcendental role to play as a condition for the possibility of experience, and it also has objectivity, as it denotes an actual entity. This is necessary to connect the metaphysical foundations of natural science to the experiential dimension of empirical science, even though the ether cannot be experienced or proven a posteriori. Without this, our experience could not be ordered and understood through a system of a priori notions—and this, in turn, means that there could not be a unifying ground for experience.

Second, it is impossible that there is completely empty space in the world, hence something needs to *fill out* the space where we cannot locate material objects (e.g., *OP*, 21: 216, 582). The ether also needs to be the medium for all forces, so that the transmission of forces between bodies is possible without resorting to action at a distance. As physical matter is constituted by an attractive and repulsive force that connects its particles, it presupposes a medium in which these forces are carried. If this medium would also consist of such forces, an infinite regress could loom, as another medium would be required, and so on.⁴

Third, the ether is needed to explain the constitution of bodies by explaining the transmission and effects of the forces that are constitutive for material bodies. Attractive and repulsive forces are not enough to explain the constitution of the essential properties of matter, such as ponderability, coercibility, cohesibility, and exhaustibility.⁵ Science requires a system of forces, but as these forces are constitutive of material bodies, they cannot be grounded in these same material bodies. Instead, they must be grounded in something that is not in the same sense constituted by forces, namely, the ether (e.g., *OP*, 21: 289, 600). Kant is very explicit here: it is the ether that serves as “*basis* (first cause) of all the moving forces of matter, for it is thought as the immediately moving *primary material* (*materia primaria*)” (*OP*, 21: 605; see also 21: 217, 183; 22: 550). The ether is to be conceived as ontologically different from moving forces, yet it is constitutive of them. As forces also constitute the essential properties of matter, the ether is indirectly constitutive of matter as well, but also needs to be conceived as ontologically different from all matter that can be experienced. This severely limits our explanation and understanding of the ether in terms of anything that can be experienced. But we know that there *must* be something that underlies all forces: any comprehensive explanation of moving forces needs to entail not only the forces themselves, but also their first cause, as otherwise, it ends up in an endless regress of forces as secondary causes that presuppose other forces as secondary causes for their explanation. As a first reason, the conception of the ether will be used not only for scientific explanations, but also for the metaphysical foundation of secondary causes and the system of forces. It serves for both first- and second-order explanations, that is, it not only explains certain physical phenomena, such as heat or electricity, but also how other explanations by means of moving forces are possible. This foundational nature of the ether is what I will focus on in this paper.

These three strands of argument⁶ are connected and sometimes Kant seamlessly switches from the possibility of experience to the filling of space. The ether ties together the transcendental project of determining the a priori grounds of all knowledge, and the metaphysical foundations of science. Herein, the ether plays a crucial role in Kant’s *OP* and fulfills multiple roles at the same time, as it is supposed to bridge the gap between metaphysics and science. As the continuous and ubiquitous grounding of forces, the ether fills out space in a homogeneous way, as it allows for the transmission of moving forces within and between bodies, as well as between bodies and the subject.

Kant worked through the ether proofs multiple times, with an occasional shift in terminology or focus, but he never completed a detailed and stringent argument. Consequently, these proofs and their complicated relation to Kant’s transcendental philosophy have led to a comprehensive debate about the ontological or epistemic nature of these proofs,

about the nature of the idea of the ether, as well as about the nature of the ‘transition’ from transcendental philosophy to science. Finally, it is also a particular topic of debate how the material and/or formal role of the concept of the ether can be both a priori and related to experience. As this paper does not have the space to engage with all these debates, I will simply refer to Basile (2013) for a comprehensive overview of different interpretations.

Here, I want to provide a slightly different and hopefully new perspective on the role of the ether and give a new answer to the question of why Kant has deemed it necessary. To do so, I want to look at Kant’s philosophy from an angle that is partially informed by some recent debates in analytic philosophy. I want to point out that Kant’s ether proofs deal with a problem that has also become a topic of discussion in contemporary metaphysics for about the last 40 years, which allows us to read Kant’s ether proofs as an old solution to a contemporary problem. My angle here is this. The ether serves as the ‘basis’ or grounding of material bodies and their essential properties in general. However, the particular nature of this grounding remains obscure in the *OP* and I reframe and reconstruct Kant’s argument in terms of *dispositions*, for which I will provide a definition below. In very few words, my argument goes as follows: the mechanical forces and the essential properties of bodies are dispositions and contingent on their activation stimulus; the ether provides an enduring and ubiquitous stimulus and hence leads to a constant phenomenal manifestation of the essential material properties of bodies. While the debates about what we now call dispositional properties in natural things and their role in science go back to antiquity,⁷ Kant wrote surprisingly little on this topic. This might be the reason why, despite its importance in contemporary debates, this notion has received very little attention from modern Kant researchers.⁸ He uses the term mostly when he is discussing *biological* dispositions in the context of germs and predispositions (*Keime und Anlagen*) and occasionally when discussing mental habits and character traits. Herein, Kant is following the general usage of this term in the biological and psychological context of his time. In this paper, however, it is used in a more general way as a means for the analysis of both causal relations and grounding relations, and with this caveat in mind, we should distinguish Kant’s own use of the term from the way it is used here. Nonetheless, I argue that the essential properties of matter in Kant are, in fact, conceived as dispositions, that means that they can be understood as properties that manifest their perceivable ‘response’ only after a specific stimulus has occurred. The ether will provide these activation stimuli for the dispositions of matter constantly and ubiquitously. Thereby, it turns the dispositional properties of matter into stable properties that are manifest throughout time. The ether serves as the objective side that is necessary for matter to be a ‘manifest reality,’ to borrow a term developed by Allais (2015).

In the following sections, I will first sketch Kant's post-critical theory of forces and material bodies and then discuss the ether as a foundation for mechanical forces that are nothing but dispositions. In the conclusion, I will argue that Kant has developed an argument that is surprisingly modern and that builds on the strengths of transcendental analysis to offer a solution for a problem in the face of which some contemporary authors have pessimistically resigned.

Forces and material bodies

In the *OP*, matter is conceived within a framework of forces for which he establishes a variety of distinctions, such as internal and external, dynamical and mechanical, and primitive and derivative forces. These forces are located in and ascribed to material bodies, but they do not originate from it; rather, the bodies are constituted by these forces which are prior to matter.⁹ Those types of forces form a system of forces that plays an important role in the transition from metaphysics to science, as the notions at stake here have both a metaphysical and an empirical side to them—they can be known a priori, as without these forces experience would not be possible, which we know it is; and these notions can be applied for our understanding of the material world. Forces are constitutive of experiences by affecting the subject, albeit they are only mediately represented in our experiences, mediated through our cognition of those objects they are constitutive of. Without forces, there would not be any affectation of the subject and hence experience would be impossible; therefore, forces precede experience. Because we cognize nature as a functionally arranged system, these forces need to fit into a system.¹⁰ Reason demands that the system conforms to the table of the categories, because outer experience is shaped by the categories and these forces are constitutive of the material things that are given in outer experience—the objects of experience conform to the conditions of the possibility of experience.

