

**KANT'S EMPIRICAL REALISM AND SCIENTIFIC REALISM: A CRITICAL
ANALYSIS OF HANNA'S INTERPRETATION OF KANT**

**Realismo Empírico e Realismo Científico em Kant: Uma Análise Crítica da
Interpretação Kantiana de Hanna**

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Resumo: Este artigo trata da solução kantiana de Robert Hanna para o problema das duas imagens e de sua defesa do suposto realismo manifesto de Kant. O meu objetivo é oferecer uma solução alternativa que considero, por um lado, mais coerente com o idealismo transcendental de Kant e, por outro, mais adequada ao contexto da ciência física contemporânea. Em contraste com a abordagem de Hanna, defendo que Kant é o representante mais radical de uma posição antirrealista em filosofia da ciência que nos permite superar os impasses e limitações tanto do antirrealismo empirista quanto de toda a gama de variações de perspectivas realistas.

Palavras-chave: Realismo manifesto. Realismo empírico. Antirrealismo. Problema das duas imagens. Kant. Robert Hanna.

Abstract: This paper is concerned with Robert Hanna's Kantian solution to the *Two Images Problem* and his defense of Kant's supposed manifest realism. My aim is to offer an alternative solution that I consider, on the one hand, more coherent with Kant's transcendental idealism, and, on the other, better fitted to the context of physical contemporary science. By contrast to Hanna's account, I argue that Kant is the most radical representative of an antirealist position in the philosophy of science that allows us to overcome the impasses and limitations of empiricist anti-realism and the whole range of variations of realistic perspectives.

Keywords: Manifest realism. Empirical realism. Anti-realism. Two Image Problem. Kant. Robert Hanna.

Introduction

Robert Hanna, in his book *Kant, Science and Human Nature*, considers *The Two Images Problem* to be “the basic problem of European and Anglo-American analytic philosophy after 1950 - and perhaps also *the* fundamental problem of modern philosophy”. It can be described as the problem of “how it is possible to reconcile two

sharply different, seemingly incommensurable, and apparently even mutually exclusive metaphysical conceptions, or “pictures,” of the world” (Hanna, 2006, p. 8). Wilfrid Sellars (1963), in his famous essay “Philosophy and the Scientific Image of Man”, called them, respectively, the *manifest image* and the *scientific image* of the world. According to Hanna’s characterization, the *manifest image* is a “subjective, phenomenal, perspectival, teleological, value-laden, person-oriented, and moral metaphysical picture of the world [that is] yielded by the conscious experience of rational human beings”. And the *scientific image* is an “objective, non-phenomenal, perspectiveless, mechanistic, value-neutral, impersonal, and amoral metaphysical picture of the world [that is] delivered by pure mathematics and the fundamental natural sciences” (2006, p. 8). As Hanna himself says, the main objective of his book *Kant, Science and Human Nature* is to find a Kantian solution to this problem. In view of that, the aim of this essay is twofold: first, to analyze Hanna’s Kantian solution to the *Two Images Problem* in that book; second, to present an alternative solution that I consider, on the one hand, more coherent with Kant’s transcendental idealism, and, on the other, better fitted to the context of physical contemporary science.

Hanna’s solution is presented in two parts. In the first, he addresses epistemological and metaphysical issues regarding empirical realism and scientific realism, by taking a critical stand against both *scientific or reductive naturalism* and *contemporary noumenal scientific realism*, while also trying to provide a Kantian third-way beyond these, characterized by him as *empirical realist*. In the second part, he tries to work out a fundamental connection between scientific rationality and practical rationality from the Kantian point of view, defending the thesis that “[p]ractical reason has both explanatory and ontological priority over theoretical reason” (Hanna, 2006, p. 252). I will focus my analysis only on the first part of his account (in chapters 1 to 4 of his book), that is, on the epistemic and metaphysical arguments that lead him to defend a Kantian scientific realism.

