



German supporters of the Kantian philosophy in the late nineteenth century took one of two forks in the road: the fork leading to Baden, and the Southwest School of neo-Kantian philosophy, and the fork leading to Marburg, and the Marburg School, founded by Hermann Cohen. Between 1876, when he first came to Marburg, and 1918, the year of his death, Cohen, with his so-called “Marburg School,” had a profound influence on German academia.<sup>1</sup> Philosophers such as J. Alberto Coffa, Michael Friedman, and Alan Richardson have revived interest in the historical importance of the neo-Kantian movements in the philosophy of science.<sup>2</sup> Recent scholarship by Don Howard, Thomas Ryckman, and Jamie Tappenden, among others, examines the role of neo-Kantian theory in specific contexts such as the background to the development of relativity theory and the philosophy of Gottlob Frege.<sup>3</sup> Our understanding of neo-Kantian thought would profit from a more comprehensive account of the philosophical context of the late nineteenth century. Nearly forgotten debates that were seminal to the development of neo-Kantian movements, such as the Trendelenburg–Fischer debate, can tell us a great deal about the philosophical agendas of thinkers such as Hermann von Helmholtz and Hermann Cohen – and, of course, of lesser known philosophers such as Adolf Trendelenburg and Kuno Fischer. As I will argue, Cohen’s contributions to the debate shed light on the implications of the turn “back to Kant” for nineteenth-century German philosophy of science.

Klaus Köhnke has observed that just as the two streets in Berlin – Trendelenburgstraße and Fischerstraße – lead in different directions to the Neue Kantstraße, so the debate in the 1860s between Adolf Trendelenburg, who was a

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profound influence on the Marburg School, and Kuno Fischer, who arguably founded the Southwest School, bifurcated the neo-Kantian movement.<sup>4</sup> The Trendelenburg–Fischer debate has profound resonance even now. The main question of the debate, concerning the interpretation of Kant’s Transcendental Aesthetic, remains crucial to Kant scholarship. Recently, it has even been argued that the difference between the Southwest School and the more strictly Kantian Marburg School is part of the prehistory of the modern distinction between so-called “analytic” and “continental” philosophy.<sup>5</sup> One source of Hermann Cohen’s enduring importance as a philosopher is his decisive intervention in the debate.<sup>6</sup> In his responses to Trendelenburg and Fischer, Cohen forged a distinctive neo-Kantian

approach that was to be a formative influence on the nascent relationship between Kantianism and modern philosophy of science.

### I the new epigone: hermann von helmholtz and kant

The immediate context for Cohen's early work was mid-nineteenth-century Berlin, where he attended Friedrich-Wilhelms-Universität (now Universität Humboldt) and was immersed in philosophical and scientific upheavals that had a decisive impact on the development of his thought.<sup>7</sup> Hermann von Helmholtz's renewal of the Kantian project in philosophy and his systems of physics and of the physiology of perception revived philosophical attempts to give a foundational treatment of the advances in physics and in mechanics since Newton.<sup>8</sup> By the end of the nineteenth century, however, it had become clear that Helmholtz's earlier program could not be adopted without revision – something that Helmholtz himself saw quite clearly. Advances in thermodynamics and electrodynamics, especially the discovery of the law of conservation of energy by Robert Mayer, James Joule and Sadi Carnot (and its later rigorous formulation by Helmholtz himself), and Maxwell's formulation of the field equations for electromagnetism, called into question the basic assumptions of classical mechanics. The subsequent debates over the approach philosophy should take spurred philosophers to consider what it meant to have a Kantian philosophy of physics. If Newtonian physics could be challenged so fundamentally, it became difficult to see how the Kantian project of determining the necessary and sufficient conditions for a system of physical laws could survive without revision.

Debate centered on the question of the relation between geometry and physics. Helmholtz's and Bernhard Riemann's groundbreaking results in geometrical topology were published in the same year, 1868.<sup>9</sup> Both argued that determinations of the spatio-temporal metric could yield results in the foundations of physical theory, and indeed their work contributed materially to the development of metric theory.<sup>10</sup> Helmholtz's work pointed the way toward a neo-Kantian theory of the synthetic a priori according to which

mathematical determinations of the metric are necessary conditions for physical theories.

