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Hermann Cohen's  
*Das Prinzip der  
Infinitesimalmethode*,  
Ernst Cassirer, and the  
Politics of Science in  
Wilhelmine Germany

Gregory B. Moynahan  
*Bard College*

*Few texts summarize and at the same time compound the challenges of their author's philosophy so sharply as Hermann Cohen's *Das Prinzip der Infinitesimalmethode und seine Geschichte* (1883). The book's meaning and style are greatly illuminated by placing it in the scientific, political, and academic context of late-nineteenth century Germany. As this context changed, so did both the reception of the philosophy of the infinitesimal and of the Marburg school more generally. A study of this transformation casts significant light on the political relevance of the philosophy of science in the Wilhelmine era. As a means of following this development across time, Cohen's text is read through its changing reception in the philosophy of his closest disciple, Ernst Cassirer.*

Ever since its first publication in 1883, Hermann Cohen's text, *Das Prinzip der Infinitesimalmethode und seine Geschichte* [The Principle of the Infinitesimal Method and its History], has formed a puzzle for all but close followers of the Marburg School of neo-Kantianism. The text is widely considered to mark a shift in Cohen's thought and to establish the most influential direction of the school, and with it begin the school's enormous influence in German philosophical, legal, and scientific thought in the three decades before the First World War. Intended to form something of a "popularization" of Cohen's ideas, the text formed the germ of Cohen's own philosophy as put forth in the second edition of his *Kants Theorie der Erfahrung* two years later. It is true that the puzzle for many readers of the Infinitesimal book was simply its contents, for despite its purportedly approachable form, it was widely considered extremely difficult and occasionally accused of being needlessly opaque. The philosopher Friedrich Kuntze noted that "Cohen's book is generally considered to be one of the most difficult books of German philosophy, and one can hear

from considerate people that the only thing they understood in the work were the citations from foreign authors” (1906, p. 249). Kuntze claimed that this difficulty stemmed from the challenging conceptual nature of the infinitesimal as much as it did from Cohen’s style. Other readers, notably Gottlob Frege, argued that this incoherence was based on the book’s flawed reading of the history of calculus itself. “Cohen’s style of writing,” Frege wrote, “. . . is by no means distinguished for its clarity, and . . . is sometimes even illogical” ([1885] 1984, p. 108).

Yet the central puzzle for most outside readers since 1883 has simply been how and why Cohen, and the Marburg school, derived from such a recondite history and philosophy of calculus a school of philosophy that would ultimately claim to encompass aesthetics, law, religion, and ethics. For even as it was to fade in direct influence rapidly after the First World War, the Marburg school is now considered to be pivotal—either through attraction or repulsion—for a truly immense array of German and European thought in the first third of the twentieth century. To list only a few of the fields and figures that have been closely linked with the school: the formation of the ideology of German social democracy (Bernstein, Vörländer, Eisner); the reformulation of law that would lead to Hans Kelsen’s theory of pure law (and with it, in part, the U.N. charter); the development of modern existentialism and ontological philosophy (Heidegger, Hartmann, and Rosenzweig); the development of modern history and critical theory (Bakhtin, Blumenberg, Elias, Kantorowicz, Lukács); and, finally, the redevelopment of the history and philosophy of science (Koyré, Meyerson, Wind).

The most common answer to the puzzle of the *Infinitesimalmethode* has been simply that the Marburg school was at its core a philosophy of science, and thus a reading of the history of calculus could epitomize the meaning of this philosophy. For proponents, connecting the Marburg school with the philosophy of science was its greatest triumph and source of legitimacy, at once linking it to the key problems of modernity and reconnecting it with the central problems of Kant’s philosophy. As Cohen argued in his 1914 introduction to the ninth edition of Frederick Albert Lange’s *History of Materialism*, his reading of the centrality of the *Infinitesimalmethode* as a philosophical turning point in modern thought was consistent with the thought of Hertz, Planck, and Einstein (1928, 1: pp. 245ff.).<sup>1</sup> Indeed, Cohen noted, Planck’s *Das Prinzip der Erhaltung der Energie* (1887) had described its own theoretical foundation through the

1. I will use Cassirer’s edition of Cohen’s works throughout in order to retain Cassirer’s selection of editions and corrections.

use of the term “*infinitesimal-theorie*” in a manner Cohen found similar to his own (1928, 1: p. 265). For opponents, however, the dominance of the philosophy of science was the Achilles’ heel of the school. Due in large part to its reception as a philosophy of science, by the 1920s the Marburg school was widely considered to be concerned with only a subsection of philosophy, to be anchored in an outdated narrative of progress, and to no longer address the principle issues of the day. By the time of the Davos disputation between Martin Heidegger and Cohen’s student Ernst Cassirer in 1928, the Marburg school was closely linked with a failed “technical” or ontic project in opposition to Heidegger’s new ontological philosophy. Although recent work has emphasized the surprising proximity of these two positions, the contemporary judgment is indicative of how heavily the Marburg school was linked with a reading of natural science, and how far the spectrum of natural science was then isolated from social, political, and existential concerns.

In this paper, I would like to suggest why the puzzle of Cohen’s *Infinitesimalmethode* text, both philosophically and politically, can only be unraveled through a reading that includes its setting within the Wilhelmine state in the midst of the so-called “second industrial revolution.” The relation of science and state was decisive for the intended audience of Cohen’s work, and it greatly influenced his assumptions about the meaning of the book. As this context changed, so did both the reception of the philosophy of the infinitesimal and its repositioning in the Marburg school. In light of the technical snares awaiting a philosophy that grounded itself on the philosophy of calculus, the question arises of why a specific and historical reading of calculus was used to ground Cohen’s philosophy, and what resources such a close reading lent the presentation and development of his work. The philosophical themes stemming from Cohen’s reading of Kant’s schematism and the anticipation of perception, the key philosophical themes at hand, could initially have been presented in a number of ways, and indeed the emphasis on mathematical calculus by members of the Marburg school itself changed greatly over the years.

One result of this line of questioning will be to explain why the emphasis Cohen placed on the role of the infinitesimal had its greatest effect not on its particular object of the philosophy of mathematics, but on the historiography of science and the constitution of philosophy. The basis for this surprising transition is already nascent in the *Infinitesimalmethode* text, for in it we can see how Cohen aimed to transform the contemporary understanding of science and ultimately—and for Cohen inseparably—the society of the *Kaiserreich*. Once understood in this light, the relation of Cohen’s earlier work to his wider and more comprehensive philosophy, his

so-called philosophy of origin or source [*Ursprung/arché*] becomes clearer, as does the relation of this field to the transformation of the natural, social, and cultural science of the *fin-de-siècle*.