According to Hanna, “Kant offers us an anthropocentric scientific realism [that] goes beyond both contemporary scientific realism [including scientific essentialism] and scientific anti-realism [including idealist, phenomenalist, and the weaker variety which

merely reduces truth-conditions to assertibility-conditions] alike, and at the same time effectively splits the difference between the two” (p. 33). Thus, according to Hanna's interpretation, there would be an ambiguity in the title of my paper, in my referring to “Kant's empirical realism and scientific realism” because, according to him, ‘scientific realism’ and ‘empirical realism’ in Kant designate the same thing. What I will try to show is that each of these forms of realism has a different epistemic status, and also that in my view while empirical realism is compatible with transcendental idealism, scientific realism is not.

The empirical realism that Hanna attributes to Kant consists in the conjunction of two theses, namely, the epistemological thesis of *direct perceptual realism*, which is strongly non-conceptualist, and the metaphysical thesis of *manifest realism*. He defines the two theses in the following way:

[T1]: *Direct Perceptual Realism*: Every self-conscious human cognizer has direct veridical perceptual or observational access to some macrophysical dynamic material objects in objectively real space and time.

[T2]: *Manifest Realism*: All the essential properties of individual dynamic material substances, natural kinds, events, processes, and forces are nothing but their directly humanly perceivable or observable intrinsic structural macrophysical properties. (p. 250)

I just want to say right from the start that I absolutely agree with Hanna's first thesis and strongly disagree with his second thesis. As I see it, Kant's transcendental idealism is perfectly compatible with empirical realism, construed as direct perceptual realism. However, the price to pay for adopting manifest realism implies giving up what I consider to be the most radically innovative and revolutionary thesis of transcendental idealism: the thesis that our objective empirical knowledge of the world is determined by the a priori structure of our cognition. So I think that the manifest realism that Hanna attributes to Kant is strictly incompatible with important aspects of Kantian theoretical philosophy. In my view, Kant is the most radical representative of an antirealist position in the philosophy of science that allows us to overcome the impasses and limitations of empiricist anti-realism and the whole range of variations of realistic perspectives,

including naive realism, scientific essentialism, and so on. That is what I intend to show at the end of this paper.

Much has been hotly debated and written about direct perceptual realism and Kantian non-conceptualism. Hanna in this book, and in other essays and books, provides us with a fine, detailed, and convincing argument that Kant's theoretical philosophy is, on the one hand, compatible with essentialist non-conceptualism, even at the seemingly painful price of having to point out, against the mainstream exegetical tradition of the first *Critique's* commentators, a fundamental gap in Kant's B-Deduction.¹ On the other hand, and perhaps more importantly, he makes us see the Kantian philosophy as a powerful tool for advancing the contemporary debate between conceptualism and non-conceptualism. Against McDowell (1994, 1998), for instance, who considers Kant to be the paradigmatic conceptualist, Hanna agrees that Kant is the historical origin of the conceptualist tradition but then goes on to defend exactly the opposite of McDowell's Kantian conceptualist view, trying to show that the Kantian doctrine of transcendental ideality of space and time is instead fully committed to the existence and representational significance of essentially non-conceptual content. Since I share with Hanna the thesis of direct perceptual realism and its close connection with Kantian theoretical philosophy, I will talk only about his second thesis of manifest realism, on which my main disagreements rest. In contrast to the first thesis, little has been said about the second one. So that's what I intend to deal in the first part of this paper.

Before analyzing the main theses of *manifest realism*, as distinct from those of *direct perceptual realism*, it is important to keep in mind the basic presuppositions of the *empirical realism* that Hanna intends to recover from his charitable rational reconstruction of Kant's theory of cognition:

- (i) that Kant's empirical realism is the conjunction of direct perceptual realism and manifest realism; (ii) that his empirical realism is logically independent of his transcendental idealism, insofar as the *strong* version of his transcendental idealism is not necessary for empirical realism; (iii) that a charitably reconstructed version of the Refutation of Idealism yields

¹ More recently, Hanna has also argued that this gap is, contrary to superficial appearances, a significantly positive feature of Kant's larger Critical philosophy (Hanna 2016 forthcoming).

