

Hermann Cohen on Kant, Sensations, and Nature in Science

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ABSTRACT The neo-Kantian Hermann Cohen is famously anti-empiricist in that he denies that sensations can make a definable contribution to knowledge. However, in the second edition of *Kant's Theory of Experience* (1885), Cohen considers a proposition that contrasts with both his other work and that of his followers: a Kantian who studies scientific claims to truth—and the grounds on which they are made—cannot limit himself to studying mathematics and logical principles, but needs also to investigate underlying presuppositions about the empirical element of science. Due to his subjectivist approach, Cohen argues, Kant not only failed to explain how scientific observation and experiments are possible, but also misconceived the role of the ideas, particularly the idea of a system of nature.

KEYWORDS Kant, Cohen, sensations, nature, science, neo-Kantianism

I. INTRODUCTION

HERMANN COHEN, THE FOUNDER OF MARBURG neo-Kantianism, is known for denying that sensations or the input received via the sense organs contribute to knowledge. In fact, Cohen famously denies the Kantian distinction between thought and intuition, and the claim that empirical intuition denotes the way a subject relates to an object via sensations. Nevertheless, as Helmut Holzhey writes, Cohen “is primarily concerned with the adequate solution to the problem of sensations. He validates the demand of sensations, while denying their independent right.”¹ Even though Holzhey says this of Cohen’s later work, it is even more evidently true of *Kant's Theory of Experience*. More precisely, while the third and most read edition from 1918 retains many of the key passages, it is the rarely studied second edition of *Kant's Theory of Experience* from 1885 that presents Cohen’s argument

¹Helmut Holzhey, *Cohen und Naturp.*, 307, my translation.

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most clearly.² It is here where his claims about sensations first appeared, and they are still unobscured by later logicist retractions and additions.³

In *Kant's Theory of Experience*, Cohen defines experience as the scientific “cognition of nature.”⁴ He insists that Kant uses the term in the “comprehensive sense,” experience as “the complete expression” of scientific knowledge, which includes both the mathematical and the non-mathematical natural sciences.⁵ Cohen starts by considering experience in line with Newtonian physics and proposes that, in this narrower sense, “The problem which is denoted by the term experience is the link between speculative elements, mathematics and observable sensation.”⁶ In another passage, he notes that “observation and experiments carried out with sensible objects” are “usually united under the header experience.”⁷ Sensations and sensible objects thus form part of the very definition of experience for Cohen. Additionally, Cohen claims that there is a “grain of truth in the idea that sensation makes a contribution to knowledge . . . that is not to be despised. For sure, sensation does not by itself provide the necessary food for thought. But . . . it is only with this partial recognition of sensibility that idealism starts to become fruitful.”⁸ “Distinguishing the contribution sensibility and reason, sensation and thought . . . make to cognition” is “the decisive beginning of systematic philosophy.”⁹

This explicit insistence on the importance of sensations is certainly surprising—at least if one is unfamiliar with the historical context of neo-Kantians breaking ranks with positivists and empiricists in the 1870s/1880s.¹⁰ The early 1880s were also Cohen’s “period of transition,”¹¹ in which he started to move away from Kant and develop his own philosophical position. While Cohen’s critical engagement with Kant is evident in the much enlarged second edition of *Kant's Theory of Experience*, his empirical worries are easily overlooked. This is so, not only because Cohen furtively deleted famous phrases in the second edition, like his claim that “synthetic a priori propositions are the only and complete content of experience.”¹² In addition, the third and most read edition of the book (1918) presents only few changes, most of which concern sensations. Cohen “reduces the importance of sensibility and sensations,” occasionally adds the notion of a “creation” (of—sensible—objects by thought), and defends the claim made in his

²Geert Edel (*Vernunftkritik zur Erkenntnislogik*) and Andrea Poma (*Critical Philosophy*) discuss the second edition separately. For translations of short excerpts from this work, as well as from *The Principle of the Infinitesimal Method and its History*, see Sebastian Luft, *Neo-Kantian Reader*. I am using my own translation; I have consulted Luft’s translation where relevant.

³More on the difference between the third and second editions at the end of the third paragraph.

⁴KTE2 59.

⁵KTE2 59; see also 508. More on this point below in the introduction.

⁶KTE2 72.

⁷KTE2 19. Hyder points out that experiments were sometimes called “prepared experience” in Kant’s time (David Hyder, “Time, Norms, and Structure,” 253).

⁸KTE2 10.

⁹KTE2 11. Renz is right to point out that Cohen does not want to give up on the distinction between sensibility and reason/understanding, because this would entail the notion of a divine intellect producing its objects of cognition. See Ursula Renz, “Zwischen Erkenntnistheoretischem Rationalismus,” 10.

¹⁰See Frederick Beiser, *Genesis of Neo-Kantianism*, 457–58.

¹¹Scott Edgar, “Hermann Cohen.”

¹²KTE1 206, missing in KTE2 407.

Logic of Pure Cognition (1902/14), namely, that intuition and thought need not be distinguished.¹³

In a 1915 letter, Natorp writes that someone who comes from Cohen's discussion of intuition in *Kant's Theory of Experience* (presumably the first edition from 1871) and the *The Principle of the Infinitesimal Method and its History* (1883) "easily misses out on the continuity of the development" between these works and his seminal *Logic of Pure Cognition* (1902/14), where Cohen has "left the distinction between thought and intuition far behind" and does not address the problem of intuition, at least not "under this header."¹⁴ In contrast to his *Logic*, "Cohen completely retains the meaning of intuition in the Kantian sense" in *Kant's Theory of Experience*.¹⁵ In *The Principle of the Infinitesimal Method*, Natorp writes:

Cohen is aware of the problematic aspect of intuition, and he certainly assimilates it to thinking when describing it as "relatedness of consciousness to something as a given." Nevertheless, Cohen sticks with the idea that the relation of consciousness [to its object] has two sides, which is why Cohen insists that the distinction [between thought and intuition] is not "antiquated." (Natorp, "Briefentwurf," my translation; see *PIM* 20; see also Mormann, "Zur Mathematischen Wissenschaftsphilosophie," 115).

I will come back to the notion of "relating to something as a given" below. What the letter shows, however, is that, according to Natorp, Cohen continues to attribute some importance to intuition and sensations in the 1880s, even in the staunchly idealist booklet of 1883.

How can sensations be central to Cohen's inquiry, given that he is unconcerned with sense organs and doubts the epistemological value of sensations? The short answer is that Cohen is only interested in sensations insofar as they are taken to present aspects of sensible objects. The longer answer revolves around Cohen's notion of natural science and a strand of his criticism of Kant that has escaped the attention of interpreters.¹⁶

Cohen's method starts with the "fact of science," "the state of affairs as it is objectively given," in order to then test "its validity and grounds [*Geltungswert und Rechtsquellen*]." ¹⁷ As Holzhey puts it, for Cohen, philosophy should consider scientific "propositions with the claim to truth."¹⁸ Cohen's method is meant to counter psychologism¹⁹—and, indeed, empiricism, as Renz rightly points out.²⁰ Cohen rejects the "myth of the given," the "immediate certainty" of seemingly given, sensible input; he denies the empiricist claim that all knowledge ought to

¹³See Edel, "Einleitung," 46*–47*, my translation.

¹⁴Paul Natorp, "Briefentwurf," my translation.

¹⁵Natorp, "Briefentwurf," my translation.

¹⁶For the way Marburg neo-Kantians approached Kant, see Manfred Kühn, "Interpreting Kant," 116.

¹⁷*PIM* 6; see also 199–200. The two terms literally mean: "the value of validity and the source of right." In a similar passage, Cohen lauds Kant for studying the "ground of scientific discoveries regarding their truth" (*KTE* 67; see also 13, 17).

¹⁸Holzhey, "Neo-Kantianism and Phenomenology," 34, my translation.

¹⁹Alan W. Richardson, "Fact of Science," 222; see also R. Lanier Anderson, "The Roots of Anti-Psychologism."

²⁰Renz, "Marburg nach Pittsburgh," 255–59, my translation.

start with sensations.²¹ As Renz writes elsewhere, Cohen starts with “historically given” scientific theories, rather than the “sensibly given.”²²

While this is undoubtedly correct, scientific propositions do not constitute an unproblematic starting point, for Cohen. Indeed, much to the contrary, scientific claims to truth need to be analyzed regarding the “grounds” on which those claims are made.²³ In 1883, it may seem that Cohen is only interested in the a priori grounds of natural science in the sense of mathematics and Kant’s principles of the pure understanding.²⁴ Some passages in *Kant’s Theory of Experience* seem to suggest the same, and Pollok rightly says that “in the wake of Cohen’s *Theorie*, Marburg neo-Kantians minimize the Kantian sensible.”²⁵ However, I want to propose here that the Cohen of 1885 is also interested in the empirical grounds of science, or rather, in the foundational role that sensations or sensible objects explicitly or implicitly have within science.