As a means of connecting a reading of the external context of the *Infinitesimalmethode* to its somewhat cryptic internal meaning, I will read Cohen's text through the philosophy of his closest disciple and hand-chosen follower, Ernst Cassirer. As the most scientifically minded member of the Marburg school, Cassirer was the authority on the philosophy of science in the "second generation." It appears to be to his reading of science that figures such as Julius Bergmann, Nicholai Hartmann, and Paul Natorp deferred. In its ramifications in Cassirer's work, the *Infinitesimalmethode* book will be seen as a source for a broadly influential reading of society and culture as well as natural science. A comparison of Cohen and Cassirer's work will suggest how the relation of the natural and cultural sciences was less distinct at the turn of the century than it would become as the century progressed. Particularly in relation to the philosophy of science, Cassirer's work can clarify the challenging meaning of Cohen's original texts, while Cohen's political project can illuminate the larger import of a theme as deceptively narrow as the history of natural science and of calculus. Interestingly, even as Cassirer retains and extends the philosophical emphasis on calculus developed by Cohen, he'll distance himself from the more literal connection of the practice of calculus to its philosophical meaning. Rather than having to read the political context of the Wilhelmine period *into* Cohen and Cassirer's philosophy, it will be demonstrated that as a philosophy of science this philosophy was in itself a deeply relevant political project in the context of the technocratic *Kaiserreich*.

After first sketching out the importance of Cassirer's relation to Cohen, the basic import of the *Infinitesimalmethode* text will be developed at some length through a reading of Cassirer's reception of Cohen's core ideas. We will then look at the place of the Marburg school in German society, academia, and politics in order to understand the consequences of Cohen's reformulation of the philosophy of science in the text. Finally, by following the further development of the key ideas of the text in Cassirer's early work, we will highlight both the broader philosophical relevance of the *Infinitesimalmethode* as it developed into a philosophy of origin, and the environment of its reception as the position of scientific research, state, and German opinion shifted.

#### **Cassirer's Early Work as a Cipher for Reading Cohen**

Hermann Cohen was the leader of the "Marburg School" of German neo-Kantianism, one of the principle architects of the movement of "ethi-

cal socialism” that deeply effected the German socialist party, and probably the most influential philosopher of Judaism in the twentieth century (Poma 1997; Pascher 1997, pp. 70–106, 114–119; Sieg 1994, pp. 225–235). He was also, in large part because of these views, one of the most controversial and consistently attacked figures in German academic life. Cassirer’s work in its early years, with its often understated political views and readable style, can be understood foremost as a reflection on and transformation of Cohen’s demanding philosophy, highly public political stances, and nearly incomprehensible style. Given the wide discrepancy between his close personal attachment to Cohen and his rare textual references to him, it has to be assumed that Cassirer often masked this relation in his public writings so as not to appear as an academic “front” with Cohen or a mere mouthpiece for Cohen’s ideas. At the height of the conflict over Cassirer’s succession to Cohen’s chair, the Marburg philosopher Paul Natorp would note precisely that Cassirer’s even-handedness in relation to the school, his diplomatic manner and non-partisan style were the greatest boon to his possible promotion. (Sieg 1994, p. 344; Holzhey 1986, 2: pp. 399ff.). Although Cassirer lost this battle, the same skills undoubtedly played a key role in his election to the Rectorship of the Hamburg University in 1929 by a drastically polarized faculty. At a time when the campus was already fraught with national socialist agitation, Cassirer won the faculty vote to become the only Jewish-German rector of a German university. He began his position with what is now considered one of the few public defenses of the liberal and socialist Weimar state (Habermas 1996, p. 100; Cassirer 1929). The lives of both philosophers, then, can be characterized by highly visible public roles in German academic and political life managed in a nearly diametrically opposed manner.

Central for understanding the relation of Cassirer and Cohen is an appreciation of the place of academics as state bureaucrats within an autocratic Wilhelmine state undergoing the second industrial revolution. Within this state, all academic production—particularly that of a progressive socialist such as Cohen—was subject to both informal censorship, largely through the influence of the cultural ministry, and, as an even more pervasive consequence, self-censorship. Cohen’s relatively outspoken political views in this environment made him the object of incessant academic and political harassment (Sieg 1994, pp. 235–347). Cassirer was closely connected with the presentation of Cohen’s philosophy to the public: Not only was Cassirer’s cousin, Bruno Cassirer, the publisher of nearly all of Cohen’s works, but Cassirer wrote several key defenses of Cohen’s work before the First World War, and co-edited the most relevant texts after Cohen’s death in 1918 in the post-humus collection *Herman Cohen’s Schriften zur Philosophie und Zeitgeschichte*. Mindful of Cohen’s fate since the

very beginning of his career, the young Cassirer compensated—perhaps overcompensated—for his mentor by repositioning the political component of his work while clarifying and popularizing its philosophical meaning in his own early texts.

Cassirer himself argued that his philosophical development could best be described from his “connections . . . and my later [philosophical] freedom from Cohen’s work” (Cassirer 1950, p. 75). Cassirer’s early work was intended to act as a bridge to Cohen’s theories, just as many of the most important aspects of his later works gain in creativity and depth when they are considered as a commentary on and progression beyond Cohen. By using Cassirer’s work as a cipher for understanding Cohen, we are provided with a more comprehensible, if perhaps less polyvalent, sense of Cohen’s project, while gaining further insight into the political and social concerns that animated the philosophy of both thinkers.

Certainly Cassirer himself described his own early philosophy as a bridge to Cohen’s work, and he hoped specifically that his work would make clear the wider implications of Cohen’s texts that were lost in specialist readings. In her memoirs, Toni Cassirer described her husband’s relation to Cohen, whom “he admired and loved extraordinarily,” in conjunction with Cassirer’s *Habilitation*, or tenure publication, of *Substanzbegriff und Funktionsbegriff: Untersuchungen Über die Grundfragen der Erkenntniskritik* (1910): “He explained to me the difficult situation that Hermann Cohen was in, since he was the only Jewish Ordinarius (Professor) in all of Germany, and gradually I came to understand that Ernst’s *Habilitation* was not really particularly important to himself, but that it should have the role of preparing the way for Cohen’s philosophy, which everywhere encountered severe resistance” (1950, p. 27).