While Helmholtz considered himself to be a Kantian, an influential stream of subsequent scholarship has focused on the aspects of Helmholtz's theories that could not be reconciled with Kantian doctrine. In *The Semantic Tradition from Kant to Carnap*, J. Alberto Coffa goes as far as to say:

Revealingly, the cleverest among neo-Kantians silently pushed Kant's pure intuition to a corner of their doctrine of geometry; what they offered as the *truly* Kantian theory of geometry suspiciously resembled one of Helmholtz's central contributions to that field. By the end of the century, the neo-Kantians' writings on this topic had become an unwitting testimony to the fact that geometry called for a ground entirely different from the one Kant had envisaged. In conjunction with the rigorization of the calculus and with what Frege would soon be doing to arithmetic, these episodes converged to establish what Bolzano had claimed in 1810: that Kant's pure intuition plays no role whatsoever in mathematics.<sup>11</sup>

I will address the question of Kant's doctrine of pure intuition in section II. First, though, there are two reasons why Coffa is wrong about Helmholtz's relation to the neo-Kantian movement in general. The first is that Helmholtz, as I have said, considered himself a Kantian, and was considered so by the paradigmatic historians of nineteenth-century philosophy. It would be a hollow exercise for Coffa to argue that Helmholtz's own theory of geometry "suspiciously resembled one of Helmholtz's central contributions to that field." The difference between Helmholtz and subsequent neo-Kantians such as Cohen comes from deeper, programmatic commitments. Accordingly, the second reason has to do with the content of Helmholtz's Kantianism, which was by no means limited to his (certainly extraordinary) advances in geometry. Helmholtz began as an empirical scientist, making progress in an array of sciences almost unthinkable today, including the physiology of perception, acoustics, and electromagnetism (he was Heinrich Hertz's doctoral supervisor). Helmholtz's approach to the

problem of determining the a priori depends on his argument that “physical geometry,” or the geometry of physics, is limited to that which we can actually perceive, and thus is constrained by the physiology of perception.<sup>12</sup> Helmholtz misinterprets Kant’s a priori, in particular the “pure intuitions” of space and time, as the necessary and sufficient conditions for a human being to physically represent an object. For example, Helmholtz argues that there *can be* no surface of more than three dimensions, because we cannot encounter such a surface physically.<sup>13</sup>

There is a serious problem with such an interpretation of Kant. On Helmholtz’s reading, the *physical* conditions for human beings to encounter an object not only constrain our possible experience of objects but also limit the class of objects that can be proven to exist. This conclusion has disturbing ramifications for mathematical reasoning especially. According to Helmholtz’s physiological account of the a priori, Kant has ruled out any mathematical construction that cannot be encountered by beings *physically* like us – beings with binocular vision, for instance.

The Trendelenburg–Fischer debate will throw these elements of Helmholtz’s reading of Kant into sharp relief. Adolf Trendelenburg, whose *Logische Untersuchungen* was the catalyst for the debate, was following Helmholtz’s rubric of Kant-interpretation.<sup>14</sup> Trendelenburg treats Helmholtz’s interpretation of the a priori as Kant’s own. In Cohen’s resolution of the debate, as I will show, Helmholtz plays the role of new “epigone.” In 1865, Otto Liebmann published *Kant und die Epigonen*, in which he argued that Kant scholarship was prejudiced by Kant’s “epigones.” Liebmann’s epigones, German Idealists, interpret Kant without showing where they depart from his original doctrine. Each of the chapters of *Kant und die Epigonen* ends with the cry “*Also muß zur Kant zurückgegangen werden!*” (“Thus we must go back to Kant!”) Cohen is the architect of one of the most influential movements “back to Kant,” that is, a *neo-Kantian* movement. Cohen inaugurated this movement by extricating Kant from Helmholtz’s interpretation. Cohen’s response to the debate, most persuasively put forward in his 1871 *Kant’s Theory of Experience* (originally *Kants Theorie der*

*Erfahrung*; hereafter cited as KTE), steers a middle course between Trendelenburg’s rejection of Kantian transcendental idealism and what Cohen sees as Fischer’s reversion to a dogmatic metaphysics. Cohen sees his solution as inspired by Kant’s own words, the words of a “genius” who had saved philosophy from the Scylla of skepticism and the Charybdis of metaphysical dogmatism. Thus, Cohen’s response to the Trendelenburg–Fischer debate self-consciously echoes Kant’s responses to Hume and Leibniz in the *Critique of Pure Reason*.