Kant has sketched this system of forces multiple times in slightly different versions, so the details remain a bit vague, with Kant being apparently hesitant to commit himself to a single outline. In the *MF*, he has argued that there can only be two types of moving forces, namely, attraction and repulsion (see *MF*, 4: 498), which are called fundamental or elementary forces.¹¹ We can experience those moving forces through their effects, as they become manifest as a quantity of motion, friction, weight, inertia, etc., and hence, they must be conceivable a priori, as they precede any actual motion. They must also be cognizable a posteriori, as we can have an (indirect) experience of them (see *OP*, 22: 152). With this dual characteristic of being both cognizable a priori and a posteriori, they serve as mediating concepts between the a priori notions of metaphysics and physics (which Kant struggles to define, but which

can roughly be understood as the experiential and systematic science of matter). It is the task of the *OP* to conceive of the system of forces in correspondence to the categories, so that they are not a mere aggregate, merely collected from experience, but systematized in correspondence to pure reason. However, the nature of the system of forces taken as a whole is epistemically “problematic” (*OP*, 22: 240), as it can be discovered neither by reason nor by experience alone.

Some forces originate from ‘within’ the bodies, others are exerted through external events; as Kant calls it, they are “implanted” and thus originally located within physical matter (“ingenitae”, *OP*, 21: 171; or “congenitae”, *OP*, 21: 173) or they are “impressed” through external events (“impreßae”, *OP*, 21: 171; cf. 21: 173). This distinction is already found in Kant’s early text *Thoughts on the True Estimation of Living Forces* (1747) and is used to express the idea that no motion can originate from matter alone (cf. 1: 26 ff.; Mathieu 1989, 88–89). We can know of these forces by means of their different manifestations for which they serve as causes that can be observed only mediately: impressed forces are manifest in the collision of bodies, for example; implanted forces are manifest in cohesion and stability, and so on. This two-fold distinction between repulsive and attractive forces and impressed and implanted forces is also mirrored in the additional division of forces into superficial and penetrative forces (e.g., 21: 308). A superficial force does not scale in relation to motion, as, for example, greater cohesive forces do not result in a change of motion. It also only shows on surface contact, i.e., in the repulsive collision of bodies. Penetrative force, such as gravity, scales with motion. Throughout the *OP*, the ether is associated with the effects of superficial forces.

External or impressed forces must somehow originate from immanent or implanted forces, so that we can avoid a regress of an infinite chain of external forces. Kant also rejects a motive force as an original cause or beginning of motion (a “primus motor”, see *OP*, 21: 218, 518; 22: 552), as one would have to ascribe spontaneity or will to it to give the initial motion a determinate direction, which contradicts matter. In other words, Kant rejects an infinite chain of external, mechanical causes, as this would make definite physical explanations (causes of causes of causes ...) impossible; and he also rejects the notion that the chain of external, mechanical causes might be originated by means of a final cause, as this would lead to an emergence of matter from the mind. But implanted forces are not easy to explain either, as they cannot be a result of matter as well. They are the results of a more primordial motion of the ether. Consequently, Kant also distinguishes between a dynamical force that serves as the original cause of motion (albeit not as a chronologically preceding *initiation* of motion), and a mechanical force that presupposes moving bodies to act upon and that would be contained in (Newtonian) physics (e.g., *OP*, 21: 356, 239). This is one

of the major tasks that the OP needs to accomplish to bridge the gap between metaphysics and physics: it needs to explain the origination of motion from ‘within’ bodies, without referring to moving forces that are ‘impressed’ in bodies by means of external causes. What Kant is looking for here is the all-encompassing internal cause that initiates and enables motion, but without temporally preceding the chain of successive external causes: “The problem is: What is it that first sets the moving forces of matter – *taken as a whole* – in motion?” (OP, 22: 200; my emphasis.). The solution to this needs to be neither a body nor a particular movement, nor a motive force, but rather something that entails its own type of *constitutive* causality.

Here, Kant often conflates moving forces with their manifestations in terms of properties of physical bodies—cohesibility, for example, is often both conceived as force and as an essential property; impenetrability as a property can hardly be described without accounting for some kind of repulsive force. These essential properties are usually defined as ponderability, coercibility, cohesion, and exhaustibility (e.g., OP, 21: 531, 483; 22: 196) that are conceived of along the lines of the table of categories (quantity, quality, relation, and modality). They are manifest as observable properties that come in degrees: one object may be more or less brittle, another may be more or less sturdy, another one may be more or less soft and malleable, etc. These phenomenal qualities of material bodies are the result of different interplays of attractive and repulsive forces within bodies and they are conceived as manifestations of the more basic properties named above. However, these properties do not exist just by themselves, but they require an opposing force of the same type (e.g., OP, 22: 610)—for example, saying that a body is cohesive means that, if the body is subjected to a certain tearing motion, *then* it will resist it by means of its internal forces. As such, these properties are *conditioned* on an interplay of secondary causes and can thus not sufficiently be explained by secondary causes alone. For example, if I use a lever, I presuppose the stability of the material involved, and thereby its cohesion; and I also presuppose that I *can* interact with it through appropriate materials (for example, the hands with which I pull the lever), and thereby its coercibility. I observe coercibility by observing the lever move in a specific way, but coercibility is not phenomenally given, but conceptually implied in my observations. As they denote the essential concepts of materials, essential properties are “anticipations of natural science in accordance to the categories” (OP, 21: 531).¹² The actual moving forces *can* be known through experience (OP, 21: 475), but only *indirectly* by means of observing the interaction of bodies, and hence they are called “problematic” (e.g., OP, 21: 184, 21: 599).¹³ This means that they require a distinct grounding.