Cohen himself took this view of Cassirer, seeing this early text and others as completing his own work to some extent. Cohen’s estimation of Cassirer’s *Substanzbegriff und Funktionsbegriff* as an extension of his own project is clearly in evidence in the correspondence of the two. “I congratulate you,” he wrote to Cassirer, “. . . on your new and great achievement. If I shall not be able to write the second part of my *Logic*, no harm will be done to our common cause, since my project is to a large degree fulfilled in your book” (Cohen to Cassirer, August 24, 1910; Schlipp 1973, p. 21). Indeed, Cohen’s opinion of Cassirer’s grasp of his work was so high that he later wrote of their first meeting: “I felt at once that this man had nothing to learn from me” (Schlipp 1973, p. 7).

Cassirer emphasizes his own interest in presenting Cohen’s philosophy from a different vantage point when he narrates his story of finding Cohen’s philosophy through his first teacher, Georg Simmel. Simmel, Cassirer writes in a well-known anecdote, “emphasized how much he him-

self owed to the study of Cohen's books, but he immediately added that those books, in spite of their real profundity, suffered from a very grave defect. They were written, he said, in such an obscure style that as yet there was probably no one who had succeeded in deciphering them" (Cassirer 1943a, pp. 222–223). Cassirer will set out to correct this "great defect," while at the same time popularizing and anchoring Cohen's work. The current revival of interest in Cassirer initially began in part through a recognition of Cassirer's distance from "neo-Kantianism" as it was commonly understood after the Second World War. Such a reading also unintentionally distanced Cassirer from Cohen. As new research on Cohen has progressed, however, the tremendous importance of his work, and the severe limitation of his designation simply as a "neo-Kantian," has become clear. Recent texts, for instance, demonstrate Cohen's enormous impact on figures such as Walter Benjamin, Emmanuel Levinas, and Martin Heidegger, while Cohen's impact on the philosophy of science has been reassessed.

Cassirer's work provides an ideal guide for summarizing both the application and limitations of Cohen's *Infinitesimalmethode*. Cassirer's *Substanzbegriff* presents an excellent overview, with characteristically little direct reference to Cohen, of the consequences of Cohen's *Infinitesimalmethode* and later *Logik der reinen Erkenntnis*. The text grounds Cohen's relatively free use of scientific examples in a close reading of contemporary science and the history of science that is still widely respected. Cassirer reminds the reader early in the text that the core of Herman Cohen's writings was developed from the theme of calculus, and many of the key moments—such as the descriptions of Galileo and Leibniz—closely follow Cohen's insights (Cassirer 1953b, p. 99). Even as the first three volumes of Cassirer's magisterial *Erkenntnisproblem* series (1902–27) stand alone as works of the history of philosophy, they also provide a reading of Cohen's work woven into a narrative the European philosophical tradition. The key figures and protagonists of Cassirer's complex *Problemggeschichte*—such as Nicholas of Cusa, Leibniz, Kant, and Maimon—each illuminate critical points of Cohen's philosophy. Cassirer's initial "presentation" of Cohen's work proves to be important for highlighting precisely what earlier commentators missed in relation to both his own and Cohen's philosophy.

#### **Cohen's *Infinitesimalmethode*, Part One: The Background in Cohen's Reading of Plato's Mathematics**

Few texts summarize and at the same time compound the challenges of their author's general philosophy as much as Cohen's *Infinitesimalmethode*. Cohen begins his text by writing that it is crucial to understand calculus "because it is the basic idea of the mathematical sciences," but the work

rapidly takes on a much wider philosophical agenda (1984a, p. 1). Even Cohen's attempt to directly explicate calculus is comprehensible only in its philosophical context, and, as Frege noted, might indeed be incomprehensible without it. Writing in a polemic against the philosopher Leonard Nelson two decades after the appearance of the book, Cassirer aptly summarized the full implications of Cohen's use of calculus as part of a larger project of a process philosophy or, in the specific use of the term of the day, a functionalist philosophy that would avoid the classic pitfalls of materialism and idealism, empiricism and rationalism. The term "functional" is here used in the Marburg school's characteristically broad application: it is a mathematical metaphor used to define any moment of experience as pure "relational" determination (Ritter 1923, pp. 1140–1141). Where later linguistic structuralists would use language as the basis of a relational definition of meaning, the Marburg school found mathematics a more fruitful and less fraught model. Although referring specifically to Cohen's later work *Logik der reinen Erkenntnis* (1902), and thus a different phase of Cohen's thought, Cassirer's comments nonetheless pithily situate calculus within Cohen's larger project. Here Cohen's philosophy is described through its widest category of transcendental logic (simply "logic" in the text below), which will in turn ground a philosophy of science:

The basic idea of Cohen's work can be stated quite briefly: if we want to achieve a true scientific grounding of logic, we should not begin from any sort of completed existence [*fertiger Existenz*]. What naïve intuition [*Anschauung*] takes as its obvious and secure possession, this is for logic the real problem; what it assumes as directly 'given', this is what must be critically analyzed and taken apart in its crucial conditions for thought [*gedanklichen Bedingungen*]. We should not begin with any sort of objective Being [*gegenständlichem Sein*], no matter of what sort and no matter what relation we place ourselves to it: for every "being" is in the first place a product and a result which the operation of thought and its systematic unity has as a presupposition. A foundational conceptual setting of this sort, an intellectual condition in which we can first speak of "reality" in the scientific sense, is found by Cohen in the idea of the infinitesimal as it is detailed and fixed in modern mathematics (Cassirer 1906, n. p. 32).

Calculus, then, will ultimately form for Cohen the model for a non-essentializing process of determining particular moments of experience in relation to their context. The crux of this "functional" definition is that any particular fact, "object," or moment of experience will be defined as a relation between the particular, which will be analogous to the integral,



and the horizon of its possibility, which will be analogous to the differential (Cohen [1902] 1997, pp. 121–144). Only through such a project, Cohen argues, can the constellation of rules or laws that explain any particular “fact” or event—whether in natural science or in other fields of human endeavor—be properly illuminated. The ultimate goal of this project will be a “critique of knowledge” [*Erkenntniskritik*] that will explain “the synthetic principles or foundations of knowledge, from which science builds itself and from which its validity hangs” (Cohen 1984a, p. 6).