## II cohen’s move “back to kant”

Cohen’s intervention in the Trendelenburg–Fischer debate was decisive, because he realized that Kant himself, the Kant of the *Critiques*, could be read as reasonably in accord with Adolf Trendelenburg’s views. Trendelenburg tried to correct a “Kantian” doctrine, but what he actually modified was Helmholtz’s misreading of Kant. Kuno Fischer leapt to Kant’s rescue, but in so doing he only further distorted Kantian doctrine.

Trendelenburg, a prominent neo-Aristotelian philosopher, recognized clearly the many problems engendered by Helmholtz’s reading of Kant – though he treated the reading as an accurate depiction of Kant himself.<sup>15</sup> In his *Logische Untersuchungen*, Trendelenburg observes that rather than arguing, as Helmholtz does, that the objects of a possible experience are limited by our physical constitution, Kantian philosophers should accept the fact that Kant’s proof in the *Transcendental Aesthetic* that space and time are merely (*bloß*) subjective, or phenomenal, is incomplete. Trendelenburg argues, against Helmholtz’s Kant, that space and time need not be considered as a priori forms of our sensibility. So while Helmholtz’s Kant limited the validity of space and time to those objects that could be presented physically, Trendelenburg argues that Kant’s “object of a possible intuition” should be changed to “object of a possible thought.” Then, Trendelenburg claims, the *Transcendental Aesthetic* must be revised, because in that case Kant would not have ruled out the possibility that space and time could be properties of things in themselves in Kant’s sense.

Trendelenburg's arguments set him at odds with Kuno Fischer, a Hegelian philosopher.<sup>16</sup> According to Fischer, Kant argues for the correct position, namely that space and time, as pure intuitions, must condition our physical representations of objects. Thus, Fischer claims, Kant's position does lead to the conclusion that objects of cognition are mere phenomena and not things in themselves. Fischer concedes to Trendelenburg that Kant's arguments in the first *Critique* do not necessarily *justify* this conclusion. However, Fischer thinks himself justified in "reconstructing" Kant's theory in order to save it. Fischer claims that Kant's doctrine requires us to begin with pure intuitions of space and time, and then to apply the categories (such as substance, as something that persists in space through time) to these intuitions (Fischer §8). However, Cohen concludes that, while Fischer's goal of distinguishing between space and time and the categories is worthy, Fischer's actual arguments conflate the two unnecessarily (Cohen 1928 [1871], 239).

Cohen enters the debate in 1871 with two linked publications: the first edition of KTE, and an essay called "On the Trendelenburg–Fischer Debate." In his discussion of the debate in these two publications, Cohen is concerned to do two things. First, he wants to preserve textual accuracy in Kant-interpretation, that is, to save it from Fischer's "reconstruction." Second, Cohen wants to revise that doctrine, in a self-conscious way, to address the genuine difficulties he sees with certain key elements of Kantian doctrine.

According to Cohen's account, Trendelenburg observes correctly that Kant does not allow for space and time to be derived from experience. However, Trendelenburg goes on to object that the mere fact that space and time are not derived from experience need not mean that they are only modifications of our sensibility prior to any experience (Cohen 1928 [1871], 234). For Cohen, the crux of the Trendelenburg–Fischer debate is the status of space and time as a priori intuitions, and as sources of knowledge: the "certain determination of the *a priori*" (Cohen 1928 [1871], 236). Cohen argues that neither Trendelenburg nor Fischer has the correct interpretation of Kant's dictum that space and time, as forms of intuition, are forms of *sensibility*.<sup>17</sup> He leaves the resolution

of this interpretive issue to the first edition of his KTE (1871). In that work, Cohen will argue that the goal for a neo-Kantian epistemology should be to distinguish "representation [*Vorstellung*]," as a psychological or physiological phenomenon, from "intuition [*Anschauung*]" as a necessary condition for determining an object a priori. Thus at the same time, Cohen rules out Trendelenburg's account of "sensibility [*Sinnlichkeit*]" as representational, and Fischer's "conflation" of space and time, as forms of sensibility, with the categories, as laws of the understanding.<sup>18</sup>

As he sees it, Cohen has to steer between two cliffs: on the one hand, Trendelenburg's assault on Kantian doctrine, and on the other, Fischer's unwarranted revisions to that doctrine. Cohen sees himself, especially in KTE, as returning to the real Kant, as revealed in the critical texts. It is clear, though, that Cohen has his own systematic aims, and that these often do not cleave to the letter of Kant's text. How, then, are we to build a bridge between Cohen's rescue of Kant and his own philosophy of science?