direct perceptual realism; (iv) that Kant's theory of non-conceptual content is the core of his direct perceptual realism; and (v) that by virtue of Kant's non-conceptualism his direct perceptual realism is sharply opposed to both the Dogma of Semantic Overdetermination that is presupposed by eliminativist scientific realism and also the indirect perceptual realism that is presupposed by the other contemporary versions of scientific realism. (Hanna, 2006, p. 141)

From my point of view, what I intend to show is: (i) that Kant's theory of scientific knowledge is the conjunction of *direct perceptual realism* and *scientific anti-realism*, which is transcendental rather than empirical in nature; (ii) the term "empirical realism" in Kant is related only to *direct perceptual realism* and not to *manifest realism*; (iii) that if, on the one hand, the empirical realism is *logically* independent of transcendental idealism, then on the other, the former (empirical realism) is *epistemically* dependent on the latter (transcendental idealism); (iv) that if, on the one hand, the weak version of transcendental idealism yields direct perceptual realism, a strong version of transcendental idealism is nevertheless necessary to explain how nature science is possible, since science is an enterprise that is necessarily discursive; (v) that if, on the one hand, Kant's theory of non-conceptual content is the core of his direct perceptual realism, on the other, Kant's theory of conceptual content is the core of his scientific anti-realism; (vi) that by virtue of Kant's non-conceptualism regarding direct perceptual realism and Kant's conceptualism regarding scientific theories, his theory of scientific knowledge is sharply opposed to any version of scientific realism, including Hanna's manifest realism.

1. Hanna's Manifest Realism

Hanna develops and defends his Kantian conception of manifest realism in chapters 3 and 4 of his book *Kant, Science and Human Nature*. In his third chapter, taking the point of view of transcendental-idealist philosophy, he seeks to criticize contemporary scientific essentialism and its two central theses: 1) the first one that says that "[t]here is exactly one true description of the world of knowable physical spatial things, and truth is the correspondence-relation between thought or language and the several mind-independent facts making up the world of knowable physical spatial things"; and the second one which states that "[t]he essential properties of all knowable physical spatial things are

microphysical properties” (p. 142). Hanna's criticism of scientific essentialism is centered on four objections: 1) the empirical non-accessibility of the microphysical world; 2) the fact that there is no a posteriori necessity; 3) the metaphysical “antinomy of scientific essentialism”; and 4) the logical contingency of natural laws. I substantially agree with his criticisms of and objections to scientific essentialism and so, for that reason, I will not deal here with the specifically negative part of his manifest realism. My target is his fourth chapter where he tries to extract the positive theory that rests behind his negative critique of the strongest version of contemporary scientific realism.

So let's see.

The manifest realism that Hanna attributes to Kant is based on the following assumptions:

- i. all properties of matter are essentially causal-dynamic and macrophysical;
- ii. by virtue of the fact of their being causal-dynamic and therefore based on scientific laws, these properties are objectively real;
- iii. by virtue of the fact of their being not only causal-dynamic, but *essentially* causal-dynamic, such properties are structural and intrinsic;
- iv. by virtue of the fact of their being macrophysical, they are directly and humanly perceptible and observational;
- v. and by virtue of the fact of their being perceptible and observational, they are manifest properties.

Hanna also calls this manifest realism that he has attributed to Kant “*causal-dynamic structuralist theory of matter.*” This realism is in sharp contrast to both modern or contemporary phenomenalism, which is subjectivist and reductionist in character and with an empiricist and anti-realist bias, on the one hand, and also to all forms of contemporary scientific realism, which are somehow committed to indirect epistemic realism or microphysical noumenal realism, on the other. There is no doubt that Hanna's empirical scientific realism provides an *alternative* to contemporary scientific realism, but I do not agree that it is compatible either with Kant's transcendental idealism or with contemporary physics, especially quantum mechanics.