Using this broader statement as a guide, we can now work back to clarify the several, and conflicting, meanings of calculus in the early text on the *Infinitesimalmethode*. Both Cohen and Cassirer clarify in numerous texts how the misplaced essentialism of “being” or “substance” can corrupt our understanding of experience. A brief glance at Cohen’s earlier work *Platons Ideenlehre und die Mathematik* (1878), can help first clarify how mathematics in general will prove central for avoiding such essentialism. Once we have grasped this more general problem, we can turn to why calculus will prove to be a particularly valuable concern within mathematics. In the earlier text, Cohen wished to demonstrate the manner in which mathematics allowed for a balance between materialism and its conceptual opposite, an essentialized or absolute idealism. Just as absolute idealism presupposes a realm of ideas *behind* what is given, so materialism presupposes a homogenous plane of matter beyond access by any particular experience. In neither case is this “being” legitimately present in immediate experience. In Cohen’s view, Plato’s mathematical idealism overcomes both by containing two interrelated moments: first a skepticism about the “obviousness” of sensual intuition, and second a “spiritualism” in that it recognizes the reality of that which exists in thought [*des im Denken Seinden*] and can be displayed through intuition (Cohen 1928, 1: p. 342). In a pivotal intimation of his later philosophy, Cohen will write that these two “opposed” moments only fruitfully develop in dialectic relation: “if the appearances are only real through ideas, so are the ideas only measures of reality and ways to the reality of things.” Ultimately, this fusion leads to a dialectical relation of hypothesis and appearance, and thus already in Plato and Aristotle to the foundational concept of modern natural science: “Hypotheses serve as ‘construction images’ [*Konstruktionsbilder*] for the methodical handling of things. . . . Aristotle understood correctly: mathematics stands in the middle between sense and ideas” (Cohen 1928, 1: p. 366).

In the modern case, the problems of the false appearances of “being” in experience are more complex, although the answer will be similar. Now, as Cassirer noted above, the problem is how naïve intuition [*Anschaung*] fools us into believing that experience itself is immediately given to us. As Cohen describes this central problem in his *Kants Theorie der Erfahrung*:

“The content of experience, which Hume took for granted, is here what is put in question” (1987, p. 374). Here the specific mathematical theme of calculus comes to the fore as the key example demonstrating the “constructed” nature of immediate experience. The importance of mathematics for Cohen in his early texts on Plato, as in his work on the *Infinitesimalmethode*, is that it allows us to demonstrate the proper balance of thinking [*denken*] and sensible intuitability [*Anschauung*] in philosophy, a balance which will then affect nearly every other feature of Cohen’s work. “The definition of the infinitesimal method,” as Cohen says, “is conditioned by the establishment of the boundaries of intuitability [*Anschauung*] and thought” (1984a, p. 6).

The challenge of understanding the *Infinitesimalmethode* both as a text and in the inherent difficulty of its subject matter will lie, as Friedrich Kuntze argued in 1906, in the manner in which this balance occurs outside the direct purview of either thought or intuition (Kuntze 1906, pp. 249ff.; Cohen 1984a, p. 2). The counter-intuitiveness of the infinitesimal, which initially provoked so much resistance to its adoption, suggests the role of what Cassirer will call its “relative being” (1912b, p. 95). Bishop Berkeley summed up the central paradox of the infinitesimal in his, *The Analyst, or a Discourse Addressed to an Infidel Mathematician*, when he wrote: “And what are these fluxions? The velocities of evanescent increments? They are neither finite quantities, nor quantities infinitely small, nor yet nothing. May we not call them ghosts of departed quantities?” (1734, p. 18)<sup>2</sup> As products of mathematics that define “reality” yet cannot be directly intuited as insular or discrete elements of being, the infinitesimal epitomizes the relation of thinking and intuition which is to characterize all of modern science. Berkeley’s mistake lay in imagining that the infinitesimal can be recognized in the impression of continuity, just as for others it lay in trying to find it under the substantial category of “thing” at all—thus in both cases leading to the mistaken conclusion that infinitesimals must be supernatural “unthings.” Calculus provides the key tool and example for avoiding the mistakes of modern empiricism and sensualism, for it demonstrates that we know the particular only through its context, and we know this context only through the basis of structural ideals.

Cohen will argue that far from being limited only to mathematical or

2. On-line transcription available at: <http://www.maths.tcd.ie/pub/HistMath/People/Berkeley/Analyst/Analyst.pdf>

See also Cassirer’s critique of Berkeley’s reading of calculus in (1994b, pp. 302 ff.). Here Cassirer notes Berkeley stressing not the failure of intuition but rather thought: “No reasoning about things whereof we have no ideas, therefore no reasoning about infinitesimals.”

scientific knowledge, the same process at the heart of the infinitesimal lies at the heart of all forms of perception. Shortly before introducing Cohen's early philosophy of Plato in his *Substanzbegriff*, Cassirer provides a brief statement of how natural science will be read once Cohen's description of the relation of thought and intuition is understood as part of a functional relation. Cassirer writes that both the mathematical and physical concept "cannot be comprehended, as long as we seek any sort of presentational correlate for it in the given; the meaning only appears when we recognize the concept as the expression of *pure relation*, upon which rests the unity and continuous connection of members of the manifold" (1953, p. 166). In a more poetic style, Cassirer continues:

All that the 'thing' of the popular view of the world loses in properties, it gains in relationships. . . . [It is] connected inseparably by logical threads to the totality of experience. Each particular concept is, as it were, one of these threads, on which we string real experiences and connect them with future possible experiences. . . . The objects of physics: matter and force, atom and ether can no longer be misunderstood as so many new realities for investigation, and realities whose inner essence is to be penetrated, when once they are recognized as instruments produced by thought for the purpose of comprehending the confusion of phenomenon as an ordered and measurable whole (1953, p. 166).

Neither "abstract" thought nor sensual intuition is here dominant; rather their interrelation is guided by the creative attempt to understand the functions connecting the particular to the whole. The ideal model of this relation is found in calculus, even as for Cohen its first intimation was set down in ancient conceptions of mathematics.