I see the link between the earlier and later texts in Cohen's interpretation of Kant's doctrine of intuition. Cohen argues that we can – and, indeed, must – interpret "intuition" in such a way that it is understood as a source of knowledge rather than as a kind of physical representation. This is how Cohen avoids what he sees as the "psychologistic" and "physiological" traps into which Trendelenburg and Helmholtz have fallen. However, in that case it is unclear whether Cohen is still dealing with a kind of *intuition* at all. One might question whether or not Cohen is still within even the spirit, much less the letter, of Kantian doctrine. Helmut Holzhey argues that, in fact, a basic innovation of the Marburg School is the rejection of the distinction between intuition and thought, or even between subject and object. Natorp and Cohen, Holzhey observes, focus on the relation between *knowledge* and its object.<sup>19</sup> We could conclude on this basis that the early Marburg School made a decisive break with Kantian doctrine, partly as a result of Trendelenburg's criticisms.

We can reduce this worry to a particular problem for Cohen-interpretation. How are we to understand the difference between the Cohen of

KTE, who argues that Kant is a “genius” whose exact wording is to be followed reverently, and the later Cohen, who argues that he can be Kantian and re-interpret the doctrine of intuition? The first way to answer this question is to point out that the targets of Cohen’s fulminations in KTE were Fischer and Trendelenburg. Fischer, according to Cohen, had gone much too far in his emendations to Kant, whereas Trendelenburg had misunderstood Kant. However, we are still left with the fact that Cohen *himself* tinkers with Kantian notions.

To determine how Cohen could have reconciled these changes with his Kantian conscience, we can look at the writings that bridge the early and later periods of Cohen’s work, in particular, *The Principle of the Infinitesimal Method and its History* of 1883 (originally *Das Prinzip der Infinitesimalmethode und seine Geschichte*; hereafter cited as PIM). In PIM, Cohen observes that Kant’s views on intuition are indeterminate, and he gives an historical justification. First, he argues, the definitions of certain terms, such as “schematism” or “intuition,” have been used inappropriately by Kant’s “epigones.” Cohen argues that, while philosophers like Helmholtz and Herbart have used these Kantian terms, nonetheless, “since we continue to distance ourselves here from the exact terminology of the Kantian school, we must search for a more exact definition of these expressions that modern scientific language has received from Kant” (PIM §22; my translation).<sup>20</sup> Cohen focuses in particular on the Kantian concept of intuition:

This new definition is needed because certain terms belonging to a systematic doctrine are detached from it and enter into a general usage that wavers from author to author, and often in the same author. This fate certainly befell the Kantian basic concept of intuition, and of course not without the guilt of its author. Whoever forges a new concept is never able to represent the manifold distinctions of the concept unambiguously, in their complete and full clarity; in this connection they remain (and should remain) intertwined. (PIM §§ 22–23; my translation)

Here, Cohen argues that Kant’s use of the term “intuition” “wavers,” even in Kant’s own writings: Kant is unable to “represent [...] the manifold distinctions of the concept unambiguously.” At the end of this passage, then, Cohen is making a claim about Kant’s actual use of the term. Earlier in the passage, though, Cohen ventures an interesting hypothesis about *why* Kant’s “general” use of the term is ambiguous. It is easy to discuss the concept of intuition in general terms, because intuition, like many other terms, has been “detached” from the scientific sense in which it was originally discussed, and has subsequently “entered into a general usage that wavers from author to author, and often in the same author.” Here Cohen is making an unusual point, and one that is rarely appreciated. He is arguing that Kant had a very specific purpose for his use of the term “intuition,” namely to back up his justification of certain scientific doctrines. Subsequently, Cohen argues, the term was taken out of its specific context and made into a general technical term (describing the physiology of perception, for instance), which was not Kant’s original intention.