Although Hanna has argued that the second thesis [T2] of his alleged Kantian empirical realism is a fundamentally metaphysical claim, as opposed to the epistemological thesis of direct perceptual realism [T1], I believe that his manifest realism's assumptions in fact imply both metaphysical *and also* epistemological claims. I will analyze, one-by-one, the basic assumptions (i-v) of Hanna's manifest realism in order to evaluate the implications and the dependence of each one in relation to the critical project of transcendental idealism.

Taking the *causal-dynamic structuralist theory of matter*, presented by Hanna, as the basic ground of his approach, I consider to be metaphysical all and only those assumptions that characterize the nature of the matter, and I consider to be epistemological all and only those assumptions that characterize the way we know and define the properties of matter. So, strictly speaking, only assumption (i) can be considered to be clearly metaphysical in my sense; assumptions (iii), (iv) and (v) are clearly epistemological in my sense, and assumption (ii) has an ambiguity that I will try to highlight.

But here a caveat is in order. The “metaphysical-epistemological” distinction does not in fact belong to a properly Kantian vocabulary, although it was Kant who so profoundly tried, from the standpoint of his theoretical framework, to distinguish between epistemological or *transcendental* propositions, concerning the nature and limits of cognitive process of objects given in a possible experiment, and metaphysical or *transcendent* propositions, concerning objects that are only thought by reason, without being able ever to be given in any experience. However, in the “Transcendental Doctrine of Method” of his *Critique of Pure Reason* and also in the “Preface” of his *Metaphysical Foundations of Natural Science*, Kant also considers to be “metaphysical” all philosophical propositions, i.e., all a priori propositions, excluding the mathematical ones, regardless of whether they are transcendental or transcendent in nature. Thus Kant in the first *Critique* speaks in terms of a *metaphysics of objects of experience* - whose matter is given a posteriori to our perception (KrV, A848/B876) but whose transcendental forms depend on our receptive capacity of sensibility and our spontaneous

capacity of understanding – and a *metaphysics of reason* – whose objects can only be thought by means of transcendent principles.

However, for the composition of a system of principles of a properly so-called nature science, Kant distinguishes, in his *Metaphysical Foundations of Natural Science*, between two kinds of metaphysics: a metaphysics of nature in general, and a metaphysics of nature in particular. According to him, the first:

treat the laws that make possible the concept of a nature in general, even without relation to any determinate object of experience, and thus undetermined with respect to the nature of this or that thing in the sensible world, in which case it is the *transcendental* part of the metaphysics of nature. (Kant, 2004, p. 5; MAN, AA 04, 469).

This metaphysics of nature in general, worked out by Kant in his first *Critique*, consists of the following a priori principles of pure understanding: axioms of intuition, anticipations of perception, analogies of experience, and postulates of empirical thought in general. The metaphysics of nature in particular, by contrast, “concerns itself with a particular nature of this or that kind of thing, for which an empirical concept is given, but still in such a manner that, outside of what lies in this concept, no other empirical principle is used for its cognition” (Kant, 2004, p. 5; MAN, AA 04, 470). In the specific case of a *corporeal nature* this empirical concept to which Kant refers is precisely the concept of matter. This second metaphysics is presented by Kant in the *Metaphysical Foundation of Natural Science*, under the set of principles subdivided into Metaphysical Principles of Phoronomy, Metaphysical Principles of Dynamics, Metaphysical Principles of Mechanics, and Principles of Metaphysical of Phenomenology.

Therefore, the metaphysical thesis of Kant's manifest realism, to which Hanna refers as a *causal-dynamic structuralist theory of matter* corresponds in Kantian terminology to *the metaphysics of nature in particular*, as worked out by Kant in the *Metaphysical Foundations of Natural Science*. But the epistemological thesis of direct perceptual realism is grounded on *the metaphysics of nature in general*, as worked out by Kant in the first *Critique*.