**Cohen's *Infinitesimalmethode*, Part Two: Calculus and the General Problem of the Determination [*Bestimmung*] of Particulars**

The reason why the infinitesimal will provide such a model for all of science is the manner in which it clarifies the relation of thought and intuitability by defining the relation of the differential to the integral as purely relational in such a way that it is both a "sign" allowing a new perception of change (Leibniz) and the actual correlation of real motion (Newton) in a manner that could be grasped in no other way. It has no set "essential" definition of "being" beyond its "relative" being as an indication or revelation of change, yet it first allows a proper understanding of real change in the world. In the attempt to discover the relation of motion to mathematics—and thus the changeable to what, in Plato, was the realm of the unchangeable—both Newton and Leibniz had refined the cal-

culus. As Cassirer notes both in his *Erkenntnistheorie* and in a later popularization of the problem for a North American audience, it is extremely telling that the two thinkers reached a similar method of balancing thought and intuitability in calculus from the opposed philosophical directions of scientific realism and logical idealism (1943b, p. 380; 1994, pp. 149ff., 401ff.). Similarly, it is critical that both will in the process abandon the naïve definition of space and time as immediately given, with Newton removing this immediate reality to an “absolute” time and space, and Leibniz dispersing it to a purely relation definition of time and space (Cassirer 1943b, p. 385). The contested field of calculus unites Leibniz and Newton by providing a means for rewriting “commonsense” definitions of the world so as to provide a more capacious definition that would allow for natural science. Kant followed Newton in holding space and time to be absolute, but transformed this “objective” absolute into the modes of intuition. Cohen will use the insights of calculus to recast Kant’s reading so that, in an argument initially developed through Cohen’s earliest work on the so-called Fischer-Trendelenberg debate on Kant’s reading of space and time, it is closer to Leibniz than Newton. Essentially, he will claim that although space and time depend on transcendental rules, their form varies depending upon the mode of knowledge through which they are constructed (Cohen 1984a, p. 129). In this way the legitimacy of non-Euclidean geometry and topology are guaranteed.

In Kant’s philosophy, the key to removing false definitions of being lay in the transcendental dialectic, which, as Cassirer notes in a defense of Cohen, is the real starting point of Kant’s critical method and, by implication, the best path to understanding Cohen’s re-reading of Kant (Cassirer 1912b, pp. 95–96; Cohen 1984a, p. 55). Given Cassirer’s summary of Cohen’s philosophy in his early response to Leonard Nelson, the reason for this is not difficult to see: the transcendental dialectic explains away illusions of understanding that arise from false notions of “being” that plague our understanding of experience. In Cassirer’s reading, the most relevant aspect of the transcendental dialectic for understanding Kant are the antinomies, and particularly the so-called “cosmological antinomies” (Kant 1965, pp. 402ff/A 434). Antinomies for Kant are a pair of propositions that follow from the same assumptions but prove apparently contradictory (1965, p. 328/A 340). They are resolved by either showing a false basis in the initial assumption or the false nature of their opposition. Kant’s analysis of each of the antinomies debunks a key element of false understandings of being. The first, the antinomy of rational psychology, debunks the idea of “substantial” ego, the second, of cosmology, debunks a “substantial” definition of the world, and the third, of rational theology, debunks the idea of our ability to conceptualize a “substantial” God.

The cosmological antinomies are, in Cassirer's view, the best starting point for understanding Cohen's re-reading of Kant. Kant finds four antinomies of cosmology, relating roughly to the categories of quantity, quality, relation, and modality. The second antinomy can stand in for the others as an example, since it relates most closely to the problems of calculus. Its first premise states: "In the world every composite substance is composed of parts; nothing exists anywhere except it is either simple or is composed of simple parts" (Kant 1965, pp. 402ff/A 434). Its opposite states: "In the world no composite things consists of simple parts and there exists nowhere in the world anything simple." The solution to this antinomy, as to all of the cosmological antinomies, ultimately lies in recognizing the false substantiation of the concept of "world" as epitomized by the very article in "the" world. In fact, as Cassirer notes, "experience as a whole is never given to us as such, as a rigid, closed entity; it is not a result lying behind us, but a goal lying before us" (1981, p. 202). Our particular experience in the present place and time never gives us access to "the" world as a whole, so we can neither have things "closed" off from it nor totally encapsulated "in" it. Instead, we have a particular set of transcendental logical rules, the categories, that lead us "from one conditioned thing to another" and we have a regulative idea of totality by which we place our particular experience in the horizon of a potential world of experience (Cassirer 1981, p. 204).

Cassirer's description of the "process of determination" [*bestimmung*] will already suggest why this process of experience, once freed of the substantial bias of the concept of "the" world, begins to closely resemble the core ideas of the infinitesimal method. In analyzing our perception of experience, we find that experience is at its very base relational or functional and fundamentally temporal: "An individual member of a particular series always points to another that precedes it, without our ever succeeding to a last member, but also, when we grasp each series as a unity, the moment we wish to indicate how it coordinates with other series and depends on them, the result is a nexus of ever-new functional connections, which, when we try to follow it out and express it, leads us straight into the indefinite distance. What we call 'experience' consists in such a set of progressive relations, not in a whole of absolute data (Cassirer 1981, p. 202). The substantial or "completed existent" element is never given in immediate experience. "The idea of totality is 'regulative,' not constitutive, because it contains only a prescription as to what we are to do in the regress, but does not determine and anticipate what is given in the object prior to any regress" (Cassirer 1981, p. 206). We constantly investigate or perceive our experience so as to redefine our definition of it, but never is it simply given without this process having taken place. Several consequences fol-

low from this approach. We never have experience of any *unconditioned* thing, and thus of any absolute being, for if we did it would stand in no relation to the rest of our experience, and would thus be incomprehensible. Nor, of course, do we ever experience a *fully* determined object, since this would require a consciousness that understood the infinite relations in time and space affecting any particular—a possibility, perhaps, for a different kind of consciousness and experience, but not for ours. Finally, the horizon against which the particular is related is always by definition one of a single plenum, since if any particular set of relations did not relate to other elements of the plenum, they too would not be intelligible in our world. Our immediate intuition of a particular does not guarantee the “reality” of an object in this plenum, rather thought and intuition together are guided by the ideal category of “reality” or the “Real” to construct objects (or, in Cassirer’s terminology, objectives) of experience—a process epitomized by the role of hypothesis in natural science. Reality is never directly given, but is rather the ideal category under which imagination unifies thought and intuition so as to achieve the greatest probable level of “determination” of the particular (Cohen 1984a, p. 27).