Kant strives to conceive of these forces in terms of attractive and repulsive forces as well as superficial and penetrative forces, but herein

he remains entirely within the realm of secondary causes. As indicated above, this system of forces must be supplemented with a primary cause that can be neither a movement nor inert matter, albeit it must contain both *in nuce*. This problem is solved by conceiving of the primordial vibration of the ether, which is characterized in opposition to the essential properties, namely, as imponderable, incoercible, incohesive, and inexhaustible (e.g., *OP*, 21: 231–232). That is, the ether is a ‘non-physical’ matter–matter that is not a causally effective *material* and neither a distinct body with phenomenal properties. The reason for this juxtaposition between the ether and material objects is clear. If the forces that are constitutive of bodies require other forces or secondary causes that reside in other bodies, no definite grounding can be achieved. What is required therefore is a matter that takes up a constitutive role to all the essential properties of bodies, while having none of these itself (*OP*, 22: 607),¹⁴ such as it acts as a primary cause and stands ‘orthogonally’ to all secondary causes. This ubiquitous, elusive, ephemeral matter pervading all bodies entails its own type of non-mechanical causality and serves as the medium by means of which the moving forces that are inherent in or impressed in bodies are communicated to other bodies. Hereby, the ether serves as ubiquitous, simultaneous, and incessant initiation of motion (*OP*, 22: 608), even though this initiation may be infinitesimally small, and hence, not always result in actual, perceivable motion.¹⁵

The essential properties are observable and also constitutive of our experience: without the possibility of conceiving any natural object under them, these objects could not be conceived of in categorical terms at all. For example, *ponderability* means that a body (within a gravitational field or under influence of a gravitational force) can be weighed and thus measured in quantity. But to do so, one needs a scale that resists the weight of a body to a certain degree and a lever that is rigid enough not to immediately bend under any weight however little, which means that the scale and lever need to be *coercible* (cf., for example *OP*, 22: 138, 275). Without coercibility, the experience of ponderability would be impossible, and vice versa: an imponderable body poses no resistance to being touched by a lever and moves away at the slightest touch like a weightless balloon. *Cohesibility* means that the inner parts of a matter resist displacement to a certain degree (which is also called “cohesion”, cf. *OP*, 22: 146) and thereby constitute the state of matter as either fluid or solid. Here, the surfaces of the different parts of matter—the size of these parts may well be infinitesimally small—assert a force to each so that these parts can either be moved against each other or separated from each other more or less easily, leading the body to be either breakable, malleable, or entirely liquid. The notion of *exhaustibility* is tied to that of a causal origin of motion. To say that a force is exhaustible means that it diminishes because of a specific cause; and to say that a force is inexhaustible means that no potential cause that might diminish it is to

be found (cf. *OP*, 21: 519). This makes it questionable if it could affect anything to a measurable (!) degree, as usually conceptions of efficient forces entail the idea that by bringing forth the effect, something needs to be diminished in the cause. Elasticity, for example, is conceived as an implanted force that can be exhausted, as elastic bodies can turn brittle or break. The explanation of these essential properties in terms of possibility and in conditional expressions indicates that they are all conceived as dispositions. This will be explored next.

But first a quick caveat: the epistemic duality of the ether as both a priori and real matter has often been considered ‘strange’ or ‘quirky’ by some researchers.¹⁶ It is ‘strange’ that crucial, apparently juxtaposed properties of matter, such as solidity and liquidity, do not originate from physical matter itself, but from the implanted or immanent forces and hence the underlying ether (on the ether as a ground for solidity, see *OP*, 21: 276, 320; 22: 232, 261–262, 275; on the ether as the ground for liquidity, see *OP*, 21: 276, 364; 22: 261). The same holds for some other phenomena related to motion that are derived from the ether, such as friction (cf. *OP*, 21: 329), the ‘molecular’ texture or composition of bodies (e.g., *OP*, 21: 181, 374), heat (*OP*, 21: 523), or even colors and light (*CPJ*, 5: 224; *OP*, 21: 387, 469; 22: 111). Given the fragmentary structure of Kant’s text, a definite reading may be out of reach, but we can try to reconstruct Kant’s position with regard to textual coherence and argumentative fit within Kant’s overall philosophy.

The ether and the dispositions of matter

While the contemporary discussion of dispositions is rather nuanced, here a somewhat simplified notion will suffice. A disposition is a property that is manifest only¹⁷ under specific conditions. Or to put this in more precise terms: an entity x is at a specific time t disposed to manifest a response r to the stimulus s if and only if, if x were to undergo stimulus s at time t , then x would manifest the response r , *ceteris paribus*.¹⁸

These activation conditions at the specific time t will here be called ‘activation stimuli’ because they ‘activate’ the conditioned, hence ‘dormant’ properties or responses. It is important to emphasize that without the activation stimulus the corresponding property or response would be absent. A fragile glass *can* break, but it can still be considered fragile even if it never actually breaks. Hence, dispositions are expressed in conditional propositions—a dispositional property does not depend on the actuality of its manifestation, it rather describes a conditioned relation between possible events or states. This can be used as a criterion to distinguish dispositions from stable or so-called categorical properties. Those are often illustrated by means of shape or extension,¹⁹ because the shape or extension of a body (physical or mathematical) does not depend on any other conditions, albeit one can of course always

introduce subjunctive or counterfactual descriptions of our perception of these properties. Fragility, in contrast, is a disposition, as it describes that *if* a certain force is asserted to a physical body, *then* it will break; and without such force, the body would *ceteris paribus* still be intact. Dispositions describe *possible* relations and have surprisingly little to do with the *actual* relations and behavior of an object.²⁰ Dispositions do not need to be manifested to be real, but one should not mistake dispositions that have not (yet) manifested themselves for mere non-manifest *possibilia*, as they do have an actual, material basis.²¹

As I have already indicated that the essential properties of physical bodies are conditioned, it seems clear that they can be conceived as dispositions: they interact with other forces and maintain a manifest reality that is both *relational* to external events as it is *causally dependent* on other forces, such as other impressed or implanted forces. For example, this is apparent in Kant's descriptions of cohesibility as a disposition that becomes apparent in the lever: by asserting a certain force on the lever, the lever manifests its solidity and thereby the response to the stimulus in the form of material integrity and stability. If such a force were absent, we would *ceteris paribus* have no experience (!) of the material integrity and stability of the lever—hence, as Kant repeatedly asserts, the system of forces precedes our experiences. The manifest properties of cohesibility become manifest (*ceteris paribus*) if and only if subjected to forces. The same holds for the other properties of ponderability, coercibility, and exhaustibility that are also manifest (*ceteris paribus*) if and only if the corresponding material object is subjected to the corresponding forces. Hence, material bodies are constituted by and through dispositions.

As pointed out above, Kant never uses the notion of a disposition in this context. But he calls the essential properties of materials “physically conditioned” (*OP*, 22: 138): they are not merely conceived a priori, but our experience of them is conditioned by “the presupposition of an internally moving matter which [in the exemplary case of ponderability] results in the immobility of the parts in contact with one another [in the lever-arm], *by itself being mobile inside this matter*” (*OP*, 22: 138; my emphasis). Herein, the primary cause of the ether serves as the necessary general condition of the possibility of experience, while the actual moving forces are the sufficient particular conditions of our actual experience. Hence, the ubiquitous vibrations of the ether act as the activation stimulus by means of which the response of immobility becomes manifest. This holds for all essential properties and their corresponding forces: “All these moving forces of different kinds and degrees are based on the principle of concussion that prevails through all space” (*OP*, 22: 275), namely the ether. For example, the ether produces cohesion by initiating infinitesimally small motions in all parts of the world matter by continuously attracting and repulsing all parts of a body against each

other to a certain degree, by “ceaselessly agitating *other* bodies” (*OP*, 22: 610; my emphasis, see also *OP*, 21: 464; 22: 21).