Having made this caveat, I will now analyze the basic assumptions of Hanna's Kantian manifest realism. The first, properly belonging to the Kantian metaphysics of

nature in particular, states that all properties of matter are essentially causal-dynamic and macrophysical. This statement can, in turn, be sub-divided into two sub-theses: one that says that the properties of matter are essentially causal-dynamic, and one that says that these properties are macrophysical. It is necessary, however, to restrict these two sub-theses to the context of the *Metaphysical Foundations of Natural Science*. According to the *Metaphysical Foundations*, the properties of matter are not limited *only* to dynamical properties, as stated in Hanna's manifest realism. There are also, besides the dynamical properties, the *phoronomical* and the *mechanical* properties of matter. If we consider only the geometry of the motion of matter in space, as moving points, abstracted from its mass and the forces that have caused the motion, the phoronomical properties are fully sufficient to characterize it. Given only the fact of matter's filling space, the dynamical properties alone are sufficient to explain that fact. The mechanical properties are also required to explain the movement of matter subject to external forces. Therefore, if Hanna wants to privilege the dynamical properties of matter, it is because he also intends to focus on the Kantian explanation of the structure of matter. If such properties are also macroscopical, as he claims, further analyses are required. So let's see Kant's arguments in the "General Note to Dynamics" (Kant, 2004, p. 62-74; MAN, AA 04: 523-535) in the *Metaphysical Foundations of Natural Science*.

In the General Note, Kant provides us with a rich opportunity to see how his Critical philosophy deals with the epistemic problem of choosing between two rival scientific hypotheses, namely, the mechanical and dynamical hypotheses about the constitution of matter. The crucial issue is: how can we choose between two theories that, on the one hand, satisfy the same principle of causality and fit with the legitimate use of the pure concepts of understanding and, on the other, account for the same empirical data and seek to explain phenomenal characteristics of matter such as density, impenetrability, cohesion, fluidity, elasticity, dissolution or decomposition? It is not a matter, here, of a competition between a metaphysical theory and a scientific one, as Kant had previously dealt with in his first *Critique*, but instead, here, between two scientific theories in which both of them, the mechanistic and the dynamical explanations, take into account the limitations imposed by the Transcendental Aesthetic and by the Transcendental Analytic.

One cannot lose sight of the fact, moreover, that these are two *hypothetical* explanations, which were certainly built with the help of the constitutive principles of understanding, but which are merely regulative metaphysical assumptions of theoretical reason. Therefore, they are not presented as *constitutive* theses about the world, as scientific realists have assumed, but rather as mere hypotheses, with a fundamentally reflective function and a fictional character, which are nevertheless absolutely necessary in order to formulate scientific explanations and theories. If we do not take into account the difference, established by Kant in the Transcendental Dialectic of his first *Critique*, between the constitutive principles of understanding and the *regulative* principles of reason, then we succumb to the transcendental illusion of reason, which, as Kant says, “carries us away beyond the empirical use of categories, and holds out to us the semblance of extending the pure understanding” (KrV, B352). Here is, for me the biggest mistake of Hanna's manifest realism: it takes the dynamical thesis about the structure of matter to be a constitutive principle that characterizes the properties of matter as intrinsic, objectively real, humanly perceptible, and observational.

It seems to me that Hanna's mistake is related to a certain reductive interpretation of Kant's introduction to the Transcendental Logic in the first *Critique* (KrV, A50/B74), in which he considers that the two faculties of sensibility and understanding exhaust the “fundamental sources in the mind.” Hanna, based on this text, argues that “for Kant there are no other basic *content-producing* faculties over and above the intuition-producing faculty and the concept-producing faculty.” (Hanna, 2006, p. 86) By contrast, I think that, staying only within the context of Kant's first *Critique*, there is another faculty, beyond the faculties of sensibility and understanding, namely *the faculty of reason*, which is also *content-producing*, and which should also be taken into account for the elaboration of scientific theories. Nevertheless the irreducible contents produced by this faculty can be used only in a hypothetical or regulative sense, “as if” (*als ob*) reality were as it is so conceived, and can never be constitutively used in such a way as to imply that reality is actually and objectively in accordance with these contents.