In actual experience, then, we are given particular moments or events that we determine in relation to the horizon of experience. Far from leading to an “abstract” definition of reality, for Cohen and Cassirer this was the key for allowing the immanence and the creative force of perception, which connects thought and intuition under the guidance of the category of “reality.” As Cassirer notes in his earliest text on Leibniz and in his *Freiheit und Form* (1916), the basic motive of Leibniz’ philosophy is already found in this basic set of problems: the notion that the “present contains within itself the past, and is pregnant with the future” ([1916] 1994e, p. 32). The basic problem of determination will serve as the “‘presupposition’ of Leibniz’ calculus even as the calculus will serve as its ‘concrete demonstration’”(Cassirer 1994e, p. 31).

#### **Cohen’s *Infinitesimalmethode*, Part Three: Calculus as a Universal Schema for Modern Natural Science and Everyday Experience**

Even within the description given so far, it can be seen why Cohen and Cassirer would hold this basic approach to the problem of experience as critical not just for the particular case of calculus, but to understanding all of modern mathematics and physics. Thus, in reference to contemporary theories of the irrational number, such as Dedekind’s idea of the “cut” of a particular irrational number, Cassirer argues against the philosopher Charles Renouvier that we now must think of the concept of number without having to limit it to finite or discrete forms (1912b, p. 90). Whereas Renouvier had claimed that the idea of an “infinite” particular

was illogical, and that the world of being could only be understood as a set of finite entities, Cassirer writes:

Whether or not something is in the sense of pure logic a legitimate 'object,' does not in fact depend on whether we can imagine its parts individually realized in the imagination, but rather it depends on whether we can make fully determined judgments about it which are separable from every other 'object.' By this basis the problem of infinite contents [in irrational numbers, etc.] are not a problem: they are the true logical-mathematical 'individuals,' which through the particular rule of the contents are separated from each other with absolute clarity. The logical being which we give to these contents entails certainly no absolute, but rather a relative Being [Sein]: it suggests in its fundamental concept simply a 'being-different than' [*Unterschiedensein*]" (Cassirer 1912b, pp. 94–95).

Just as Cohen had claimed that Plato used mathematics as a mediation between the ideal and sensual, so Cassirer here argues that calculus, and all forms of modern mathematics, present a new form of "relative being." The particular is determined in its horizon of experience in a manner that is neither purely "thought" nor "intuition" but is rather a limit ideal based on their interrelation, guided by imagination [*Einbildungskraft*] and the regulative ideal of reality (Cohen 1984a, p. 18). The conditions of the possibility of mathematical experience are the same as the conditions for the possibility of all experience. Cassirer continues, "Removed from the necessary relational forms of experience, there would be no phenomenal 'content' more: for the 'appearances' are as empirical objects only given in experience and do not exist at all outside of this experience" (1912b, p. 90).

When the philosopher Leonard Nelson attacked Cohen for "mysticism" concerning the infinitesimal, Cassirer responded that: "the infinitesimal is not a thing [*Ding*] but a condition [*Bedingung*], not any sort of reality at hand, but an instrument of thought for the discovery and construction of true being [*wahrhaften Seins*]" (Cassirer 1906, p. 32 n1). In Cohen's reading, the theory of the infinitesimal is exemplified by its history in the development of calculus. The initial historical attempts at understanding the infinitesimal involved comparison of two extensive entities, one much smaller than the other, such as in the method of exhaustion (Cohen 1984a, p. 30). Only once the bias in favor of the necessary intuition of extension was dropped could the infinitesimal properly be understood. Just as both Newton and Leibniz discovered the "infinitesimal method" while searching to describe motion from the side of "reality" and "ideality," respec-

tively, so does this method provide access to a moment of “true” experience that cannot be reduced to either world or mind, intuition or thought (Cohen 1984a, p. 2). Even mathematically the infinitesimal is only a “relative-being,” it nonetheless correlates or provides access to “true experience” in a manner demonstrated by its practical application and first noticed in Galileo’s definition of accelerating motion (Cohen 1984a, pp. 32, 44).

The first thinker to place the insights of Newton and Leibniz in the Kantian format was not Cohen but Kant’s contemporary Salomon Maimon (1753–1800). Cassirer’s reading of Maimon in the third volume of his *Erkenntnisproblem* is singular in almost the entire series for its *direct* interpolation of Maimon’s philosophy as a predecessor to his own and that of Cohen (Cassirer 1994c, pp. 80–115).<sup>3</sup> The critical component of Maimon’s treatment of calculus is its use in describing the Kantian “thing-in-itself,” and with it any element of “fact” or “object” whether of science or of perception (Cassirer 1994c, p. 83). Maimon claimed that the “thing-in-itself” is a formally contradictory concept that could never be known or usefully theorized in itself, even as the term functions as a signifier for this very contradiction. This contradictory nature is found in the very definition of the thing-in-itself as “something” from which the characteristics of thought as we know it are removed; the term has a function similar to an imaginary number in its suggesting a turn of thought which is in itself not open to intuition (Cassirer 1994c, p. 90). Maimon’s basic understanding of calculus is summarized through his re-inscription of it into the Kantian system: “differentials of objects are the so-called *Noumena*; the objects that develop from this set of relations are the so-called *Phenomena*” (Cassirer 1994c, p. 100). Although somewhat unusual in his use of the Kantian terminology, what Maimon appears to mean by this is that the differentials of objects are noumenal in the sense of connecting up with an unknowably infinite horizon of connections. In this definition, which was to prove influential on Kant’s own changing readings of the problem, both the ‘thing-in-itself’ (*Noumena*) and immediate experience (*Phenomena*) have ceased to be defined substantially, and are now defined only as idealized poles of a single functional relation.

The appearance of objects here functions “so that understanding cannot simply have “objects” appear without taking them as “appearing,” that is without taking them as flowing” (Cassirer 1994c, p. 98). Our entire definition of nature is no longer understood as an “objective being” but as “the entirety of relational determinations” (Cassirer 1994c, pp. 85–86).

3. Kuntze (1906) appears to have first noticed this relation between Cohen and Maimon. Cohen recognizes the affinity in his (1925, p. 389, n12).



Maimon's thought thus demonstrates how the dualism of inside and outside, subject and object, are dispelled. The appearance of these forms will henceforth cease to be a given fact, but a consequence or construction of different forms of knowledge that can be explained and analyzed. This is essentially the basis, then, of the Marburg definition of functionalism: any particular object is shaped by the entirety of the relations, or functions, in which it stands. Maimon, however, ultimately remained skeptical about the possibility for this system to provide a description of physical reality, and to explain how thought and perception coincide (Cassirer 1994c, pp. 123–4). The intervening century, Cassirer argued, had provided numerous new examples in which Maimon's basic template could indeed be modified to form the best possible schema for understanding the relation of knowledge and reality (Cassirer 1994c, p. 83).