The following passages provide a first indication for such a reading. For Cohen, Locke’s distinction between sensation and reflection is an “indispensable prerequisite of any critical analysis, that analyzes the value and validity of cognition. . . . It is a different question, however, whether Locke has drawn this old distinction correctly.”²⁶ Cohen’s transcendental “method is expected to provide the correct definition” of “the relation of thought to sensation.”²⁷ “The distinction between sensibility and thought is to be determined on the basis of the distinct contributions which both make to science and truth, rather than on the basis of their psychological origin.”²⁸

My exact interpretative proposition is the following. If you want to know on what basis scientists claim to be able to distinguish between “valid” and “invalid” claims, you will inevitably encounter basic presuppositions about the empirical element of science and the contribution to “science and truth” that sensations are supposed to make.²⁹ Sensations form part of the underlying assumptions of the natural sciences—and they are relevant for Cohen insofar as they do so.

Before proceeding any further with my argument, it is worth addressing an obvious objection. Cohen (in)famously proposes that, while his transcendental method starts by analyzing the propositions put forward by scientists, it aims at determining “those elements of consciousness that are sufficient and necessary to serve as the basis for the fact of science,” and he specifies that he means “a priori elements.”³⁰ Only by detecting such “elementary notions,”³¹ as he calls them in a similar passage, is it possible to show that science has an “indissoluble” foundation

²¹*PIM* 27.

²²Renz, “Zwischen Erkenntnistheoretischem Rationalismus,” 11, my translation.

²³*PIM* 6.

²⁴See *PIM* 7.

²⁵Konstantin Pollok, “Transcendental Method,” 358; see also Jeremy Heis, “Critical Philosophy,” 388–90.

²⁶*KTE2* 47.

²⁷*KTE2* 72.

²⁸*KTE2* 13.

²⁹See *KTE2* 10–11.

³⁰*KTE2* 77.

³¹*KTE2* 11.

“that is necessary as such.”³² In these passages, Cohen suggests that he is hoping to find eternally valid notions, ahistorical conditions of experience, even if “the insight into them [and their specific formulation] will [only] increase over the progressive cultural development of spirit.”³³

I do not want to enter into the discussion about historical and ahistorical claims throughout Cohen’s work.³⁴ Suffice it to say that Cohen’s notion of “a priori elements of consciousness” does not necessarily exclude anything that has to do with sensations. Cohen makes very clear in 1882 that he is not looking for the “principles of reason,” or for “mental essences.”³⁵ Anything that is a formal condition of (scientific) experience is a priori, for Cohen.³⁶ Cohen primarily takes the Kantian principles to condition experience.³⁷ One of those principles concerns an a priori element of sensations (more on this in section 3). But that is not all. In the infamous passage referenced above,³⁸ Cohen proposes, against Kant, that the Kantian idea of a complete system of nature may also be an a priori condition of experience.³⁹ I will discuss this proposition in section 4.

In general, I agree with Heis, who writes that, on Cohen’s interpretation, the a priori functions similarly to an axiom in relation to a theorem⁴⁰—or, I would say, as a presupposition to a theory. Cohen’s transcendental method investigates “what makes them [scientific books] into sciences, wherein their character of generality and necessity rests . . . what tools and ways of knowing explain [their] validity.”⁴¹ Those tools and methods often involve presuppositions about the empirical element of science and Cohen wants to see if and to what extent those presuppositions are not arbitrary but a necessary and law-like aspect of scientific experience.

Coming back to my interpretation of Cohen’s argument, I want to propose, more specifically, that sensations are relevant for Cohen for three reasons:

- 1) “experience” or scientific knowledge includes empirical, non-mathematical sciences, which to a large degree consist in the systematic observation of nature and that are based on basic propositions about the empirical element of science;
- 2) mathematical Newtonian science not only requires and refers to sensible objects, but implicitly shares some basic presuppositions of empirical sciences;

This is so because:

- 3) the empiricist assumption that natural science is about an external, independently existing world is linked to the very notion of nature, a fact that even an idealist Kantian cannot deny.

³²KTE2 79.

³³KTE2 11.

³⁴See, for example, Edel, “Faktum der Wissenschaft”; and Werner Flach, “Cohens Ursprungsdenken.”

³⁵Cohen, “Biographisches Vorwort,” x.

³⁶See Marco Giovanelli, “Zwei Bedeutungen”; Edel, *Vernunftkritik zur Erkenntnislogik*, 41–43, 407–10; and Luft, “Reassessing Neo-Kantianism,” 94–96.

³⁷See Giovanelli, “Zwei Bedeutungen,” 185.

³⁸KTE2 77.

³⁹KTE2 77.

⁴⁰Heis, “Neo-Kantianism.”

⁴¹Cohen, “Biographisches Vorwort,” x. I am grateful to Heis for the reference and the translation.

I have already mentioned (1) in the opening paragraph of this article. Many interpreters focus on sections of *Kant's Theory of Experience*, which seem to suggest that Cohen identifies experience solely with mathematical Newtonian science.⁴² However, other passages paint a different picture. In 1885, Cohen writes that Kant focuses on “mathematical natural science” to clarify the philsocial inquiry and method.⁴³ He goes on to say:

this clarification [which Kant achieved by focussing on mathematical natural science] brought with it the possibility of applying the clarified philosophical question to other areas of cognition. . . . The question regarding science is not that simple, much less was it that simple in Kant's time. Physics, as it is distinguished from ethics and logic, does not only and exclusively consist in mathematical natural science but includes something different . . . other areas that are covered by the term nature. . . . It was necessary to address also other types of cognition, beside mathematical natural science, and to determine their validity, namely, descriptive natural sciences. While the procedures and means of enquiry are different from those of mathematical natural science, they are nevertheless linked, just as they all refer to the same object, namely, nature. (*KTE2* 56–58; see also Edel, *Vernunftkritik zur Erkenntnislogik*, 389)

Cohen emphatically includes non-mathematical sciences in his notion of experience. He mentions medicine, biology, chemistry, zoology, anthropology, and geography in the above-cited section, but his book focuses mostly on biology, chemistry, and what he calls, with Kant, the “description” and “history of nature.”⁴⁴ The fact that Cohen considers these empirical sciences becomes particularly relevant when he argues, against Kant, that empirical sciences call into question the validity of Newtonian physics. (I will return to this point in section 4).

The “clarified philosophical question,” which Cohen wants to apply to descriptive sciences, entails asking on what grounds a science is supposed to have “validity,” which presuppositions make it possible for scientists to distinguish in a systematic manner between claims that are deemed false and those that are deemed correct. Cohen does not specify the assumptions he wants to look into in this passage. However, one such assumption is clear enough. Experiments and observations are possible; one can observe the functioning of natural phenomena and, at least partly, the effect of natural laws. Cohen gestures toward another presupposition in this passage. There is something called nature, which all natural sciences study; this entails the assumption that a coherent explanation of all aspects of nature, a coherent system of all natural sciences ought to be possible. Both these presuppositions are shared, to some extent, by mathematical natural sciences, and will be addressed in sections 3 and 4, respectively.

This leads us to Cohen's second reason (2) for claiming that sensations are important. Newtonian physics concerns “the link between speculative elements, mathematics and observable sensation.”⁴⁵ How and why does Newtonian physics involve “observable sensation”?

The answer forms part of Cohen's third proposition (3). Sensations are relevant for all natural sciences because of the very notion of nature. Cohen puts this, at

⁴²See Nicholas Stang, “Concept of Experience,” 14; see *KTE2* 79.

⁴³*KTE2* 56.

⁴⁴*KTE2* 19.

⁴⁵*KTE2* 72.

first, rather poetically: “Science is the doctrine of bodies, and the light of science therefore seems to be attached to bodies and sensations.”⁴⁶ He later specifies:

Those principles of science also have and assert their own objective relation to sensations. . . . Where nature comes into question, a relation to sensation is presupposed and demanded. Hence, it is not sufficient anymore for pure thinking to make statements or to limit itself to the sovereign intuition of mathematics; rather it becomes necessary to grapple with a factor, which is not only variable, but also seems to be heteronomous. (*KTE2* 45)

It is important to be clear about this point. Cohen is not proposing that sensations present information about a mind-independent world. Rather, he proposes that this empiricist assumption is inherent in the very conception of natural science (as presupposed by scientists of his time). It is a key feature of natural science that it is not supposed to be a self-contained mathematical or logical system, but instead a discipline that makes claims about nature; and natural bodies are supposed to exist independently of scientific theories and they are supposed to be accessible, at least partly, via sensible perception. Demmerling is therefore right to associate historical neo-Kantians with McDowell’s *Avoiding the Myth of the Given* and *Having the World in View*.⁴⁷ Like McDowell, Cohen is not a foundationalist, presupposing the sensibly given as a secure basis of knowledge; but conceiving knowledge purely in terms of language, mathematics or logic would make it seem divorced from the world—or, indeed, nature. Employing an expression that has recently been used by Watkins and Willaschek, natural science is supposed to “latch onto” the world, and sensations are usually taken to be the starting point for such a connection.⁴⁸ Without wanting to derive any realist conclusions (about the mind-independent existence of objects), Cohen simply acknowledges that the link between science and the physical and observable world is a problem that an idealist needs to address.⁴⁹ Even though the laws of Newtonian physics are not derived from the observation of nature (at least not if one follows Kant), those laws are nevertheless supposed to be true of nature, and their effects ought to be at least partly observable within nature.