The ether is not defined in terms of dispositions, but in terms of intrinsic or stable properties. It is described as imponderable, incoercible, incohesible, and inexhaustible (e.g., *OP*, 21: 231–232). These properties confirm the table of categories (quantity, quality, relation, and modality) mentioned above, but by virtue of their negation; they are only logically, but not ontologically related to any moving forces. They do not display any immediate effect that can be experienced. It seems hard to conceive of these properties as dispositions. What could the activation stimulus for *imponderability* be? No matter what forces are asserted, the ether remains imponderable *under all circumstances*. Here, imponderability designates the inapplicability of the notion of weighing. The same seems to hold for incoercibility, incohesibility, and inexhaustibility. There is no counterfactual description under which the ether would display a *different* set of manifest properties. But Kant does not rely on the use of negation to indicate the unconditioned nature of the ether. It is also described as an “ubiquitous, all-penetrating, inwardly all-moving (agitating) and in this agitation uniformly persisting (perennial) elementary substance” (*OP*, 21: 600; my translation).²² Here, Kant makes it clear again that the ether does not serve as an external and observable cause of change, not as a secondary cause, as it is only “inwardly” moving; and its agitation is “uniformly persisting” and hence does not change its properties in a response to any stimulus whatsoever. Its essential properties are stable throughout time and independent of all causal relations, they are not scalable and, as they are not relational, they do not come in degrees (see *OP*, 21: 228). However, they are not manifest properties that can be experienced directly. Kant rather suggests that these properties are *always* and *everywhere* manifest, no matter the circumstances. The *ceteris paribus* clause that is crucial for describing dispositions in counterfactual propositions falls flat here. The ether is fully characterized by means of *stable* properties that cannot be conceived through possible behavior, but only as actuality; albeit they are not *manifest* properties, as they cannot be perceived directly. This puts the ether at odds with both the properties essential to bodies and with the phenomenal qualities that are given in our perceptions.

While this may not hold for *all* of the rather multifaceted descriptions of the ether that Kant employs throughout the *OP*, many (if not all) of those that use a more traditional vocabulary can be read in agreement with this interpretation. For example, the ether is described as a ‘caloricum’ (*Wärmestoff*, literally ‘heat matter,’ e.g., *OP*, 21: 224).²³ But it is clear that this is to be distinguished from the heat that is inherent within a body, as this particular heat is rather the effect for which the vibrations of the ether are the ultimate cause. The ether’s heat cannot be perceived directly, the concept of a ‘caloricum’ rather serves the purpose to express

the internal agitation of the ether that is manifest in certain agitations in physical bodies and perceivable only therein. Herein, ‘caloricum’ is to be distinguished from its phenomenal manifestation as particular, scalable heat. It rather designates a boundary of minimal rigidity and maximized internal excitation that makes the ether unlike all other materials.

On the first glance, this lack of responses under certain conditions seems to deprive the ether of causal powers as well. But the fact that material bodies cannot establish any causal relation with the ether does not mean that the ether cannot establish a causal relation with material bodies—it is rather an asymmetric and hence constitutive relation. It constitutes the forces inherent in physical matter through different types of unsolicited (!) motion, for example through a pulling drive to motion (*conatus*), a pushing drive to motion (*percußio*), or through a vibration that consists of a series of different, juxtaposed initiations to motions (*oßcillationes*, *vibrations*, and *undulations* (OP, 21: 532–533, cf. OP, 22: 275, where he also calls this *concußio*—henceforth, I will subsume these different types of rapid and presumably infinitesimally small initiations of motion under the term ‘vibrations’). It should be noted that these vibrations should not be conceived as an actual motion of *something* but as a *structural modification* of the parts of a body. Through all this, by virtue of being an all-pervasive initiation to motion and an ubiquitous, multi-directional vibration, the ether serves both as ground for impressed and implanted forces (see e.g., OP, 21: 310; 22: 275). Through both types of forces, it also constitutes the essential properties and states of matter. If the ether acts on bodies, i.e., as the activation condition is fulfilled, the dispositions become actual, perceivable, and temporarily stable modifications of bodies. However, if the activation condition was not fulfilled, the materiality of bodies would dissipate. An ontology of matter that is based on conditions alone, in which there’s nothing in the material or physical world but conditions ‘all the way down,’ is incomplete, since reason will inevitably look for the unconditioned that grounds any chain of conditions.

Through these vibrations, the ether creates the tension within bodies that we can experience as solidity; and it produces varying degrees of solidity either by “the pressure of the ether through gravity” (OP, 21: 374) or “by expansion (as heat) and the simultaneous escape (binding) thereof” (OP, 22: 148). Both fluidity and solidity as states of matter are established through the ether (e.g., OP, 21: 260–261, 374). The vibrations are unsolicited and incessant, as the ether bears no exhaustion or reduction of itself. As a continuously active matter, the ether “maintains” all types of movement by these vibrations, which consist of infinitesimally small repulsions and attractions (OP, 22: 194). Kant leaves out the details of how this is supposed to work, but he clearly seems to think that by such oscillations and vibrations, the ether serves as the medium for all bodies and their movements, and it also acts as the

initiation of motion and hence of all forces. Without such a principle of continuous ‘excitations’ (*Erregungen*) of the ether, all mechanical and elastic forces could be depleted through ‘exhaustion’ (*Abspannung*) and thus lead to a “complete standstill of moving forces of matter” (*OP*, 21: 310)—thereby the ether serves as the immanent cause of implanted forces and impressed forces alike. It is everything but ordinary matter and it explains all that cannot be explained by moving forces. As others have already noted, Kant seems to make the ether responsible for the constitution of all appearances (see Mathieu 1989, 92).