**Cohen's *Infinitesimalmethode*, Part Four: Calculus, the Late-Nineteenth Century Rage for Psychophysics, and the Priority of Quality**

Cohen was not at all alone in the late-nineteenth century in his fascination with calculus and its relation to experience. The psychophysics of Gustav Fechner (1801–1887) and the popular reception of J. F. Herbart's (1776–1841) psychology were part of a surge of interest in the ways in which the problem of calculus might explain the subtle perceptions of human beings in the way they connected to experience (Schnädelbach 1984, p. 78; Cassirer 1994b, pp. 379–410; Cohen 1984a pp. 52–55, 139–141, 156ff.). The surprising popularity of such physiological explanations lay in the manner in which experience appeared to be reducible to measurement, qualitative perception to quantitative indices.<sup>4</sup> Cohen's *Infinitesimalmethode* is in no small measure a polemic against such approaches. Cohen argued that Fechner's colorful combination of psychophysics and metaphysics in particular, and empirical psychology in general, assumed a dualism of body and soul, inside and outside, of a "being" [*Wesen*] of consciousness and material, "that ultimately had no foundation in experience" (Cohen 1984a, pp. 157–158). Rather than reducing qualitative understanding to quantity, philosophy had to demonstrate that all quantitative experience first derives from qualitative meaning. The question held heavy stakes for the Marburg school, for the development of empirical psychology within philosophy was one of the significant threats to the school's viability under the Prussian cultural ministry—as demonstrated by the hiring of an empirical psychologist in place of Cassirer, the recommended

4. An example would be Fechner's famous principle that the intensity of a sensation increases as the log of the stimulus ( $S = k \log R$ ) to characterize outer psychophysical relations in *Element der Psychophysik* (1866).

candidate, for a post in 1910 (Sieg 1991, pp. 304ff.; Sieg 1994; Ringer 1990, pp. 51ff.).

Cohen's somewhat counter-intuitive use of calculus to defend the value of philosophy and qualitative meaning hinges on his transfer of the center of gravity within Kant's *Critique of Pure Reason* from the *a priori* categories of reason and intuitions of time and space to the principles and schematism. Synthetic principles describe, in Cassirer's functionalist summary, how "the function that characterizes a specific category relates to the form of pure intuition and permeates it in a synthetic unity" (Cassirer 1981, p. 175). Kant's ultimate explanation of why natural science was able to use mathematics to understand the world, and thus why *synthetic a priori* judgments were possible, was simply that the "rules" for understanding "the world" were the same as the "rules" that governed "our consciousness" since experience is, after all, one. Kant's explanation of this problem within the principles is found first in the problem of extension, an area covered by the so-called "general axioms of intuition." These axioms have as their foundation the idea that "all perceptions are extensive magnitudes" (Kant 1965, p. 148/B 202). Perceptions in any form of experience, whether in mathematics or everyday life, work through extensive magnitudes whose rules will be identical no matter where or how they are encountered.

In the "anticipations of perception," Kant made a parallel claim for quality and intension on the basis of calculus as the "axioms of intuition" made for quantity and extension on the basis of geometry. Kant's principle of the anticipation of perception is directly formulated as, "in all appearances the real which is an object of sensation has intensive magnitude, that is degree" (Kant 1965, p. 201/B 207). Our temporally changing definition of both the "more" or "less" of sensation, and, more importantly, of the relation of the ideal to the particular—say in Newton's ideal laws of motion in relation to actual events of motion—are defined by the anticipation of perception, which in turn forms the basic template of calculus. Calculus finds so many corollaries in the "real" world of natural science, however, for the same reason as the axioms: its innermost rules are also intrinsic to any experience whatsoever. Cohen thought that these rules prove of much greater importance than those in the "axioms of intuition," since they will describe the limitative relation of how any idea conditions a particular fact, how the horizon of experience inflects the particular moment of time and space. The anticipation of perception thus plays a role in every aspect of Kant's philosophy since everywhere that the categories and the intuition of space and time are involved there will be limitation in relation to the particular. The anticipation of perception, and with it the fundamental awareness of calculus, can thus be applied to the entirety

of Kant's philosophy as a sort of universal solvent which will allow Cohen to recast the meaning of the whole of Kant's philosophy.

It would thus be difficult to overstate the importance of this principle for Cohen. "The principle of anticipation," he writes, "contains in itself the problem of the critique of knowledge" (1984a, p. 28). In his argument with the psychologists, Cohen will argue that the rules of intension can explain the process of extension, rules of quality can be used to derive quantities, but the reverse is not true. The basic rationale for Cohen's argument can be suggested by recalling Cassirer's argument with Renouvier over the nature of numbers and entities. The only definition of a "legitimate" mathematical or scientific object, Cassirer had claimed, was whether "we can make fully determined judgments about it which are separable from every other 'object'" (Cassirer 1912b, pp. 94–95). The only means of doing this in a manner that explains all mathematical and scientific objects, however, was not by claiming legitimacy only for objects that can be intuited as finite entities or quantities, but through the method of determination—epitomized by Dedekind's "cut"—in which "the particular rule of the contents are separated from each other with absolute clarity." The key to this relation of the particular to the whole, however, ends up being founded on the qualitative relational model of the differential to the integral. Quality rather than quantity is thus ultimately the universal foundation of scientific explanation and calculation. The same basic qualitative role in the anticipations of perception will similarly provide the only comprehensive definition of the appearance of physical objects in space and time. Cassirer later summarizes this relation, which he finds epitomized in Leibniz' *multorum in uno expressio*, in regard to space: "The consciousness of a single point contains reference to space as the sum and totality of all possible designations of position . . . the "integral" of consciousness is constructed not from the sum of its sensuous elements (a, b, c, d . . .) but from the totality, as it were, of its differentials of relation and form ( $dr_1, dr_2, dr_3, dr_4 . . .$ )" (Cassirer 1955a, pp. 100, 104–5).