This is the central and systematic reason why sensations are important, for Cohen. Natural science needs sensible objects that (a) provide particular objects scientific theories apply to and (b) count as having an independence from the mind or, at least, the theories of the subject (so that sensed objects can help corroborate scientific claims). Lastly, (c) sensed objects need to be taken and can be explained as transmitting some information to the subject, to impinge on or “affect” her senses (otherwise, science would seem purely self-enclosed). “Pure intuition constructs common types [*Gemeingebilde*]. . . . Sensation, by contrast, refers to and demands exclusively singular entities [*Einzelgestalten*], and these singular entities claim their

⁴⁶*KTE2* 11.

⁴⁷Christoph Demmerling, “Wahrheit, Begriff und Erfahrung,” 18–19. For different links between neo-Kantianism and analytic philosophy, see Hans-Johann Glock, “*Neo-Kantianism and Analytic Philosophy*.”

⁴⁸Eric Watkins and Marcus Willaschek, “Kant’s Account of Cognition,” 86.

⁴⁹As Heis (“Neo-Kantianism”) points out, Cohen later proposed a more idealist notion of the physical world, as he applauded the advent of electromagnetism. However, the function sensations are taken to have implicitly remained an issue for Cohen.

objective validity as existence.⁵⁰ In another passage, Cohen writes, “Intuition and thought can indeed arouse the suspicion of being pure fantasies; sensation by contrast reverberates with the relation to an external world.”⁵¹

Sensation is often taken merely as an element of consciousness, Cohen writes. “But sensation contains the relation to the object!”⁵² The “object that affects the senses” is taken to “correspond to sensation.”⁵³ “Evidently, sensation signifies the thought of an effect of affection.”⁵⁴

Cohen’s odd phrasing indicates that he is not making any claim as to whether or not sensations stem from mind-independent objects (this is an irrelevant psychological question). Rather, Cohen claims that sensations stand in for, represent, and help specify the thought of mind-independent, particular natural objects to which science applies and that scientists observe. It is an integral part of natural science to presuppose such an object.

Given this approach, it is unsurprising that Cohen refuses to define sensations in terms of sensory input and divorces the meaning of sensibility from sense organs.⁵⁵

Sensation as sensibility is distinct from thinking insofar as it refers to the object as a given, which is then thought or “determined” within thinking, but the given is attested to by intuition, and only it can provide evidence for the given, . . . whereas sensation only designates it. (*KTE2* 488)⁵⁶

Leaving aside for a moment the distinction between sensations and intuition, the following is clear. Natural science presupposes that not only can its subject matter, namely, natural objects, be thought about, but it can also be sensed. Within Cohen’s critique of scientific cognition, sensation counts as nothing but a particular way of defining an object, namely, as a physical object that can be “sensed,” that is, given in perception.⁵⁷

Cohen suggests that the sensed object needs to be “attested to” by intuition and it is here where we get to the core of the problem of sensation, for Cohen. To perceive an empirical object, according to Kant’s notion of empirical intuition, you need not only a manifold of sensations, but also rules or structuring elements, which are the forms of intuition, the schemata, and the categories. “The pure is the order of the matter of sensation,” as Cohen puts it.⁵⁸ Sensations present the specific qualities of particular empirical objects “without which the pure [forms of intuition and categories] would be empty.”⁵⁹ This content is supposed to have been received in some way from an object that affects the senses: “The undefined object of empirical intuition. The first part of this determination is matter and corresponds to sensation.”⁶⁰

⁵⁰*KTE2* 485; see also 561, 598.

⁵¹*KTE2* 424.

⁵²*KTE2* 151.

⁵³*KTE2* 151.

⁵⁴*KTE2* 152.

⁵⁵See Lydia Patton, “Critical Philosophy Renewed,” 114.

⁵⁶Thanks to the anonymous reviewer for pointing out this important passage and providing a translation.

⁵⁷See *KTE2* 434.

⁵⁸*KTE2* 159.

⁵⁹*KTE2* 151.

⁶⁰*KTE2* 151.

Cohen thus broadly adopts the Kantian picture of empirical intuition. However, he is wary of Kant's strict distinction between form and matter. For Cohen, it is an "unfounded demand" that the form needs to be a "contentless form . . . which has to fit any accidental content that may enter from the 'actual world.'"⁶¹ In fact, the pure forms of intuition have a very specific content, for Cohen, namely, time and space and, as a derivate, pure mathematics. Not "any accidental content" can fit this form, not any content is expressible in terms of mathematics.

This was really the transcendental question: . . . how can the external empirical intuition as matter be linked to inner intuition in such a manner that the former receives its purification in the latter as in its form and, hence, its scientific qualification? (*KTE*₂ 158)

The notion of inner intuition must not be taken in the strict Kantian sense here. Cohen uses 'inner' and 'pure,' and 'inner' and 'geometrical' intuition interchangeably in the previous sentences, and he states that "the sensible nature of intuition must be purified into geometrical intuition."⁶² Cohen's question thus reads: how is it that sensations are amenable to being formed by the pure forms of intuition? Or more precisely: how can the qualities of a sensed object turn into geometrical determinations, which Cohen takes to be the ground for specifying other scientifically relevant properties of sensed objects? This is what Cohen means when claiming that intuition needs to "attest to" or "provide evidence" for the given object "designated" by sensations.⁶³

This transition from sensations to intuition, or rather the transformation of a given, sensed object into a mathematically specified object of scientific study, is the crucial and tricky problem, for Cohen. This problem is the last remainder in Kant's theory of the question of how thought fits with or "corresponds to" the object. Scientists ask for a way of verifying or at least applying their theories to something other than human cognizing, namely, to the world or, more precisely, nature that their theories are about. If the laws deducible from the forms of intuition fit scientific theories, this merely proves a match between different aspects of finite, scientific cognition. Additionally, if the forms of intuition received just "any accidental content," then this would not serve to show whether or not specific mathematized theories about nature apply to nature. So, in order to fulfill the demand of science, mathematics has to pick up on something within sensations.

In fact, for Cohen, sensations need to have a minimal structure or form of their own, which science can pick up on and express in mathematical terms. More precisely, given Cohen's disinterest in the actual constitution of sensations, he is suggesting that scientists need to convincingly attribute a universal and necessary structure to sensations and sensed objects. Only if this is the case can sensed objects be taken to have a certain theory-independence (namely, a structure that all sensed objects necessarily have, independently of which theory is applied to them) and can they hence serve to confirm scientific claims about them. The gradation of sensible qualities is the structure that Cohen will look into, within a

⁶¹*KTE*₂ 234.

⁶²*KTE*₂ 158.

⁶³*KTE*₂ 488.

Kantian framework. He will conclude, however, that this structure is insufficient for enabling sensed objects to play the role they are supposed to (see section 3), and he will go on to consider whether a complete system of all sciences can ensure the objective verification that sensed objects fail to provide (see section 4).

Before starting the main discussion, it ought to be said that Cohen's concern with sensations (and, indeed, with descriptive sciences as a heteronomous problem) is unusual within his oeuvre, and among neo-Kantians who are anti-empiricist and idealists like Cohen. It is also absent in the secondary literature. Holzhey highlights the fact that, "in his later work," Cohen increasingly rejects any relevance of sensations—without exploring the relevance this notion had previously.⁶⁴ Poma merely notes that sensations count (primarily) as a motivation for thought for Cohen.⁶⁵ Richardson, who presents an overview of the neo-Kantian conceptions of experience, focuses exclusively on a logical or mathematical foundation of truth.⁶⁶

This apparent lacuna in the literature is not surprising, since Cohen's discussion had a short shelf life. (The second edition of *Kant's Theory of Experience* does not even feature in the first volume of Cohen's collected works, which unites the first and the third editions.) In 1887, two years after Cohen revised his book, Natorp wrote a programmatic piece entitled "On the Objective and Subjective Grounding of Knowledge," where he does not pick up on any of Cohen's empirical worries. While Natorp describes logic as the "theory of validity of cognition" per se,⁶⁷ Cohen criticizes Leibniz's "overestimation of logic,"⁶⁸ which led Leibniz to "neglect the considerable material treasure, that can be raised in sensibility."⁶⁹ Where Natorp proposes that logic provides the coherent unity of science, Cohen maintains that the "systematic unity of nature" (and of all sciences) is a concept that belongs to non-mathematical, empirical science.⁷⁰ And, tellingly, they use the same example to the opposite effect. Natorp defines the object as the law, much like Cohen did in 1877,⁷¹ and argues that truth is a question of subsuming a particular under a universal, as is the case when explaining "the movement of planets" by means of a "central force" and the "law of gravity."⁷² In 1885, Cohen argues that it is not enough to define the "sun as a center of gravity." The sun must also be studied "regarding the kind of matter it burns."⁷³

Some may claim that Cohen's project was doomed to fail and has rightfully been forgotten. I disagree. Cohen's problem is certainly tricky and perhaps even

⁶⁴Holzhey, "Neo-Kantianism and Phenomenology," 34–35.