Rather, Cohen observes, when Kant uses the term “intuition” purely philosophically, he uses it in a much more particular sense. By freeing Kant’s term “intuition” from its historical context, Cohen allows himself the liberty of constructing another meaning for the term. Even in KTE, Cohen emphasizes that the new meaning plays exactly the same role in Kant’s system as Kant’s original term:

Kant calls the science of all *principles of sensibility* [*Prinzipien der Sinnlichkeit*], which he founded, *Transcendental Aesthetic*. Above all, we ask: What does Kant mean by sensibility? In Kantian doctrine, sensibility is a source of knowledge [*Quelle des Erkennens*] [...] Kant does not begin with sensibility as a principle from which he derives his psychology; instead, he begins from the processes themselves, if one is permitted to use this word [*Prozess*] in an entirely general sense. Here, “process” means only the activity of knowing [*die Thätigkeit des Erkennens*]. Kant begins with this, not from an organ. All knowledge is related to *objects*. That knowledge is called

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intuition [*Anschauung*], which is related to objects *immediately*. (KTE 15; my translation)

Here, Cohen removes the term “sensibility” (*Sinnlichkeit*) from its association with physical sense organs – in other words from Helmholtz’s account of sensibility. As Cohen observes, Kant himself does not associate sensibility with the physiology of sense. As a result, Cohen considers himself free to consider “intuition” (*Anschauung*) only in its role as a “source of knowledge” (*Quelle des Erkennens*) in Kant’s system.

Cohen’s rejection of the physiological and psychological accounts of pure intuition is the most attractive feature of his system to analytic philosophers such as Frege, who singled out this aspect of Cohen’s work in a review of *The Principle of the Infinitesimal Method*. However, Cohen is still constructing a neo-Kantian system based on the Kantian a priori. Indeed, Cohen considers himself to be a more faithful Kantian than Trendelenburg or Helmholtz. How, then, are we to understand Cohen’s later philosophy of science in terms of this early debate?

### III cohen’s mature account of intuition: scientific fact and theory

As Coffa argues, the doctrine of pure intuition seems to pose grave problems for a Kantian theory of science. To take a common example from the Introduction to the *Critique of Pure Reason*, Kant claims that the “justification” for the judgment that  $7 + 5 = 12$  is based on intuition. Here, much to the dismay of those familiar with Frege, Kant appeals to counting on one’s fingers as the source of the intuition in support of the process of addition (Kant 15–16). Most of the post-Fregean, post-*Principia* philosophy of mathematics that followed Cohen will reject such a claim out of hand, in favor of the idea that logic is the sole foundation for mathematics. However, the specific logicist theory to which Cohen responds in KTE is Adolf Trendelenburg’s. By recasting Kant’s account of intuition in response to Trendelenburg’s criticisms, Cohen intends to allow space for an expansion to (not a revision of) Kant’s system that will track changes in the way intuition is interpreted by successive scientific

theories. Cohen’s task is to show that Kant does not rule out such changes.

Trendelenburg claims that “ $7 + 5 = 12$  is certainly an analytic judgment, *insofar as* [when we] assume base 10, the *sum*  $7 + 5$  grounds the number 12” (LU 2nd ed., 241; my translation). To recall Kant’s definition, an analytic judgment is one that does not extend a concept. So, for instance, if we were to define 12 as  $7 + 5$  in a given language, in the same way that we define a bachelor as an unmarried man, the specific judgment  $7 + 5 = 12$  would be analytic. Trendelenburg argues that mathematics works in just that way: if we presuppose a certain mathematical system such as base 10, the propositions of mathematics expressed in that language are true by definition.

In KTE, Cohen points out that Kant makes his argument (that  $7 + 5 = 12$  is synthetic) in the context of making the distinction between analytic and synthetic judgments in general (KTE 203). Kant’s argument is meant to show that, when we are making the particular judgment that  $7 + 5 = 12$ , we cannot do so without appealing to some “synthesis of intuition.” That is, Cohen observes, we cannot do so without showing that the concepts appealed to can be the object of a possible experience: “All propositions that are to be valid of objects of experience are synthetic, therefore they must contain a connection between the schematized categories and intuition” (KTE 204; my translation). Here, Cohen makes the distinction between “propositions that are to be valid of objects of a possible experience” and those that are not. Insofar as a proposition is meant to be valid of objects of a possible experience, it is not a proposition of “pure” mathematics, but rather assumes some relationship between mathematics and intuition – where, as we have seen, intuition is simply another “source of cognition” (*Quelle des Erkennens*). For Cohen, the objects “given” in intuition are simply the facts established by the empirical sciences. Cohen recasts the fundamental relationship between intuition and thought, then, as the relationship between pure mathematics and physics.