It is by means of these vibrations that the ether fills out space: by being causally effective *only* in the constitution of moving forces and material bodies of different types, e.g., liquid or solid, and hence by expanding bodies through space (cf. *OP*, 22: 145, 212). Herein, it allows bodies to be *located* in a particular place in space and as such it serves as the condition of outer experience (*OP*, 21: 228). Furthermore, it serves as an (unscalable) boundary notion for ‘empty’ space, as it allows us to apply the notion of the filling of space *to a certain degree* (*OP*, 22: 206). While the ether that fills out space cannot be experienced, due to the impossibility of interacting with the subject in a determinate way, we do not experience space as entirely void of all matter. As explained above, the notion of a body filling out space relies on its causal efficacy and some bodies have stronger reactions in terms of impenetrability, solidity, cohesion, etc., as they are more or less determined by stronger or weaker forces. The ether serves as the boundary notion for minimal causal efficacy, at least as long as there are objects placed within or particles moving through it. What seems to be empty space may rather turn out to be filled with occasional particles of dust, or by a very light and transmissive liquid. Hence, Kant argues that the moving forces of the ether indirectly “fill a space [both] extensively and intensively” (*OP*, 22: 211). The ether fills all of space, but its intensity can be understood as the strength of its dynamic power present at every point in space, in so far as it is interacting (or could interact) with a body in a specific way or to a certain degree. For example, the gravitational force is transmitted through the ether, and it is stronger close to a massive body and weaker in the distance.²⁴

As it is defined by dispositions, the ether is an “imperceptible matter” and can only be an object of experience by mediation, i.e., by affecting other, immediately perceptible bodies (*OP*, 21: 229, cf. 21: 610). As an all-permeating matter, it connects all that is perceived as determinate bodies, it is situated “in-between” them (*ibid.*). What we perceive as empty is not empty in an absolute sense, as a mere *nothing*, but it is empty as it does not contain any perceivable bodies that are made out of distinct *materials*. The ether fills out space, but does not occupy it, as it does not resist other bodies taking up space; it becomes perceptible only by means of allowing us to relate bodies to each other and to ourselves.

Instead of the ether, it is matter that is “what makes space into an object of the senses” (*OP*, 22: 508). Thereby, we must presume the ether as the quasi-substantial, incessantly *productive* whole that continuously and simultaneously brings forth those material properties that we *can* experience, rendering experience possible.

To summarize—it seems that in all these characterizations of the ether, the main line of argument is—the ether is nothing like material bodies, as it cannot be interacted with and as all interactions depend on the continuous vibrations of the ether. Hence, Kant’s theory of forces can be separated into dynamical and mechanical forces that can be characterized in terms of their *potential causal* effects²⁵ on the one hand, and the ‘proto’-forces that have an *actual and constitutive* effect on moving forces and matter on the other. It seems that the vibrations of the ether serve as *constant activation stimuli* for the dispositions of matter, as they initiate motion within the bodies and from outside of bodies as well, acting on them in incessant, infinitesimally small ways. The vibrations of the ether, for example, put the parts of a material body in constant (albeit infinitesimally small) motions against each other, so that solidity and cohesion are actuated throughout (e.g., *OP*, 21: 374). A body can never be at rest, it is constantly acted upon by forces (e.g., *OP*, 21: 310). As the activation stimulus is constantly given, the dispositional nature of the essential properties of matter is always actuated and the response is constantly manifest. Thereby the dispositional properties can be both considered potential manifestations, cognizable a priori, and understandable through counterfactual descriptions, *and* they can also be considered actuated and stable properties that can be experienced throughout time. The ether could thus be called a *causally operative necessary condition* for the manifestation of phenomenal qualities, while the bodies themselves act as *sufficient, but not necessary* conditions. Needless to say, this is a rather original take on the nature of physical dispositions and the filling of space.

Conclusion—filling out space

Beyond this foundational role, the notion of the ether has to lift a heavy weight in Kant’s philosophy, as the ether serves to explain many different phenomena and entities that are difficult to reconcile within an otherwise mechanistic worldview. For example, the ether is conceived as the matter of light and fire (*OP*, 21: 515) and, perhaps in tacit reference to the cartesian ‘animal spirits’ that are circulating through an animal’s veins, as ‘nerve matter’ (*Nervenstoff*, *OP*, 21: 564). Above, I have pointed out that the ether is seen as heat as well, but rather as the ubiquitous ‘borderline’ heat of the universe, not as the sensual heat that we can experience. Hence, my interpretation of a non-experiential and foundational role of the ether sits somewhat uneasy next to all these

features that may not all be conceived as intrinsic or stable properties. But this might be seen as symptomatic of a more general problem, as physics that had not yet come to terms with its own multi-faceted nature. Kant, like other philosophers of his time, was still trying to establish a reductionist and axiomatic physics, in which all laws could be based on a few principles that could be justified through metaphysics, and where, once the foundations were set, the rest were just conceived as details. Herein, the ether was seen as a ‘one size fits all’-solution for everything that cannot be described by means of mechanical forces alone.

Above, I have tried to reconstruct several major claims of Kant:

- 1 Material bodies are constituted by and through dispositions;
- 2 Our experience of the material world is limited to dispositions;
- 3 Dispositions require a grounding for metaphysical reasons;
- 4 Consequently, such a grounding is metaphysically necessary but impossible to experience.

To summarize: A body can fill out space and time only when it is causally active, but within the material world, all moving forces are physically conditioned. Hence, the essential qualities of material bodies can be understood as dispositions—and it goes without saying that all the inessential qualities depend on and result from different iterations of moving forces and essential qualities. As material bodies need to causally affect the subject, we can experience stable properties such as extension and shape only by means of other, causally active forces, which turn out to be of dispositional nature. Science and experience of the material world are thus limited to dispositions, which are effectively reducible to an interplay of attractive and repulsive forces. But these forces require a metaphysical grounding, as otherwise the initiation of motion for the system of forces as a whole could not be conceived and the system of forces would remain incomplete. Consequently, the grounding of the material world is metaphysically necessary but impossible to reach by means of science and experience.²⁶

While these arguments are situated within the context of eighteenth-century science and philosophy of science, there is something surprisingly modern about them. To point this out, I will sketch a quick comparison with an argument proposed in an influential paper by Simon Blackburn, “Filling in Space” (Blackburn 1990). Herein, Blackburn makes the same four claims that I have derived from Kant above. He begins his paper by noting that most people believe that dispositional properties need to be grounded in non-dispositional or categorical properties (which I will call ‘stable properties’ here, to avoid any confusion with Kant’s own notion of categories). However, science fails to account for stable properties: resistance, hardness, mass, electric charges, fields, and so on—all scientifically-known properties constitutive of the physical world turn out to

be dispositions, precisely because they are known to us only by means of their causal efficacy on other things, given the appropriate circumstances. Science develops a *functional* understanding of things; thus, it is consistently inclined to conceive of the properties of these things in terms of dispositions. But if we conceive of this actual world *only* in terms of dispositions, then our notion of reality becomes problematic. By using a possible worlds analysis of counterfactuals, Blackburn argues that there would be ‘neighboring’ possible worlds that are extremely similar to ours and in which the same counterfactuals apply, hence, the same truths would hold, despite a possibly fundamentally different substantial (or stable) grounding. Truth and reality would hence be disjointed from each other. The only non-dispositional properties available to our knowledge, so Blackburn tells us, are subjective phenomenal properties that play no role in science, such as the appearance of color that is not contingent on any activation stimulus. Hence, we either end up with an endless regress of dispositions ‘all the way down’ or we just accept that there will never be a scientific description of any actuality, any grounding of dispositions. Rae Langton puts it concisely when discussing Blackburn’s analysis: “Properties which adequately ‘fill in space’ are necessary, and impossible: metaphysically necessary, but impossible to reach” (Langton 2015, 106). But quite in contrast to Kant, Blackburn’s argument ends here. He closes his brief discussions of this modern predicament with philosophical resignation, namely, the acceptance of Humean skepticism²⁷: “carelessness and inattention alone afford a remedy” (Blackburn 1990, 65).