⁶⁵Poma, *Critical Philosophy*, 35, 43.

⁶⁶Richardson, "Conceiving, Experiencing;" see also Edgar and Patton, *Method, Science and Mathematics*.

⁶⁷Natorp, "Objective and Subjective Grounding," 168.

⁶⁸KTE2 39.

⁶⁹KTE2 40.

⁷⁰KTE2 511.

⁷¹Cohen, *Kants Begründung der Ethik*, 20.

⁷²Natorp, "Objective and Subjective Grounding," 167; see also 171.

⁷³KTE2 510. When Ernst Cassirer references this passage ("Erneuerung der Kantischen Philosophie," 263), he is quick to insist that the description of nature does not conflict with a mechanical or causal explanation of nature; earlier he identifies nature with a "system of processes of movement" (Cassirer, "Erneuerung der Kantischen Philosophie," 256, my translation)—both claims contrast with Cohen's 1885 argument. More on Cohen's position is offered in sect. 4.

unsolvable. Nevertheless, his failure to salvage the empirical or realist element suggested by Kant and presupposed by scientists is not only interesting as a step toward Cohen's subsequent purely logicist account of cognition. It also highlights problems that remained relevant in Cohen's oeuvre until the end. And it is exciting, both as a critique of Kant and as an attempt to tackle the world-cognition relation in idealist terms. Even if he, admittedly, did not manage to formulate any definitive answers, the questions Cohen raises are unique and deep and point to serious problems in Kant and in an idealist theory of cognition that remain relevant to this day. The present article analyzes *Kant's Theory of Experience* in terms of Cohen's critique of Kant.

2. KANT'S SUBJECTIVISM AND THE TASK COHEN SET HIMSELF

For Cohen, Kant's subjectivist foundation of truth and science is at the root of many problems of Kant's philosophy, which, when this root is removed, may well be solvable.⁷⁴ Cohen sometimes misrepresents Kant's subjectivism as a form of psychologism, particularly when he follows Helmholtz and Lange in assuming that Kant derives the a priori categories from the way the psyche operates. As Beiser writes, "old habits lingered," despite the fact that Cohen "criticizes Herbart, Lange, Meyer" and breaks with "his earlier psychology."⁷⁵ I will only rarely mention Cohen's psychologistic take on Kant, and instead highlight the extent to which I believe Cohen presents Kant's philosophy correctly. Kant derives his categories from the forms of judgment; the categories represent the basic features of objects of judgment. When Kant then derives principles of Newtonian science from the categories (in connection with the forms of intuition and the concept of matter), he basically proposes a theory of objects as they need to be (thought of) in order to be judged coherently. This is subjectivist in the sense that key features of objects depend on the requirements of coherent judgment and thought. While interpretations of Kant vary widely, I believe this line of interpretation is defensible and quite standard, and I will indicate where Cohen's claims overlap with those of contemporary scholars.

According to Kant, his idealism, in contrast to Berkeley's, ensures the "objective reality" of cognition, as it supposes "a law" of experience that functions as a "sure criterion for distinguishing truth from illusion."⁷⁶ Necessary universal and law-like features of objects of experience enable subjects to distinguish between those claims that correctly express the universal and necessary laws (of nature) and those that do not. The problem is that, on the reading sketched above, objects display the same law-like features, for Kant, because they necessarily exhibit the

⁷⁴For Cohen's earlier interpretation of Kant's theory of subjectivity, see Charlotte Baumann, "Kant, Neo-Kantians."

⁷⁵Beiser, *Genesis of Neo-Kantianism*, 486–87.

⁷⁶*Prolegomena* 4:126. References to the *Critique of Pure Reason* use the standard A/B pagination. For other works, I cite by (volume:page) of the edition published by the Königlich Preussische Akademie der Wissenschaften zu Berlin and then by Walter de Gruyter (1900–). This pagination is also referenced in the Cambridge Edition of the Works of Immanuel Kant (1992–), which I use for the English translation (except for "Berliner Physik," which is my own translation).

categories and the forms of intuition, which are the basic features of objects for thought. Consequently, objects have these law-like and regular features only *for* a subject (that experiences in the way Kant assumes) and only *if* the subject actually uses always and necessarily the exact categories and principles Kant posits.⁷⁷ It is an unprovable claim, for Cohen, that Kant actually detected all categories and such an unprovable claim can hardly serve as a secure basis for scientific truth.⁷⁸

While Kant's subjectivist starting point is internally problematic for Cohen, it also meant that Kant failed to engage critically with basic presuppositions about sensations and empirical sciences, presuppositions that Kant shared with scientists at the time, but which he believed to be able to deduce from his subjectivist foundation. Cohen takes it upon himself to investigate these basic assumptions within a Kantian framework.

First, Cohen looks into the assumption that experiments and scientific observation are possible. According to Kant, sensible qualities like red, warm, or loud are received via the senses. This given manifold of qualities is "synthesized" or united into a coherent sensible object with the help of the categories and forms of intuition. The question is: how can sensations like red and blue or objects that have such qualities help verify scientific propositions? How can those qualities become scientifically relevant and, hence, be used for experiments and scientific observation?

Cohen discusses this question against the backdrop of Kant's claim that perception is gradual. Cohen thus analyzes whether scientific observation and experiments can present cases, to which scientific theories apply, *because* sensed objects necessarily have gradual qualities, which fit a Newtonian theory of motion, and all scientific analysis of natural objects is based on Newton's theory of motion. Cohen believes that this connection is implied by Kant's theory, even though Kant himself fails to develop it.

Second, Cohen addresses the question of whether Newtonian physics is indeed a universal physics underlying all other sciences. One can also say that Cohen looks into the presupposition that all sciences are about nature and hence, when conducted properly, ought to cohere with one another—and that this coherence is grounded in the fact that Newtonian physics underlies all sciences. Additionally, according to Cohen, scientists and Kant both suggest that it ought to be possible to formulate scientific claims about nature that are and remain universally valid; Newtonian physics is the prime example due to its foundational role. Cohen thus analyzes both the universal status of Newtonian physics and the question of the possibility of universal scientific claims in general; he does so by way of a critique of Kant's argument regarding the Ideas.

In the remainder of this article, I will trace Cohen's argument as he shows how and to what extent given sensible objects can confirm Newtonian theories (section 3), and concludes that Newtonian physics cannot have the universal status Kant assumes (section 4).

⁷⁷KTE2 502.

⁷⁸See Luft, *Space of Culture*, 66.

3 . EXPERIMENTS AND THE
“OBJECTIFICATION” OF SENSATIONS

For Cohen, there is a gap in Kant’s philosophy between bare perception and its scientific usefulness, that is, its ability to display the kind of laws it is supposed to display or even help verify. Kant never worried about this problem, since, on the above interpretation, it is a foregone conclusion that sensible objects cohere with a Newtonian theory of motion. Any object of experience necessarily displays the categories and forms of intuition. Newtonian physics, to a large extent, specifies those same categories and develops their systematic implications. As Friedman puts it, “the way in which the motion of matter is investigated in . . . the *Metaphysical Foundations [of Natural Science]* is entirely determined by the table of the categories.”⁷⁹ (Relational) categories are “realized or instantiated” by mechanical laws.⁸⁰ Consequently, it is only of minor importance for Kant how exactly sensed objects display the laws of Newtonian mechanics. After all, it is the correspondence with the categories and forms of intuition that proves the validity of the laws of motion, not actual perception or experiments carried out by scientists.⁸¹

Kant discusses sensations under the header Anticipations of Perception in his *Critique of Pure Reason*, where he specifies the category of ‘reality.’ Reality is different from ‘actuality’; it derives from the Latin *res* (thing), and refers to the particular sensible qualities that make one thing distinct from another. Kant proposes that we know prior to any actual experience that (sensations and) sensible qualities of objects have a degree or an “intensive magnitude.”⁸² Colors have shades and sounds have pitches that are located on a continuous scale.