According to Kant, or at least according to Kant as I am interpreting him, the ideas of reason provide certain irreducible contents for scientific knowledge, which are

neither false nor true, and thus not *descriptive*, but rather are *prescriptive*, and therefore they cannot be realistically interpreted. These contents are projected by human reason onto nature in order to satisfy our own desires and interests. If we lose this critical perspective, and overlay these contents with real ontological value, we fall into insoluble aporias and antinomies. In a Kantian perspective, the constitution of empirical knowledge includes both an inductive process and also a heuristic method of proposing hypotheses. Reason, hypothetically employed, introduces a large number of theoretical simplifying supplementary contents, that can never be taken in a constitutive sense. It is from this perspective that I think the dynamical thesis about the structure of matter should be interpreted. The regulative sense of the contents produced by human reason, or more precisely, as Kant will further develop in his third *Critique*, by the power of judgment, is intrinsically linked to the idea of a *system* (EEKU, AA 20, 208-209). Without this function of the power of judgment to provide a creative anticipation of nature, an organic and systematic constitution of scientific theories would not be possible.

In this way, only the sensibility can have direct, non-conceptual intuition of the object (= the direct perceptual realism thesis) and only the understanding can conceptually and immediately refer to the representational content of intuition, through its constitutive principles. By contrast, the transcendental ideas of reason, or of the power of judgment, as regulative principles, can never directly refer to the representational content of intuition, but only to the empirical use of the understanding, as Kant pointed out in the Appendix to the Transcendental Dialectic (KrV, B 671-672).

In this sense, the explanation of the specific differences of matter, when Kant opposes the dynamical theory to the mechanical theory, acquires a fundamental importance in the Kantian philosophy of nature, insofar as in the *Metaphysical Foundations of Natural Science* we have the opportunity to appreciate the interconnection between the three faculties - sensibility, understanding, and reason (or the power of judgment) – or rather between intuitive empirical representations, constitutive principles of understanding, and metaphysical ideas of reason. So let's see more closely the arguments that Kant uses in favor of dynamicism against mechanism.

2. The anti-realist status of the causal-dynamic theory of matter

According to the *Metaphysical Foundations of Natural Science*, there are two ways to explain the empirical differences of matter theoretically: either by means of the mechanical theory, or by means of the dynamical theory. The first explains matter “by combination of the absolutely full with the absolutely empty,” whereby the material substrate is composed of atoms in empty space. By contrast, the second explains matter “by mere variety in combining the original forces of repulsion and attraction,” whereby the material substrate consists of a field of original forces operating to a greater or lesser degree (Kant, 2004, p. 72; MAN, AA 04: 532). The question that immediately arises is: how to choose between these two competing hypotheses, which could be so-called ‘meta-scientific,’ where they are both underdetermined by the same set of empirical data?

In the case of the mechanical explanation, the ideas of the atom and empty space are both sufficient hypotheses to explain all specific differences of matters. This explanation is called “mechanical,” because the atoms are conceived as natural machines, “mere instruments of external moving forces” (Kant, 2004, p. 72; MAN, AA 04: 532). Kant holds that this theory implements a purely mathematical physics, to which Euclidean geometry smoothly applies. However, the mechanical mode of explanation could not be strictly necessary, and might be revealed invalid “so long as a possibility remains for thinking the specific difference in densities even without any empty interstices” (p. 73; 533). The dynamical explanation then arises as a result of the freedom of human reason in its fully legitimate use for conceiving a plurality of types of matter. According to Kant, the dynamical mode of explanation, based on the relationship between fundamental moving forces, is “more appropriate and conducive to experimental philosophy.” The reason for this is that taking the forces of attraction and repulsion as the ground of the explanation of matter, we would then take into account the conditions given by empirical intuition, the basis of experimental physics, and not just those given by pure intuition, the basis of mathematics. Primarily for that reason, the dynamical natural philosophy shows itself to be a viable and advantageous way of explaining the major observable features of matter without resorting to the mechanical hypothesis,

which has a purely geometrical status. Kant thereby provides, from theoretical and a priori consideration alone, an inference to the theory of the moving forces of attraction and repulsion, as the best explanation for the empirical differences between kinds of matter. The application of the pure concepts of the understanding to the dynamical definition of matter, i.e., matter conceived under the rubrics of its quantity, quality, relation, and modality, allows us to derive its four fundamental properties. The quantity or magnitude of matter provides its volume and density, the quality of the matter, its cohesion, the relations the matter, its elasticity, and the modality of quality, the physical and chemical structure of the bodies.