Cohen’s orientation toward mathematical physics is characteristic of his approach to the

foundations of science. Cohen's mature philosophy of science recommends that a priori reasoning should be more and more grounded in scientific fact, even scientific fact that has been established empirically, as the "given" to which concepts should refer. The ultimate goal, for Cohen, is the unity of fact and thought, a unity that should be considered a regulative ideal in Kant's sense. Cohen replaces the opposition between (subjective) phenomena and (objective) things in themselves with the opposition between our scientific knowledge and the object of that knowledge.

Cohen devoted his career in the history and philosophy of science to rethinking the relationship between mathematics and scientific theories. From the time of the Trendelenburg–Fischer debate, Cohen was dedicated to the idea that mathematics is a science of *sui generis* reasoning that can legislate for itself, according to the laws of thought. The practice of mathematics must not be constrained by any physical limitation of perception, but only by the most general relationship between the laws of thought and the empirical facts of science, the "given."

Cohen's history and philosophy of science began with his formulation of a neo-Kantian epistemology. This epistemology has two features. Cohen takes scientific facts as the subject matter for epistemology. These facts are "given," or available to us, through the medium of scientific theories. According to Cohen, giving a justification for scientific facts depends on reconstructing and analyzing the theories that reveal those facts.

Cohen was most preoccupied with the transition from mathematical construction to scientific theories. He was interested in showing how mathematical ideas can be realized. That project will require, at least, an account of how mathematical principles can be identified as one of the steps necessary to construct a scientific theory.

In the course of this project, Cohen was led to rethink the distinction between pure and applied mathematics. From the standpoint of epistemology, Cohen thinks, there is no principled distinction between the two. "Pure" mathematics can be used as the foundation of a theory of natural science. According to Cohen, there is no reason to argue that pure mathematics thereby becomes

"applied." Instead, Cohen thinks of mathematics as a way of constructing fundamental principles, which legislate the law-like relations between elements of a theory. These elements might include the basic concepts and notions of the theory. Cohen argues that, in view of the fundamental role of mathematics in grounding our knowledge of facts, all mathematics should be called "free" rather than either "pure" or "applied." As he remarks in the conclusion to PIM:

That which is conceived by pure mathematics is nonetheless *applicable*, because pure [mathematics] is only that which is capable of being applied under given conditions. But, certainly, pure [mathematics] is not preoccupied with the fact that these conditions are given. That is why the qualification that specifies mathematics as *free* seems relevant.<sup>21</sup>

Cohen believes that philosophy can contribute to science by rigorously pursuing ever more general, and ideally universal, concepts and principles with which to express the scientific facts of which we are in possession. "Free" mathematical reasoning is not chained to a particular set of physiological facts. Rather, mathematical reasoning is restricted only by the set of conditions necessary to apply it to the objects of a possible experience.

Cohen's version of the neo-Kantian turn "back to Kant" takes the relationship between philosophy and science to be the central problem of epistemology. That problem took a particular form at the time that Cohen was working. The natural sciences made stunning progress and, more fatefully for philosophy, a significant number of the empirical scientists who were instrumental in that progress were also philosophers. The goals and methods of philosophy increasingly came to be identified with those of the sciences. One of Cohen's real contributions to the philosophy of science is his argument that philosophy can help to realize the "ideal goals" of the sciences. That is, Cohen argued that the purposes of philosophy and science can be identical without philosophy having to abandon the idealist position in favor of materialism, empiricism or "psychologism."

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Cohen's interpretation of, and radical revisions to, Kantian doctrine allowed him to develop an epistemology that, ideally, would not require speculation beyond the "facts of science." Cohen argued that the best way to pursue his goal of taking philosophy as a complement to the sciences is to develop a method for the philosophy of science that takes as its evidence the facts established by scientific theories.



### notes

Much of the background work for this paper was undertaken at McGill University. In Montreal, I benefited greatly from discussions about the Trendelenburg–Fischer debate with Brian van den Broek, Emily Carson, Raymond Klibansky, Alison Laywine, Stephen Menn, and Claude Piché. Don Howard and Damian Veal gave very productive factual and philosophical comments on a penultimate draft of the paper. The subject and much of the content of this paper was suggested to me by comments from Jamie Tappenden and Alan Richardson on my dissertation (of course I remain the source of all errors of fact and of reason in the paper). I would like to thank Alex Barber, Dan Breazeale, Don Howard, Rene Jagnow, Alan Kim, Michael Hallett, Ulrich Sieg, and Jamie Tappenden for their consistent help and encouragement with my work on the neo-Kantians and on Kantian philosophy.