Cohen considers this principle to be one of Kant’s greatest insights. Nevertheless, Kant fails to capture the exact meaning of his own finding. On Cohen’s reading, Kant makes the “mistake” of starting with a psychological fact, the “particularity of consciousness,” that human beings have sensations that are gradual.⁸³ Kant partly corrects this in the second edition of the *Critique of Pure Reason*, as he now claims that only sensible qualities are gradual,⁸⁴ rather than those qualities *and* sensations.⁸⁵ Nevertheless, Kant continues to define sensation as a reference to “the subject as a modification of its state.”⁸⁶ He still interprets degree as the “degree of influence on sense” and, according to Cohen, suggests that sensed objects have gradual qualities *because* those qualities are given as sensations (and sensations are gradual).⁸⁷

This interpretation proposed by Cohen is problematic, but certainly not uncommon. Jankowiak writes that “most commentators” believe that Kant is

⁷⁹Michael Friedman, *Kant’s Construction of Nature*, 19.

⁸⁰Friedman, *Kant’s Construction of Nature*, 20.

⁸¹For a critical discussion of the supposed close link between Kant’s categories and Newtonian physics, see Karin de Boer, “Kant, Reichenbach.”

⁸²A 166/B 207.

⁸³KTE2 433.

⁸⁴B 207.

⁸⁵A 166.

⁸⁶B 376.

⁸⁷B 208; KTE2 434.

“inferring from a psychological premise about internal sensations,”⁸⁸ from sensations to sensed objects and hence “from effect to cause.”⁸⁹ Consequently, Kant’s argument is considered a failure. In Kant’s defense, it must be said that sensations are non-durational and, hence, are not directly gradual and measurable. Sensations can only be imagined as gradual by projecting them onto external sense, imagining them as a point on a line.⁹⁰ Additionally, Jankowiak proposes that the relation between sensations and sensed object is one of identity rather than causation.⁹¹

Cohen’s point is nevertheless relevant as a first step. His claim is primarily that the occasional reference to sensations is misleading. Kant invites worries that are irrelevant—including the one Jankowiak mentions regarding the causal link between sensed object and sensations. Cohen insists that the “procedure of consciousness” when sensing cannot be relevant.⁹² And he strongly opposes Kant’s early distinction between sensations and “what they represent in terms of the object.”⁹³ The only relevant meaning of sensations is that they refer to something as a physical object that is *taken* to be given in perception.⁹⁴ Hence, the question is not, “How do sensations give us an object?,” but rather “What is it that makes scientists and others define some objects as those that are given by sensations?” Or: “How do scientists ‘objectify’ sensations and make them represent sensible objects?” For Cohen, Kant provides the tools to answer this question but does not use them systematically.

The answer revolves around Kant’s notion of degree. For Cohen, the term does not mean the “degree of influence on sense”;⁹⁵ rather, it refers to a means for “objectify[ing] the object of sensation.”⁹⁶ “Intensity . . . is not the mode of excitation of consciousness, but rather the designation of origin of the objectivity of the object.”⁹⁷ The degree of the qualities of sensed objects should be understood as an access point for turning them into objects that can confirm scientific theories, as a way to “make the real which is suggested by sensations accessible for scientific determination,”⁹⁸ or, more precisely, definable by physics.⁹⁹ Cohen also speaks of “a-priori-tising something about sensations,”¹⁰⁰ making them expressible by means of universal and necessary laws of physics. As it stands, Kant’s *Anticipations of Perception* merely discusses unspecified sensible objects with gradual qualities that are taken to correspond to sense impressions like red or loud.

For Cohen, Kant misses the opportunity to systematically link the gradation of sensible qualities to the notion of objective time developed in the *Analogies of*

⁸⁸Tim Jankowiak, “Kant’s Argument,” 387.

⁸⁹Jankowiak, “Kant’s Argument,” 397.

⁹⁰See Reinhard Hiltcher, “Einheit der Anschauung,” 129.

⁹¹Jankowiak, “Kant’s Argument,” 400.

⁹²*KTE2* 488.

⁹³*KTE2* 433.

⁹⁴See *KTE2* 434, 488.

⁹⁵B 208.

⁹⁶*KTE2* 434; see also *PIM* 109.

⁹⁷*KTE2* 438.

⁹⁸*KTE2* 598.

⁹⁹*KTE2* 429.

¹⁰⁰*KTE2* 432.

Experience and to the notions of motion, speed, and acceleration Kant discusses in his *Metaphysical Foundations of Natural Sciences*. It is true that Kant proposes that the Anticipations of Perception allow for the “second application of mathematics (*matemasis intensorum*) to natural science.”¹⁰¹ In other words, the principle enables scientists to apply intensive magnitude to physics. However, Friedman has convincingly argued that Kant makes a strict distinction between the real in space that, in some unspecified causal way, affects our senses (Anticipations of Perception) and matter as the movable in space that is studied by Newtonian physics (*Metaphysical Foundations*).¹⁰² The real that affects our senses is neither a perceptual description of x , nor scientific conception of x . It is an a priori concept, that is, a notion that is necessarily implied by the very structures of thought and intuition. And it is the abstract notion of an object that is spatial or geometrical (and is taken to have affected the senses in some unspecified manner and have gradual qualities).

Cohen’s main problem can be paraphrased by saying that the object that Kant considers in the Anticipations must be a physical rather than a geometrical object.¹⁰³ A geometrical figure cannot affect the senses of a subject and it cannot be consulted in experiments and observations. If the “real” discussed in the Anticipations is a physical object, then Kant needs to propose a much closer link between the first *Critique* and the *Metaphysical Foundations*. Kant ought to have shown how, by means of considering sensed qualities as gradual, one reaches the notion of an object that can move toward or “touch” the senses of the subject according to physical laws—and display the laws of physics that scientists seek to confirm by observing objects. While Kant reportedly did sometimes speak of affection in terms of motion¹⁰⁴—light hitting the retina of the subject, for example—he does not consistently develop this link. (In fact, Kant’s system rather suggests a different link. The fact *that* sensible qualities have a degree—and are therefore defined by the degree to which their opposite or “negation” is also present—is specified by means of the opposing forces discussed in dynamics).

For Cohen, gradation objectifies sensations in two ways. By means of attributing gradual qualities to a representation, we (1) transform “sense data” into “data of intuition” (i.e. define qualities by mathematical and geometrical means),¹⁰⁵ and (2) “legitimize the object as an object of experience” (i.e. consider it as a sensible and physical object, whose qualities are passively given in perception).¹⁰⁶

Cohen gives an example of aspect (1) when he writes, “In order to cognize the objective element of color, are we not forced to consider it as a frequencies/

¹⁰¹*Prolegomena* 4:58; see also A 178–79/B 221.

¹⁰²Friedman, *Kant’s Construction of Nature*, 108–11.

¹⁰³This talk of two objects may be misleading. Cohen is not interested in asking whether or not geometrical or physical objects exist or whether they affect the senses of the subject. He is merely saying: natural science presupposes physical objects. And then he asks: can scientists give a coherent account of a physical object that satisfies the requirements on this object made by science (i.e. can they explain how it is supposed to transmit information to the subject; see also the three requirements outlined in the introduction)?

¹⁰⁴Kant, “Berliner Physik,” 29:75.

¹⁰⁵See *PIM* 19.

¹⁰⁶*KTE* 233.

correlation of wavelengths [*Schwingungsverhältnisse*] and therefore according to the theorems [*Sätze*] of space?"¹⁰⁷ It may be assumed that Cohen references Helmholtz's theory,¹⁰⁸ which the latter expounded in "On Human Vision." Helmholtz proposes that the perception of color is due to different velocities of "aether vibrations" that stimulate the eye.¹⁰⁹ Rather than considering Helmholtz's proposition as a description of mind-independent reality (there being an "aether" that vibrates and affects sense organs), Cohen interprets Helmholtz's theory in terms of how science can represent sensations, make them precise and measurable, and express them by mathematical and geometrical means. The key point, for Cohen, is that the gradation of sensed qualities enables Helmholtz to consider sensible qualities as movements and, hence, mathematically. This is why, in contrast to Helmholtz, who thinks of oscillating movements in mind-independent, physical space, Cohen refers to geometrical space within which movement can be represented. The "geometrical laws" or "spatial determinations" he mentions in this and similar passages are the principles of geometry (for example, between two points there is only one straight line).¹¹⁰ Additionally, Cohen insists repeatedly that the infinitesimal completes geometry,¹¹¹ so he may also be referring to the differentials, which Cohen identifies with the laws of motion.¹¹² The velocity and the acceleration at each point of a movement can be depicted, geometrically, as curves. As Holzhey puts it, "geometry determines the objects of cognition in their reality by using the infinitesimal method."¹¹³

Cohen's second claim (2) is: "The category of reality by means of continuity constitutes a type of object which certifies the object as an object of sensation."¹¹⁴ According to Cohen, Kant had suggested that sensations are gradual and *therefore* we consider sensed objects as having gradual qualities. Cohen inverts this claim. By thinking of an object as having gradual and continuous qualities, this object counts as a sensible object.