While Blackburn (and Langton) resign themselves to epistemic humility of Humean or allegedly Kantian provenience, the interpretation developed above shows that the same does not apply to Kant’s post-critical position. Here, two major differences between Kant’s take on the filling of space and Blackburn’s stand out. First, for Blackburn, the infinite regress of dispositions threatens our notion of reality, while for Kant an infinite regress of dispositions threatens the completion of the system of forces and hence the possibility of science and experience. This difference can be reconciled if we focus on our scientific knowledge of the material world only and ignore all aspects of reality that might, at least for Kant, never be an object of natural science, such as the human mind. Both authors would then likely agree that an infinite regress of dispositions building on dispositions building on dispositions... would endanger the possibility of scientifically accurate knowledge of the material world. The second difference is more crucial. For Kant, a resignation in the face of an unsolvable dilemma between epistemic ignorance and metaphysical necessity would be deeply undesirable and impose profound problems for our epistemological justification of the possibility of experience. While for Blackburn, the grounding of dispositions can never be known, it takes up a rather peculiar epistemic status for Kant:

we *must* conceive of the ether, as without it, the system of forces had no grounding and would hence be incomplete; but the ether itself cannot be an object of experience. The system of forces is a presupposition of the possibility of experience, and as we know that experience is, in fact, possible, we know that the system of forces must be complete. While Blackburn offers epistemic nihilism, Kant argues that this gap between metaphysical necessity and experiential ignorance concerning the foundations is not that bad. Transcendental philosophy can step up to help us out here. Blackburn seems to think it would be the task of natural science to discover the foundations of all dispositions. But as I have argued above, the ether is precisely this mysterious entity with intrinsic properties that eludes our scientific knowledge—albeit Kant offers us a way out by proposing to understand the ether as a transcendental postulate with objectivity. The system of forces *can* entail transcendental notions with objectivity, as we can postulate the ether *and* assert its objective existence too. We may not know anything about the ether in the same sense as we have knowledge of the material world, namely, as knowledge of objects identified in space and time and by means of the categories, but for transcendental reasons, we can still conceive of the belief in the existence of the ether as a justified true belief. What we know of the ether is by means of negating the essential properties of matter, it is defined as their opposite. Therein, it is uniquely characterized. Neighboring worlds in which the essential properties of the ether (imponderability, incoercibility, incohesibility, and inexhaustibility) are changed will also maintain different counterfactuals and truths because of this fundamentally different reality. But beyond that, no more knowledge is to be gained and no inquiry into further details is possible. While we can know *that* the ether exists, we cannot know *how*, at least not more than these few details developed here.²⁸ This is a very modest epistemic position, but still more optimistic than Blackburn.

But Kant's position is not free from problems either. In the *CPR*, Kant had argued that intuition is necessary for the individuation of objects and without it, concepts remain empty (A51/B75).²⁹ Intuition is a necessary condition for experience and objective knowledge, as concepts can only provide general features and only intuition allows us to individuate an object—but there is no intuition of the ether, and hence it cannot be an object of knowledge. This is one of the reasons why this approach of developing a 'hybrid' concept that is both a postulate and a concept with objective validity is so 'strange' and why the question how it fits into Kant's system of philosophy is a rather controversial subject of debate. Unlike empirical concepts, the notion of the ether denotes a singular object that is not in need of individuation. The concept of the ether does not contain universal features that might apply to a variety of singular objects, and herein it rather resembles the ideas of reason, such as the soul, the world, and God. But, quite in contrast to the ideas

and postulates of the *CpR*, it also entails the theoretical assumption that the ether must be causally active *within* the world: the ether is not a hypothetical material, but “one whose forces give it reality” (*OP*, 21: 218). This is a crucial difference from the other postulates and ideas of Kant’s transcendental philosophy and the reason behind Kant’s claims concerning the objectivity of the ether concept.³⁰ The reach of transcendental philosophy into the realm of the objective can be justified here because it is derived from the claim that objective experience is possible, something that Blackburn would not deny either. As objective experience is possible, its conditions of possibility must be assumed as a given. This includes causality as a material possibility, which is reflected in the formal nature of our grasp of material objects that can be conceived only through their causality (otherwise they could not be distinguished from dreams, mere appearances, or mathematical objects). However, such an interpretation moves the ‘strangeness’ of the concept of the ether to the notion of *constitutive causality* that is at stake here as well: the ether must be able to causally interact with materials and moving forces, *and* it must be radically different from them. The plausibility of Kant’s ether solution hinges on whether this apparently paradoxical claim is a plausible or defensible position. But that is a question that needs to be answered elsewhere.³¹

Notes

- 1 For the sake of simplicity, I use ‘material bodies’ for extended, physical bodies located at a particular region in space and time. Strictly speaking, Kant also conceives of the ether as a type of fluid matter, hence it is not a body.
- 2 “Die Idee des *a priori* erkennbaren Systems der empirisch gegebenen bewegenden Kräfte der Materie als Ausfüllung einer Lücke durch das regulative Princip der synthet. erkenntnis.”
- 3 It has long been noted that the epistemic status of the concept of the ether has changed throughout Kant’s later writings. In the *Metaphysical Foundations of Natural Science*, Kant emphasizes the hypothetical status of ether and writes that “this refutation of empty space proceeds entirely hypothetically, for the assertion of empty space fares no better” (*MF*, 4: 564; cf. also the so-called *Jäsche-Logik*: “[...] the ether of modern physicists is a mere matter of opinion. For with this as with every opinion in general, whatever it may be, I see that the opposite could perhaps yet be proved.” *JL*, 9: 68) In the later drafts of the *OP*, he however, insists on the necessity of the concept of the ether without which no experience of material objects would be possible.
- 4 This is a problem that can be found in Newton’s philosophy as well, see Toulmin and Goodfield (1982, 196) for a discussion.
- 5 As Eckhard Förster puts it: “The formation of material bodies is not possible by the fundamental forces of attraction and repulsion alone; it requires furthermore the agitations of the ether” Förster (1989, 297–298). For a contrasting take, see Guyer (2005).
- 6 Other interpretations discuss four arguments, such as Guyer (2005), or only two, such as Emundts (2004), but as I want to focus on the way the ether