1 For a general account of this influence, see Überweg §40, 446f. Cohen's students included August Stadler, Albert Görland, and the philosopher of law Rudolf Stammler. Überweg traces the influence of the Marburg School in the early thought of Kurt Sternberg, Erwin Schneider, the Hegelian Berthold Kern, and even Hans Reichenbach (Überweg 447–48). [Editor's note: further details of the extent of the Marburg School's influence can be found in the Editorial Introduction to this issue of *Angelaki*.]

2 See Coffa, Friedman (1992, 2000, 2001), and Richardson (1998, 2003), as well as Michael Friedman's article in this issue.

3 Howard examines the role of Ernst Cassirer, a student of Cohen's, in the philosophical reaction to nascent relativity theory. Ryckman looks at Ernst Cassirer's interpretations of relativity,

and briefly discusses Cohen as well. Jamie Tappenden's forthcoming book *A Reassessment of the Mathematical Roots of Frege's Logicism* also takes the nineteenth-century neo-Kantian background into account.

4 Köhnke (1986, 261; 1991, 170).

5 See, for example, Friedman (2000).

6 See Holzhey (1972, 48).

7 For a thorough and well-researched account of Cohen's early years in Berlin, see Sieg.

8 For recent evaluations of Helmholtz's influence on nineteenth-century physics, see the works by Cahan and by Purrington. For an account of Helmholtz's influence on nineteenth-century neo-Kantianism, see the first chapter of Friedman (2001), as well as Friedman's article in this issue.

9 See Helmholtz (1868) and Riemann for the original essays.

10 Riemann's work was the origin of manifold theory, and both Helmholtz and Riemann were instrumental in the development of group theory. Both were important sources for Felix Klein's seminal Erlangen address (the "Erlangen Programm").

11 Coffa 43.

12 Helmholtz's theory linking physical geometry to the physiology of perception helped to inspire the influential "psychophysical" theories of Wilhelm Wundt (a pupil of Helmholtz's) and Gustav Theodor Fechner. For an excellent account of the development of Fechner's theory, see Heidelberger.

13 See Helmholtz (1971 [1878], 377).

14 All citations from the *Logische Untersuchungen* are from the second expanded edition (Leipzig: Hirzel, 1862).

15 Adolf Trendelenburg was a professor in Berlin at Friedrich-Wilhelms-Universität, now Universität Humboldt. He is now nearly forgotten in anglophone philosophical circles, but at the time was a renowned philosopher who influenced German thinkers as diverse as Franz Brentano, Edmund Husserl, Franz Rosenzweig, Cohen himself, Eugen Dühring, Rudolf Eucken, Friedrich Überweg, and Friedrich Paulsen (see Köhnke 1986, chapter I). In his most

ambitious work, the *Logische Untersuchungen*, Trendelenburg argues that the problem of philosophy in general is to show the relation between particular facts and universal principles.

16 Fischer was a professor at Jena for most of his career. In 1860, he published two major works on Kant: *Kants Leben und die Grundlagen seiner Lehre*, and two volumes on Kant in his *Geschichte der neuern Philosophie*. His other major publications include the *System der Logik und Metaphysik*. Fischer is often counted as the founder of the Southwest (or Baden, or Heidelberg) School of neo-Kantianism, which would go on to include Wilhelm Windelband, Emil Lask, and Heinrich Rickert, among others. Fischer was also influenced deeply by Hegel's approach to philosophy. In fact, the example of Fischer shows how little the judgment that the neo-Kantians in general were rabidly anti-Hegelian can hold up under scrutiny.

17 There has been a contemporary debate among Kant scholars about whether space, for Kant himself, is a concept or an intuition. For the details of this discussion see, for example, Carson; a response to the account is in Friedman (1992).

18 See, for example, Cohen (1928 [1871], 246).

19 For this view, see Holzhey (1979).

20 See, for example, Cassirer:

True, from his metaphysical heights Schopenhauer looked down genteelly on the "men of the crucible and of the alembic," but nonetheless in his epistemology he used, utterly naively and without critical scrutiny, the language that natural science, and in particular physiology, had constructed. In fact, *Helmholtz* made this language incomparably sharper and more precise; but even he used it far beyond the limits within which it is valid in a strict sense, and within which alone it possesses a real meaning beyond the metaphorical. (Cassirer, this issue, 96)

21 PIM §91; my translation.

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