Sensed objects are different from logical objects or geometrical shapes, because their qualities change gradually.¹¹⁵ This means that physical objects can have contradictory qualities, be still a bit red and almost already white at the same time. Additionally, geometrical shapes, in contrast to physical objects, may be moved around, but they cannot accelerate. This is why the "higher differentials," including the second differential that expresses acceleration, are central, for Cohen.¹¹⁶ They play a key role in "all objectification by means of physics,"¹¹⁷ salvaging the "material meaning of things."¹¹⁸ Experiments are possible because one can distinguish

¹⁰⁷ *KTE2* 178.

¹⁰⁸ See *KTE2* 163.

¹⁰⁹ See Edgar, "Physiology of the Sense Organs," 105–8.

¹¹⁰ For the first quoted term, see *KTE2* 178; for the second, see *KTE2* 233.

¹¹¹ *PIM* 21; see also 13.

¹¹² Holzhey, "Einführung des Herausgebers," 10.

¹¹³ Holzhey, "Die Leibniz-Rezeption," 293, my translation.

¹¹⁴ *KTE2* 434.

¹¹⁵ See Giovanelli, *Reality and Negation*, 41–44.

¹¹⁶ *PIM* 73–74.

¹¹⁷ *KTE2* 426.

¹¹⁸ *PIM* 22.

between a (logically coherent) scientific hypothesis and physical objects, which, while law-like and regular, may not end up confirming the particular hypothesis a scientist puts forward.

Cohen thus concludes: sensible objects only count within Newtonian science if and insofar as they are changing, defined as movements or display gradual differences from other things—and can hence be considered according to the laws of motion. With the help of the infinitesimal calculus, Newtonian scientists define sensible objects as those objects that have gradual qualities and display the laws of motion. “The lasting importance of the infinitesimal” is due to its ability of “transforming by means of pure intuition geometrical objects into physical objects.”¹¹⁹ (Cohen specifies that by “pure intuition” he means “mathematical intuition.”¹²⁰)

Cohen had announced at the beginning of his book that “the laws of motion . . . must be proven in reference to sensible objects and processes.”¹²¹ He has now achieved a positive, provisional result. Sensible objects can, indeed, display Newtonian laws of motion and, within the Newtonian framework, they can corroborate specific claims. But can sensed objects, understood in the above-sketches way, truly fulfill the role that they are supposed to have within natural science?

Sensed, physical objects (understood with the infinitesimal calculus) are certainly distinguishable from logical objects of thought and they clearly fulfill one requirement of sensible objects specified in the introduction. Cohen’s account of Newtonian sensible objects offers a law-like way of explaining how they must be taken to affect the senses of the researcher or her instruments. But, as outlined in the introduction, sensed objects also need to be (a) particular entities that (b) can convincingly be presented as independent from scientific theories. Cohen needs to consider whether sensed objects, on his account, can be consistently conceived as theory-independent and particular. (A consistent conception is Cohen’s only worry, not whether this conception is a correct account in terms of replicating the actual world; for Cohen, the actual existence or knowability of sensed objects is irrelevant.)

Sensed objects cannot be regarded as theory-independent by claiming that sensations, by themselves, give or present objects;¹²² this much is clear, for Cohen. However, Beiser rightly insists that, for the Cohen of 1885, sensible qualities are given rather than “created” by the subject (in contrast to what Cohen will claim in his later work).¹²³ Thought requires a “working material,” as Cohen puts it.¹²⁴ It is here where a certain theory-independence can come in.

As suggested in the introduction, sensed objects could be conceived of as theory-independent if one can consistently propose that they have a minimal

¹¹⁹ *PIM* 22.

¹²⁰ *PIM* 19, 20.

¹²¹ *KTE* 20.

¹²² *KTE* 136.

¹²³ Beiser, *Genesis of Neo-Kantianism*, 486. For Cohen’s later work, see Thomas Mormann and Mikhail Katz, “Infinitesimals,” 253.

¹²⁴ *KTE* 240.

structure or form of their own that the mathematical explanation picks up on or formalizes; gradation is the candidate for such a structure. But is intensity or gradation, indeed, a feature of perception in general that happens to fit with and thereby confirm the universal validity of Newtonian physics, as Kant suggests? Or, is intensity merely a feature of perception *within Newtonian physics*? In other words, is gradation a necessary feature of any account of sensible objects (and, hence, is present within all natural sciences), or have Newtonian physicists found a consistent way of interpreting sensible qualities that fits with their particular theory?

What is at stake and comes into the focus of Cohen's discussion is hence the status of Newtonian physics as universal physics. Are the sensed objects of Newtonian physics the one and only conception of sensible objects that underlie all other sciences? If this were the case, then gradation would be a universal, necessary, and inescapable aspect of any conception of sensed objects and, hence, could stand in for the notion of mind- or theory-independence (since any scientific account of sensed objects necessarily construes sensed object in this way). Cohen doubts that this is the case, however. Kant fails to show that the notion of a sensed object or, for that matter, the category of reality necessarily implies intensity—for example, the degrees of perfection of the real, as Leibniz argues—and that, for this reason, intensity is a necessary feature of sensible objects. Instead, on Cohen's reading, Kant furtively appeals to some psychological, personal way of experiencing, that cannot serve as the basis of philosophical claims.

Additionally, Kant himself mentions chemistry, biology, and the “description” and “history” of nature, as sciences that seem to contradict Newtonian physics. Neither the order of chemical elements nor the interrelation of organs can be explained in terms of movement in space.¹²⁵ To make matters worse, Newtonian physics does not seem to be able to account for the particularity of sensible objects. Newtonianism presents objects merely as cases of the laws of motion, and Cohen insists in 1885 that sensed objects are much more than that.¹²⁶ The cataloguing of natural objects and their changes uncovers an incredible diversity, which the Newtonian theory of motion does not seem to capture.¹²⁷

I will discuss the status of Newtonian science in the next section. It is important to note, however, that the above-sketched worry arises for Cohen because gradation has a different status for him than it does for Kant. In contrast to Kant, for whom the fact *that* sensed qualities have a degree that can be known prior to experience, but not the qualities themselves,¹²⁸ Cohen assumes that gradation itself is not prior to experience, but requires the infinitesimal, which is a necessary, yet empirical, concept. It is empirical, first, in the sense that it is not a “logical operator,” but “a givenness of intuition into which the concept of reality is carved.”¹²⁹ The infinitesimal presents the conceptual solution to the problem of given sensation, a means for expressing sensible qualities scientifically. Second, and more importantly, the infinitesimal is empirical in the sense that it has been invented by scientists

¹²⁵ *KTE*2 510.

¹²⁶ See *KTE*2 510.

¹²⁷ *KTE*2 215.

¹²⁸ See Giovanelli, *Reality and Negation*, 226–27.

¹²⁹ *PIM* 90; see also 20.

over the course of history. The worry is whether this invention has universal validity such that it is necessary for any scientific account of sensed objects or whether it just has validity for the account provided and required by Newtonian science.¹³⁰

4. EMPIRICAL SCIENCES, THE LIMITS OF NEWTONIAN PHYSICS, AND THE ROLE OF KANTIAN “IDEAS”

Non-mathematical natural sciences rely much more heavily on observation and experiments than does Newtonian physics. Since *Kant's Theory of Experience* traces his critical reasoning on Kant, Cohen takes little interest in the question of how exactly non-mathematical scientists experience or come to describe sensible objects in the way they do. Rather, Cohen asks, much like Kant does, what the existence of empirical sciences means for Newtonian physics. Does Newtonian physics underlie all other sciences, as Kant assumes? As already noted, this seems unlikely to Cohen, given the diversity of sciences.

Nevertheless, Cohen revisits Kant's argument about the universal status of Newtonianism. Kant confirms the universal status of Newtonian science by means of three closely related strategies: (1) Kant assumes that Newtonian physics derives from unchanging categories and principles; (2) Kant suggests that we may suppose there is one unifying principle underlying all (seemingly conflicting) sciences,¹³¹ even though it may not be knowable for the human intellect.¹³² Consequently, Kant does not assume that a new science will emerge that invalidates Newtonian physics; (3) Kant proposes that principles that (seem to) contradict Newtonian physics must be taken to be merely “regulative”—not having the same status as those underlying Newtonianism.

It is worth briefly expanding on points (1) and (3), which are most relevant for Cohen.