serves as the ‘basis’ for the moving forces and essential properties of matter, the other arguments concerning the ether as a ground for the unity of experience, etc. will have to be left out here. The role of the notion of the ether in the *OP* has been subject to many debates. One controversial question is whether the ether is relevant for the subjective side of experience, for the objective side, or both. Also controversial is whether it provides material or formal unity to experience. As I am here not dealing with the ether as a precondition of experience, I will gloss over these debates. To give just a very brief overview over selected positions: Tuschling (1971, 177) calls it “an idea of a new type” and finds no conflict with the types of ideas developed in the *CPR*. Friedman (1992) argues that the ether must be considered a regulative idea, because it has us assuming that not so much the totality, but every experientially represented aspect of space is conceived as a unity. The ether, however, should not be considered a proper object of experience. Guyer (2005) argues that the ether is too empirical to be transcendently deduced. Howard (2019), building on Hoppe (1969), argues that the ether proofs and the *Selbstsetzungslehre* explore *both* the objective and subjective poles of Kant’s attempts at effecting the transition between transcendental philosophy and science, constituting the material and formal side of the notion of force.

- 7 See Schmid and Vetter (2013).
- 8 For example, the almost 3000-pages long and comprehensive *Kant-Lexikon* has neither an entry for disposition, nor do dispositions play a major role in any of its entries. See Willaschek et al. (2015). Notable exceptions in secondary literature are Langton (2004) and Allais (2015), who herein follows Langton.
- 9 Herein, Kant follows Leibnizian ideas ever since the *Physical* Monadology.
- 10 On physics as a system, see the contribution by Stephen Howard in this volume.
- 11 The ether plays a role in the *MF* as well, but besides having the same name, this concept bears significant differences from the ether in the *OP*. For a helpful comparison between both notions in the *MF* and the *OP*, see Hall (2014: 72sq); for an overview of the development of the notion of the ether before the *OP*, see Edwards (2000, Chap. 7).
- 12 However, the ether cannot be considered *problematic*, because it is necessary:

This material [i.e. the ether], therefore, which underlies this generally possible experience a priori, cannot be regarded as a merely hypothetical, but as a given, originally moving, world-material; it cannot be assumed merely problematically, for it first signifies intuition (which would otherwise be empty and without perception).

(*OP*, 21: 217)

As it is the necessary foundation of the total system of all matter, the ether proof is not only necessary, but also “apodictic” (*OP*, 21: 237).

- 13 The differences within of forces or essential properties between bodies require an explanation (see, e.g., *OP*, 21: 374). Cohesion, for example, leads to differences in density throughout the universe, and this difference cannot be explained by attractive and repulsive forces alone. Förster (2000, Chapter 3) has argued that this is one of the major reasons why the meta-physical foundations of science require a transition to science, because they fail to provide all of the concepts necessary to explain some of the very basic facts of the universe as a whole—differences in density, but also aspects like light, heat, others.

- 14 This is made clear in this passage, wherein the repetitive and paratactical structure of the argument is expressed in grammatically abbreviated and jumbled sentences:

Es muß eine Materie seyn durch welche die practische Wägbarkeit möglich ist ohne für sich ein Gewicht zu haben die Sperrbarkeit ohne äußerlich coërcibel zu seyn die Cohäsion ohne innerlich zusammenzuhängen endlich die Erfüllung aller Räume der Körper ohne Erschöpfung oder Verminderung dieses all-durchdringenden Stoffs und zwar darim [sic] weil alle mechanisch- d.i. äußerlich bewegende Kräfte als Erscheinungen nur durch die dynamische möglich sind und dieser ihre Wirkung die Erfahrung möglich macht.

(OP, 22: 607)

Filling in some of the missing words, here is a rather free translation:

There must be a matter by means of which ponderability in practical weighability is possible without having weight for itself, and coercibility must be possible without being externally coercible, and cohesion must be made possible by a matter that is not internally coherent itself. This all-penetrating matter will finally be filling all spaces of the bodies without exhaustion or diminution and that is because all mechanical i.e. externally moving forces as phenomena are possible only through the dynamical forces of this matter and because this matter makes experience possible by means of the effects of these forces.

- 15 This initiation of motion goes along with Kant's notion of a first cause or basis: we should not read this as an initiation that temporally precedes any actual motion, but rather as picking up on the Leibnizian idea that every movement of a body through space (*actio*) is at any given point composed of one or multiple moving forces with a vectorial direction (*impetus*) that are each initiated by an infinitesimally small force in which the original source of activity lies (*conatus*). For more details, see Leibniz's *Specimen Dynamicum* or Lyssy (2016), part IV.
- 16 Mathieu (1989, 90) speaks of "Merkwürdigkeiten" and "Schrullen" that Kant displays here. "Weird" would be a more modern translation that captures the spirit that is expressed here. Adickes is even harsher and calls it "senile acquiescence" of personal pet opinions, Adickes (1920, 394).
- 17 In most cases, this "only" needs to be qualified in temporal or causal terms, as one can think of countless convoluted counterexamples that complicate this comfortable conception. For example, the activation stimulus can be conceived as such that it 'de-activates' the disposition; or we can think of external causes happening so that they regularly manifest the effect instead of or simultaneous to the dispositional property. But for the general gist of my argument, these debates are not relevant here. We can try to avoid what one could call the 'death by a thousand qualifications.'
- 18 This definition is inspired by Molnar (1999).
- 19 See, for example, Prior (1982). This is not uncontested, as others have argued that shape and extension are, in fact, dispositions, by virtue of being describable through subjunctive clauses. Some go so far to argue that all properties are dispositions, see Mumford and Anjum (2011). This however does not fit well with Kant, who insists that physically conditioned bodies need to be conceived in opposition to an unconditioned matter, namely, the ether. As the ether is not conceived through conditions but rather their negation, the same must hold for dispositions. So there must be properties that