All these empirical features of the matter are therefore explained by the degree of filling of space, and this degree is determined on the basis of the fundamental moving forces and not in terms of the composition of atomic corpuscles in empty space. Kant's dynamical theory rejects all the basic reasons that support a discontinuous interpretation of matter. By trying to unify continuity and substance, Kant also intends to avoid the dualism presupposed by the mechanical natural philosophy of matter, between matter with weight and matter without weight (*aether*). Kant introduced the concept of "aether" in a way that is sharply differently from Newton. For Newton, "aether" is a useful concept for explaining gravitation. By contrast, for Kant, who accepts action at a distance, it is just a *limit-concept*, which is not necessary for the gravitation theory, since the principle of action at a distance does not require a medium in which the action of gravitational forces may propagate. The hypothesis of the aether follows directly from the principle of moving forces as intensive quantities. Assuming that forces have a certain degree, one can easily conceive of an aether, i.e. a material substance with an infinitely small weight. This assumption does not introduce anything new into the dynamical theory, because it is a natural consequence of the general principle of dynamics. This in turn is another advantage of the dynamical explanation of matter in relation to the mechanical explanation: the continuity between principles and hypotheses. The hypothesis of a empty space, by contrast, is entirely extrinsic to the mechanical principle, which states that the forces depend only on their forms (machines). A science of this type is, for Kant, an error of the imagination, which takes the place of coherent thought. To

demonstrate the possibility of empty spaces, the mechanical explanation has mathematical evidence in its favor. Nevertheless, the dynamical hypothesis is metaphysically most appropriate for trying to reduce the apparent variety of given forces to a smaller number, the fundamental forces, which then explain the effects of the others.

Although Kant admits that it is impossible for the dynamical explanation to demonstrate the possibility of the fundamental forces, through a constructive procedure, which is proper to mathematics, still, its certainty is founded only on the condition of the irreducibility of the fundamental forces to other first principles. Kant, indeed, introduces something highly original, as compared to his predecessors Lambert and Descartes, when he says that matter does not fill a space only because of its extension. Solidity and impenetrability are not fundamental properties that alone justify the filling of space by matter. What Kant claims is that we should derive these properties from a more fundamental principle. To say that a principle is “more fundamental,” is to say that it cannot be derived from any other. One cannot understand the possibility of the moving forces, precisely because they are fundamental. This is because Kant considers mechanical explanation to be mathematical, and the dynamical explanation to be metaphysical. Although human reason cannot go beyond the fundamental forces, such an investigation would be, according to Kant, more useful for science, mainly for extending as far as possible the search for dynamical explanations, while also taking into account the empirical concept of matter. As Kant says: “for these alone permit the hope of determinate laws, and thus a true rational coherence of explanations” (Kant, 2004, p. 74; MAN, AA 04: 534). It is due to a metaphysics that is in the service of a coherent application of mathematics to natural science, that the properties of matter can be considered “as dynamical, and not as unconditioned original positings (*Positionen*), as a merely mathematical treatment might postulate them” (p. 74; 534).