(1) Kant discusses four sciences in his *Metaphysical Foundations of Natural Sciences*, which analyze aspects of moving matter along the lines of Newtonian mechanics. (Cohen uses “mechanical” and “Newtonian” interchangeably and equates it with the theory Kant expounds in the *Metaphysical Foundations*.¹³³ For the sake of simplicity, I follow his usage.) For Kant, Newtonian physics is “foundational” for all other physical sciences. But Kant's approach implies that, while organisms are an inexplicable starting point of biology, biologists must explain them in mechanical terms, that is, by means of causality and laws of motion.¹³⁴ Moreover, for Kant, the description of natural objects relies on mathematical (Newtonian) science.¹³⁵

Regarding (3), Kant distinguishes between “regulative ideas” and “constitutive principles.” Organisms do not function according to mechanical laws alone; they also operate according to the notion of a telos or purpose (all organs doing what

¹³⁰Francesca Biagioli is right to say that the “determinability” of sensations presupposes “specific mathematical methods,” for Cohen (“Cohen and Helmholtz,” 83). But Cohen suggests this may be so only with regard to their determinability within the realm of Newtonian physics.

¹³¹A 645/B 673.

¹³²CJ 5:259.

¹³³He uses it interchangeably for example in *KTE2* 58.

¹³⁴See Hein Van den Berg, *Kant on Proper Science*, 149.

¹³⁵See Friedman, *Kant and the Exact Sciences*, 11, 284.

is necessary for the purpose of maintaining the organism as a whole). The notion of a purpose contradicts that of (mechanical, linear) causality, because the effect causes the cause. The organism is the result or effect of the interaction of organs, but also the cause of their specific interrelation. Since mechanical causality and teleology contradict one another (at least from the viewpoint of limited, human reason), we are forced to consider only one of the two principles, namely, causality, as “constitutive” of objects of experience.¹³⁶ Teleology is merely “regulative,” a subjective guideline for research.¹³⁷ In addition, other concepts that contradict linear causality are regulative, for Kant. The unconditioned merely serves to motivate a search for further conditions.¹³⁸ The demand for a coherent system of all sciences is a “subjective law of economy,” a tool for reducing the number of concepts.¹³⁹ They are all “ideas” and do not “prescribe a law to objects,” that is, define their lawful and necessary features.¹⁴⁰

Points (1) and (3) are, of course, closely linked. Friedman notes that a “constitutive procedure of the understanding . . . proceeds from the top down, as it were, by schematizing the pure concepts of the understanding in terms of sensibility so as to provide the basis of a mathematical science of nature.”¹⁴¹ The principles underlying Newtonian mechanics are constitutive, for Kant, *because* they can be derived from the categories and forms of intuition—and the schematized categories necessarily define objects of experience. If a principle cannot be derived from the categories, it is not constitutive almost by definition; in the case of a conflict with another principle that has such an a priori foundation, the latter always has precedence.

Since Cohen does not believe in the assured status of the categories, the argument is unconvincing to him. For Cohen, a truly critical inquiry may, “for example, find that the notion of a system is necessary and constitutive for science.”¹⁴² With the term ‘system,’ Cohen means both the systematic totality of nature and that of all sciences that study nature. Cohen thus proposes that two contradictory principles—causality *and* the system or purposeful order of nature—can be necessary conditions of objects and their scientific cognition. In fact, Cohen even proposes that the Kantian ideas are presupposed by scientists and therefore a “fact of science.” Hence, “the unconditioned, the idea, the boundary concept, the systematic unity . . . ought to have transcendental validity, which they can only have due to their worth and function [*Leistung*] for scientific cognition.”¹⁴³

While Cohen continues to pay lip service to the Kantian distinction between regulative and constitutive principles, he effectively denies any strict difference.¹⁴⁴

¹³⁶ *CJ* 5:229.

¹³⁷ *CJ* 5:281–82.

¹³⁸ A 508/B 536.

¹³⁹ B 362.

¹⁴⁰ B 326.

¹⁴¹ Friedman, *Kant and the Exact Sciences*, 51.

¹⁴² *KTE2* 77.

¹⁴³ *KTE2* 512.

¹⁴⁴ Cohen admits that the “principles of reason” are regulative and do not have “the same determining validity” as the “principles of the understanding.” However, he goes on to say that regulating means, “determining by means of rules. Rules are not identical to laws [of objects of experience], but comparable to them” (*KTE2* 514). See also Edel, *Vernunftkritik zur Erkenntnislogik*, 489–92.

This may seem familiar to students of neo-Kantianism. However, in contrast to Cassirer, who favors the “regulative” over the constitutive, Cohen inversely considers regulative principles as constitutive as well.¹⁴⁵ And in contrast to Cohen’s later work, Cohen does not deny Kant’s typology of principles as a consequence of rejecting the distinction between sensibility and the understanding.¹⁴⁶ Rather, Cohen proposes that the so-called regulative principles may play a necessary part in defining the objects of science. Being present in experience or coherent with objects of (a Newtonian science of) experience ceases to be a criterion for a constitutive role.

If the Kantian ideas that contradict Newtonianism were constitutive of the objects required by science, then Newtonian physics would not provide the unitary framework for all scientific truth.

Having opened up this possibility, Cohen proceeds to show that the Kantian ideas are indeed constitutive and that, consequently, the validity of Newtonian mechanics is limited. Cohen makes two basic claims: (1) Many natural phenomena and their principles cannot be accounted for by Newtonian mechanics; (2) Newtonian physics is inherently self-contradictory, insofar as (2a) it presupposes other sciences that contradict it, and (2b) its methodology presupposes ideas like the unconditioned whose validity Newtonianism denies.

(1) Newtonian physics relies on abstraction and fails to capture the diversity of natural objects.¹⁴⁷ While “a mechanical theory of heat” unites physics and chemistry, it disregards the “difference between chemical elementary substances” and presupposes that substances can be analyzed in terms of their movements.¹⁴⁸ The very fact *that* the same natural objects are analyzed in different sciences cannot be accounted for.¹⁴⁹

(2a) “The forms of nature which carry out the movements, remain unexplainable, indeterminable, yes, indescribable.”¹⁵⁰ Newtonian scientists only know movements of abstract matter; they cannot apply their theorems or even describe the objects to which those theorems apply without relying on other sciences that contradict Newtonianism. Newtonian physics cannot establish any “complete object of nature.”¹⁵¹

(2b) Deducing is part of Newtonian mechanics and the very presupposition *that* the minor premise is contained in or implied by the major premise contradicts Newtonian principles.¹⁵² When making deductions or inductions, it is implied for Cohen that one could in principle continue to seek ever more implications and conditions, until one reaches the totality of all conditions or a first unconditioned ground. The notion of the unconditioned contradicts mechanical causality, and mechanical thought cannot explain orders of elements or their containment and implication; hence the methodology of Newtonian mechanics contradicts its own supposedly universal principles.

¹⁴⁵See Friedman, *Parting of the Ways*, 117.

¹⁴⁶See Massimo Ferrari, “Between Cassirer and Kuhn,” 22.

¹⁴⁷*KTE2* 19, 215.

¹⁴⁸*PIM* 31.

¹⁴⁹See Wolfgang Ritzel, “Ding-an-sich Theorie,” 180; see also *KTE2*, 58.

¹⁵⁰*KTE2* 215.

¹⁵¹*KTE2* 58.

¹⁵²*KTE2* 521–22.

It is questionable whether any of these worries can be problematic for Kant. But Kant's potential reply is beside the point for Cohen. Kant *ought* to have cared about the research practices of Newtonian scientists and the empirical objects to which their theories apply. One cannot observe and measure a movement without some entity that moves, and such an entity is often an organism, a chemical substance or another object, which functions according to principles that conflict with Newtonian mechanics.

A dependence on conflicting sciences would be less problematic if Cohen, like Kant, assumed an underlying yet hidden principle that makes all sciences coherent. Yet, he does not. For Cohen, the infinitesimal underlies all Kantian "principles of the understanding,"¹⁵³ but it is the "foundational notion of [Newtonian] mechanics,"¹⁵⁴ not for sciences like biology or chemistry.

On Cohen's reading, Newtonian mechanics is thus reductivist, self-contradictory, and not bolstered by any hidden principle or by the fact that it derives from a priori structures of thought. He concludes: "Mechanical experience has revealed itself as 'something completely accidental,' since its necessity is based on synthetic units, which are synthetic only in relation to mechanical experience itself."¹⁵⁵ Cohen references a passage from Kant's Doctrine of Method, which he discusses repeatedly. Kant argues that the mathematical method does not apply to philosophy, since the synthetic a priori judgments that philosophy discovers are not unconditionally true; rather, they are valid in "relation to possible experience," and, hence, dependent on this condition.¹⁵⁶ Notably, Cohen has changed Kant's expression "possible experience" to "mechanical experience," thereby highlighting his point that the basic laws of mechanics are not valid for all (human or finite) experience, but only for a very particular kind of scientific experience, namely, Newtonian physics. Newtonian mechanics "synthesizes" or constructs objects with the help of the categories and forms of intuition, and thereby produces the objects of *mechanics*. Only if one accepts the axioms of Newtonian mechanics and considers objects under this light are mechanical laws necessary and verifiable.