- are not dispositions; and, by virtue of being a ‘real material,’ the ether is not sufficiently captured by conditional propositions of subjective experience.
- 20 Dispositions are not identical to the underlying material structures either and cannot be reduced to them. A certain molecular structure will determine the fragility of a body, but it is not identical with it, because the molecular property is given no matter what, while fragility is described in terms of conditional behavior. We can easily conceive of a neighboring possible world in which the same counterfactual descriptions hold, even though the material structure of the glass is different (assuming that its phenomenal properties remain unchanged). It will also be difficult, if not impossible, to describe the material structures in question without using the dispositional predicates they are supposed to replace.
 - 21 See Martin (1994).
 - 22 “[...] allverbreiteter, alldurchdringender, innerlich allbewegender (agitirender) und in dieser Agitation gleichformig beharrender (perennirender) Elementarstoff [...]”
 - 23 This ‘heat’ cannot be felt, but the term rather refers to the incessant motion that must be ascribed to all parts of space.
 - 24 On this, see also Wong (1995, 408). He also argues that the ether serves as a “replacement of the category of substance by the concept of a single world-material” (Wong 2001, 681), including a conceptual shift from a substance ontology to a field ontology. In his reading, the ether is Kant’s version of the modern notion of a physical *field*. This is an attractive interpretation, as it allows us to grasp the causal efficacy of the ether, but the relationship between fields and physical bodies within modern physics is complicated and does not correspond to the way Kant relates bodies to the ether. For Kant, the ether precedes the existence of bodies, it is defined in opposition to them, and it is constitutive of bodies. Whether the same can be said of the modern physical conception of fields seems doubtful to me.
 - 25 Kant even calls the moving forces “powers” (*Potenzen*, *OP*, 21: 182).
 - 26 Rae Langton has fleshed out this latter argument in more detail. “Kant thinks that intrinsic properties do not have a role to play in science: that was the point of his argument against Lambert and Newton” (Langton 2004, 184).
 - 27 Langton calls this ‘Kantian Humility’: the acceptance that there are intrinsic properties that are presumably foundational that we cannot know, see Langton (2004, 180). Here, I argue that the ether is precisely this mysterious entity with intrinsic properties that eludes our scientific knowledge—albeit Kant offers us a way out by proposing to understand the ether as a transcendental postulate with objectivity. We may not know anything *about* the ether in the same sense as we have knowledge of the material world, as objects identified in space and time and by means of the categories, but for transcendental reasons, we can still conceive of our belief in the existence of the ether as a justified true belief. This kind of knowledge is equivalent to the knowledge gained from transcendental arguments. (I’d like to thank Bryan Hall for pointing this latter equivalency out).
 - 28 Langton calls this an ‘inscrutable’ knowledge that makes intrinsic or stable properties “ominously similar to a Kantian thing in itself” (Langton 2004, 176).
 - 29 For a comprehensive debate of the connection between the ether proofs and Kant’s critical philosophy, see Emundts (2004).
 - 30 As per the antinomies, the causal activity of free will is a postulate by practical reason and thus not part of our knowledge of the natural world, hence

we do not need to assume any corresponding *object*. God is not active within the world, but is the reason or cause for the existence of the entire world.

31 I thank Giovanni Pietro Basile, Bryan Hall, and Stephen Howard for helpful comments on this paper.

References

- Adickes, Erich. 1920. *Kants Opus postumum*. Berlin: Reuther & Reichard.
- Allais, Lucy. 2015. *Manifest Reality: Kant's Idealism and His Realism*. Oxford: Oxford University Press.
- Basile, Giovanni Pietro. 2013. *Kants Opus postumum und seine Rezeption*. Berlin: De Gruyter.
- Blackburn, Simon. 1990. "Filling in space." *Analysis* 250: 62–65.
- Edwards, Jeffrey. 2000. *Substance, Force, and the Possibility of Knowledge: On Kant's Philosophy of Material Nature*. Berkeley: University of California Press.
- Emundts, Dina. 2004. *Kants Übergangskonzeption im Opus postumum: Zur Rolle des Nachlasswerkes für die Grundlegung der empirischen Physik*. Berlin: De Gruyter.
- Förster, Eckart. 1989. "Kant's Notion of Philosophy." *The Monist* 272: 285–304.
- Förster, Eckart. 2000. *Kant's Final Synthesis: An Essay on the Opus postumum*. Cambridge, MA: Harvard University Press.
- Friedman, Michael. 1992. *Kant and the Exact Sciences*. Cambridge, MA: Harvard University Press.
- Guyer, Paul. 2005. "Kant's Ether Deduction and the Possibility of Experience." In *Kant's System of Nature and Freedom: Selected Essays*. Edited by Paul Guyer, 74–85. Oxford: Oxford University Press.
- Hall, Bryan. 2014. *The Post-Critical Kant: Understanding the Critical Philosophy through the Opus postumum*. New York: Routledge.
- Hoppe, Hansgeorg. 1969. *Kants Theorie der Physik: Eine Untersuchung über das Opus postumum*. Frankfurt am Main: Klostermann.
- Howard, Stephen. 2019. "The Transition within the Transition: The Übergang from the Selbstsetzungslehre to the Ether Proofs in Kant's *Opus postumum*." *Kant-Studien* 110 (4): 595–617.
- Langton, Rae. 2004. *Kantian Humility: Our Ignorance of Things in Themselves*, Reprint. Oxford: Clarendon Press.
- Langton, Rae. 2015. "The Impossible Necessity of 'Filling in Space.'" In *Pas-sions and Projections*. Edited by Robert N Johnson and Michael Smith, 106–115. Oxford: Oxford University Press.
- Lyssy, Ansgar. 2016. "Kausalität und Teleologie bei G. W. Leibniz." Stuttgart: Franz Steiner.
- Martin, Charles B. 1994. "Dispositions and Conditionals." *The Philosophical Quarterly* 44 (174): 1–8.
- Mathieu, Vittorio. 1989. *Kants Opus postumum*. Frankfurt am Main: Klostermann.
- Molnar, George. 1999. "Are Dispositions Reducible?" *The Philosophical Quarterly* 49 (194): 1–17.

- Mumford, Stephen and Rani Lill Anjum. 2011. *Getting Causes from Powers*. Oxford: Oxford University Press.
- Prior, Elizabeth W. 1982. "The Dispositional/Categorical Distinction." *Analysis* 42 (2): 93–96.
- Schmid, Stephan and Barbara Vetter. 2013. "Einleitung." In *Dispositionen. Texte aus der zeitgenössischen Debatte*. Edited by Stephan Schmid and Barbara Vetter, 7–57. Frankfurt am Main: Suhrkamp.
- Toulmin, Stephen and June Goodfield. 1982. *The Architecture of Matter*. Chicago, IL: University of Chicago Press.
- Tuschling, Burkhard. 1971. *Metaphysische und transzendente Dynamik in Kants Opus postumum*. Berlin: de Gruyter.
- Willaschek, Marcus et al. (eds.). 2015. *Kant-Lexikon*. Berlin: De Gruyter.
- Wong, Wing-Chun. 1995. "Kant's Conception of Ether as a Field in the *Opus postumum*." In *Proceedings of the Eighth International Kant Congress*. Edited by Hoke Robinson, 405–411. Milwaukee, WI: Marquette University Press.
- Wong, Wing-Chun. 2001. "On the Idea of an Ether-Deduction in the *Opus postumum*." In *Kant und die Berliner Aufklärung*. Edited by Volker Gerhardt, Rolf-Peter Horstmann, and Ralph Schumacher, 676–684. Berlin: De Gruyter.