So, based on the Dynamics section of the *Metaphysical Foundations of Natural Science*, I did not find the grounds for a consistent defense of Hanna's manifest realism, which supposes that causal-dynamic properties of matter are objectively real, as well as directly humanly perceivable, observational, and macrophysical. Certainly, impenetrability, cohesion, density and elasticity are macrophysical and directly

perceivable properties. However, our reason requires that these properties be explained. To this end, it makes use of theoretical a priori hypotheses that are totally arbitrary but able to explain, for example, why lead is more dense than wood. And because they are a priori, they are not given to any empirical intuition, even if they are consistent with the empirical intuition. In this way, there are hypotheses that are more or less arbitrary, and more or less fictional, that conform more or less to empirical intuition. If we take the example of “Proposition 1” of the Dynamics of *Metaphysical Foundations of Natural Science*, which states that “matter fills a space, not through its mere *existence*, but through a *particular moving force*” (Kant, 2004, p. 34; MAN, AA 04: 497), or “Proposition 4,” which states that “matter is *divisible to infinity* and, in fact, into parts such that each is matter in turn” (Kant, 2004, p. 40; MAN, AA 04: 503), we will find serious difficulties in the way of supporting Hanna's thesis that such propositions are directly perceivable, observational, and macrophysical.

Moreover, the dynamical properties of matter cannot be properly called “essential,” in the sense provided by Kant in the Preface of his *Metaphysical Foundations of Nature Science*. For by “essence,” Kant means “the first inner principle of all that belongs to the possibility of a thing” (Kant, 2004, p. 3; MAN, AA 04: 467). Thus, one can assign an essence to geometric figures, but never an existence to them just by virtue of their essence. In this sense, because the mechanical conception of matter takes into account only the essence of the phenomena, it mathematically enables us to construct the diversity of kinds of material bodies in intuition. By contrast, the dynamical conception, which is based not on the essence of the phenomena, but instead only on their existence, deals not with the possibility of matter, but rather with its reality. So according to Kant, the dynamical theory is more appropriate for natural science than its rival hypothesis. Therefore, Hanna's assertion that the properties of matter are *essentially* causal-dynamic seems to conflict with Kant's definition of essence. On the contrary, we should say instead, along with Kant, that the properties of matter are *existentially* causal-dynamic but not *essentially* causal-dynamic.

If the superiority of dynamical explanation over mechanical explanation arises in virtue of existence and reality, and not in virtue of essence and possibility, then should

we agree with Hanna's manifest realism, whereby causal-dynamic properties of matter are objectively real in the realistic sense? Of course not! This would deal, in my view, a serious blow to the heart of Kant's transcendental idealism. To choose between these two alternative theories, Kant took as a criterion, more than the mathematical possibility of the reality, on the one hand, and more than manifest reality, on the other. His criterion is based on the conformity of the laws of the understanding – as the causal law - with both the objects of experience and the hypothetical ideas of reason.

I want to make clear that the dynamical ideas of reason are *not* concepts of the understanding applied to the non-conceptual content of intuition, but instead metaphysical products of reason used to organize the conceptual content of the understanding and, in the Kantian architectonic, they can have only a hypothetical use and a regulative or heuristic value. While the understanding seeks to unify the manifold of experience through its concepts, reason seeks to unify the conceptual content of the understanding through its ideas, looking for the maximum possible extension of experience (KrV, B 672-673). The ideas of reason, with their fundamentally metaphysical nature, although they do not apply directly and constitutively to any object of experience, nevertheless have a legitimate regulative use that is absolutely essential to the understanding.

The superiority of the dynamical hypothesis over the mechanical hypothesis is based on the assumption that the explanation of the nature of matter is grounded on an abstract principle rather than on a concrete image of an object corresponding to a concept that can be exhibit a priori in intuition. Kant's metaphysics of nature introduces an extremely important epistemological issue, or "problem-space," about what counts as a sufficient reason for choosing between rival scientific theories, highlighting the complex epistemic game between empirical intuitions, mathematical constructs based on pure intuition, the constitutive principles of the understanding, as the principle of causality, and the metaphysical ideas of reason, with its no less important regulative role. So one can without contradiction accept Hanna's thesis about direct perceptual realism, with regard to the non-conceptual content of intuition, and also firmly reject his manifest

realism thesis in favor of the anti-realist conception with regard to the properly metaphysical content of scientific reason.

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