Cohen therefore concludes as follows. Sensible objects could only contribute to verifying scientific claims if one reached a "systematic" as opposed to a "synthetic" account of nature.¹⁵⁷ Only if one managed to unite all observable aspects of nature and all sciences in one coherent system would it become vacuous to claim that what is true according to this all-encompassing system is still false on some other hypothetical basis. Cohen calls this safe foundation of truth "the thing-in-itself as the systematic idea."¹⁵⁸ Cohen's reconception of the thing-in-itself is complex, but his aim is to pay attention to a "deeper need for realism" and to combat the subjectivism of a Kantian theory whereupon all natural scientific truth is only "founded in the cognizing spirit and virtually accidental."¹⁵⁹ The term 'thing-in-

¹⁵³ *KTE2* xii.

¹⁵⁴ *PIM* 48.

¹⁵⁵ *KTE2* 511; see also 573.

¹⁵⁶ A 737/B 765.

¹⁵⁷ *KTE2* 511.

¹⁵⁸ *KTE2* 509.

¹⁵⁹ Cohen, *Kants Begründung der Ethik*, 30, my translation; *KTE2* 502. See also Holzhey, "Empirische und intelligible Zufälligkeit."

itself' indicates that the system of nature is the only candidate that could possibly provide a safe and objective ground for universal truth claims—which, in a naïve correspondence theory of truth, would have been the role of mind-independent reality. The system of all sciences could stand in for the theory-independent standard that the sensible objects of Newtonian physics cannot provide—and, hence, serve to corroborate scientific theories.

Unlike Kant, who tried to “bridge the gap” between Newtonian and other sciences in his opus postumum,¹⁶⁰ Cohen supposes that neither Newtonianism nor competing sciences can be taken as unproblematic starting points (whereupon merely the “gap” between them becomes a problem). Rather, Cohen proposes that establishing a system of nature requires “the task of limiting [the claims of Newtonian science].”¹⁶¹ “After the objects of experience are constituted as synthetic units with the help of mechanics, [mechanical] experience itself must be made the object [of inquiry].”¹⁶² One needs to examine Newtonian mechanics so as to detect internal contradictions as well as aspects and questions that mechanical experience necessarily excludes, and ask whether these gaps can be filled with the help of other sciences. The system of all sciences is a “boundary concept” for Cohen, in the sense that it serves to delineate and partially transcend the boundaries of mechanical experience.¹⁶³

Cohen contradicts Kant's dictum that the idea of a system is a “subjective law of economy.”¹⁶⁴ The system of nature is “constitutive of experience itself,” as Horstmann puts it, as it is “necessary for experience . . . on non-empirical grounds.”¹⁶⁵ Horstmann does not mention that Cohen goes beyond the realm of Newtonian science. Nevertheless, Horstmann is right that the system is constitutive, for Cohen, not in the sense that it is necessarily instantiated in experience (which it is not), but insofar as scientific knowledge requires an objective and safe guarantor of its universal truth claims, which only an actual system of all natural sciences, a “final theory” of nature, can provide.¹⁶⁶

While this is a consistent argument, Cohen partly undercuts it, as he agrees with Kant that a coherent system of nature is neither an actual, existing entity, nor something that can even be attained.¹⁶⁷ Rather, the system remains an infinite task for science.¹⁶⁸ It is a boundary concept also in the sense that the final theory of nature is “never to be obtained.”¹⁶⁹ This is problematic, because on Cohen's own reasoning it is not the notion of coherence as such, but only an actual and complete system of all natural sciences that serves as the guarantor of universal truth claims. Cohen thus proposes that scientific and universal claims to truth require something that science cannot and will never be able to provide.

¹⁶⁰See Friedman, *Kant and the Exact Sciences*.

¹⁶¹*KTE2* 520.

¹⁶²*KTE2* 493.

¹⁶³*KTE2* 512, 493.

¹⁶⁴*KTE2* 525.

¹⁶⁵Rolf-Peter Horstmann, “Transcendental Aesthetic,” 133.

¹⁶⁶Stang, “Concept of Experience,” 37.

¹⁶⁷*KTE2* 505, 527.

¹⁶⁸*KTE2* 502.

¹⁶⁹Stang, “Concept of Experience,” 37.

CONCLUSION

As this article has shown, Hermann Cohen's discussion of 1885 has much to say about Kant's oeuvre and the assumptions that both Kant and scientists make about science's empirical side.

In terms of Kant scholarship, it is clear that many have worried about his seemingly dogmatic claim to have found all categories or fundamental forms of thought. But few have been as thorough as Cohen in exploring the problematic implications this has for Kant's entire system, in particular for his conception of science. Fewer still have attempted such a thoroughly idealist, but (arguably still) Kantian, reconception of sensibility by specifying and limiting Kant's claims about the intensity of perception. And Cohen's argument about the Kantian ideas and the independent standing of empirical sciences is unique.

Nevertheless, this article has sought to demonstrate that the highlight of Cohen's 1885 work is his discussion of empirical "tools and ways of knowing" in order to explain their "validity."¹⁷⁰ Cohen investigates the presuppositions about sensations and empirical sciences that are implicit or explicit in natural science, alongside Kant's (implicit) assumptions about the sensible elements of science.

When Cohen discusses what makes empirical observation possible, he reaches a partly positive result. Sensible objects can present cases of a Newtonian theory of motion because of the intensity of their qualities. However, Cohen then goes on to suggest, against Kant, that considering intensity as a characteristic of sensible objects is a result, rather than a precondition, of Newtonian physics. If, indeed, the intensity of sensible qualities were invented to enable the application of Newtonian physics, then intensity is likely to be merely a feature of sensed objects within this particular science—rather than a shared aspect of all sciences. Hence, on Cohen's reading, the universal status of Newtonian physics seems less plausible than on Kant's account.

This leads to the second assumption that Cohen investigates, namely, the universal status of Newtonian physics. Cohen starts his discussion of this second assumption by criticizing Kant for excluding certain principles as 'ideas' from the realm of the constitutive features of natural objects. Kant's reasons for doing this are dogmatic and part of his problematic subjectivism, Cohen argues. Rather than simply denying the objective validity of all principles that contradict Newtonianism (which already presupposes that Newtonian physics is universally valid), one ought to investigate whether those competing principles may also have a foundational role and Newtonian physics may not be the general physics underlying all other sciences. For Cohen, there are many indications to this effect (Newtonian physics both presupposes or requires other sciences and fails to explain or even to make conceivable many aspects of natural objects).

The question then becomes: what else could ensure universally valid claims about nature if Newtonian physics cannot do so? Cohen argues that only a system of all sciences could possibly fulfill this role. If something is true according to an actual, complete, and coherent system of nature and all natural sciences, one can

¹⁷⁰Cohen, "Biographisches Vorwort," x.

only claim that it is false on some other grounds that fall outside the realm of natural science, but it is generally true in terms of a scientific account of nature. The problem is that, while necessary for enabling universally valid claims, such a complete system is unattainable on Cohen's own account.

In 1885, Cohen concludes that, while sensations and empirical sciences indicate valid demands, these demands cannot be met by means of the empirical methods or by means of the assumptions about empirical sciences suggested by scientists. It is correct to assume that, since all sciences are about nature, it ought to be possible to make them cohere with one another, which would entail not only a complete system of nature, but also the universal validity of scientific claims. In his *Logic of Pure Cognition*, Cohen proposes a different, namely, top-down, strategy to reach these goals: a purely logical foundation of truth in the form of a first "principle of origin," from which all concepts and their validity derive.¹⁷¹ Other neo-Kantians like Cassirer propose general notions like coherence or (mathematical) systematic structures and functions as guarantors of truth, rather than demanding an actual coherent system of all natural sciences.

Furthermore, empiricists and empirical scientists are right to point out that science requires particular (given) objects to which scientific theories apply, and which have a certain independence from those theories so as to be able to provide an indication that the theory may be false or flawed. In his *Logic of Pure Cognition*, Cohen admits that the "singular" is the "hardest problem of logic,"¹⁷² and Zeidler notes that Cohen implicitly pays tribute to empirical realism in framing this issue.¹⁷³ Fittingly, the neo-Kantian Rickert also discusses the problem of the singular in *The Object of Cognition*.

In this negative way, namely, as a problem, sensations thus remain a major issue for Cohen and other idealist neo-Kantians. Holzhey has pointed this out, yet without detailing the origin or original problem that Cohen would later address in other contexts.¹⁷⁴ The present article fills this lacuna.¹⁷⁵

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¹⁷¹See Flach, "Cohens Ursprungsdenken."

¹⁷²Cohen, *Logik der reinen Erkenntnis*, 507; see also 144.

¹⁷³Kurt Walter Zeidler, "Problem des Einzelnen," 189.

¹⁷⁴Holzhey, *Cohen und Naturp.*, 307.

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