At the broadest level, Cohen argued that the apparently elusive meaning of the infinitesimal is in fact evident in what he took to be the root form of human judgment and logic, the so-called limitative or infinite judgment. Limitation itself is one of the categories of quality, which includes "reality," "simple negation" and limitation. The logical form of judgment relating to these categories are affirmative ["all men are mortal"], negative [it is not the case that "the soul is mortal"], and limiting, or infinite, judgments [it is the case that "the soul is non-mortal" (*Nichtsterblich*)] (Kant 1965, p. 88/B 97). Limitative or infinite judgments are for Kant of the form "x is non-y," so that they affirm a quality by negating it against something else. A variant of these judgments, developed

earlier in Aristotle and medieval Arabic thought and implied by Cohen's argument, emphasizes the negation of "improper" predicates, such as "The wall is non-seeing" as the core of "infinite" judgments (Wolfson 1948, p. 186). The importance of these judgments is suggested by Kant's noting: "Now by the proposition, "The soul is non-mortal," I have, so far as the logical form is concerned, really made an affirmation. I locate the soul in the unlimited sphere of non- mortal beings" (1965, p. 108/B 97) Although Kant will largely drop this observation and conclude that this aspect of correlation between the table of categories and the older table of judgments was not particularly revealing, Cohen thought he found in it a general form of thought that was at the same time the methodological core of calculus. Limitative judgment, in Cohen's view, has precisely the same form as the mysterious relation of the integral and differential in calculus (Cohen 1984a, pp. 86ff.; Cohen 1997, pp. 210ff.; Funkenstein 1986, 1993, pp. 271–284). The particular is only defined relationally against the infinite plenum of the whole of possibility. Cohen's attempt to make this connection is often considered at once one of the most intriguing and least coherent aspects of his philosophy.

For Cohen, limitative judgments precisely describe the relation of thought and intuition in the infinitesimal as leading to a hybrid form of "objective intuition" which is not purely sensible, but rather a *means* of knowledge (Cohen 1984a, p. 18). For Cohen, this is "the secret of the differential idea, which is revealed as the logical secret of knowledge" (1984a, p. 29). Ultimately, the value of these statements for providing an open-ended means of definition goes back at least to negative theology in its statements on the attributes of God—such as Maimonides' and Nicholas of Cusa, the latter of whom is extensively analyzed by Cohen and Cassirer (Cassirer 1994c, pp. 20ff.; Cohen 1997, pp. 31ff; see Maimonides 1956, p. 83). Although ridiculed by Hegel and Lotze, limitative judgments were held by Cohen to be the key to understanding the infinitesimal, and with it modern science. Cohen suggests the value of an absurd example, drawn from earlier attacks on limitative judgments: We might understand the definition of human by suggesting that "non-human" can be defined by the three terms "triangle, melancholy, and sulfur" (Cohen 1984a, p. 36). In Cohen's view, the fact that the mind immediately develops a *sense* of the object of such limitative judgments demonstrates a central aspect of thought: for it demonstrates a union of thought and intuition using imagination to make sense of a reality in a manner similar to that of the infinitesimal. Precisely in regard to leaving open the definition of "objects" such as "human" or "consciousness," these judgments have great value. Through them "we are able to form some concept by considering it in opposition to its opposites." In defining consciousness

[*Geist*] for instance, Cohen notes that we could neither call it material nor a “substance” at all, “it is part of an infinite group which is a third type (*tertium comparationis*)” (Cohen 1984a, p. 37). Just as in mathematics “number” proves to be defined most inclusively through a process of qualitative determination similar to the infinitesimal, so in logic and experience any particular “object” will, in Cohen’s view, ultimately be most inclusively defined by the form epitomized by infinite judgment. Cohen’s philosophy thus defined itself as at the opposite extreme of all attempts—notably those of the empirical psychologists—to “quantify” human spirit and find a substantial definition for humanity, even he shared with the psychologists the language of the infinitesimal.

The final key to the universal applicability of limitative judgment and calculus for Cohen is found in its relation to the problem of continuity. Continuity is traditionally defined through the idea that *natura non facit saltum* [“nature does not make leaps”]. Essentially, limitation will reveal that continuity is a constitutive feature—indeed, for Cohen it is *the* constitutive feature—of all thought and with it of all experience. “Continuity,” Cohen succinctly writes, “is the general basis of consciousness” (Cohen 1984a, p. 34). The mind always places each particular in its wider context, and this context by definition—once it is seen to rest on infinite judgments—is a continuum or plenum. In striving to make sense of the particular within the context of the whole through the category of “reality,” the mind necessarily uses the productive imagination to combine intuition and thought (Cohen 1984a, p. 28). We can now see, however, that the principle of continuity established between the particular and the horizon of “possible” reality will guarantee that this productive imagination is never merely fantasy. Rather in the manner of the infinitesimal it is conditioned at once by its “ideal” determinates and its corollary in experience in a manner that cannot be considered simply “inside” or “outside” but rather as an unfolding of future possibilities from the present (Cohen 1984a, p. 19).

Precisely this open-endedness allows Cohen later to see limitative judgments as linked in a dialectic that will explain how science, or any human endeavor, “unfolds” newly relevant questions and perceptions out of the problems posed by old answers and theories (Cohen, 1902; Funkenstein 1986; Gordon 1999; Kinkel 1912). Each moment of the development of a scientific concept conditions the particular interplay of thought and intuition for a given historical period and particular form of knowledge; the dissonances of this relation of thought and intuition already contain within themselves the material for the next “unfolding” of the concept. A good example is developed by Amos Funkenstein in the history of theories of motion: different theories of motion entail different “facts,” such as, say,

the supposition of rest as a natural state in Aristotle's physics to that of inertia in Newton, which in turn condition our sense of "reality" in a given period (Funkenstein 1986, pp. 52–53). The tension between thought and intuition, fact and theory, created by each definition of motion contains the problems from which develops the next theory of motion. The process leads to a result that has been compared to Kuhn's theory of paradigm shifts, yet is more dialectical: for from what is "projected" by the possibilities and failures of the old system arises a new system (Funkenstein 1986, p. 40; Cassirer 1957, p. 306).

**The Context of the Marburg School's Philosophy of Science in Wilhelmine Germany, Part One: Cassirer's 1912 Retrospective of Cohen's Work**

Cohen's work was often attacked as being peculiarly anchored in the philosophy of science, and certainly the *Infinitesimalmethode* text does not appear to belie this idea. As Cohen's confrontation with quantitative psychology suggests, however, his project is quite different than that of the normative science of his day. In Cassirer's statements on his teacher's work, it in fact becomes clear that he saw a central issue in Cohen's philosophy to be the role of science that underlay *other* philosophies of the late nineteenth century—whether they recognized this influence or not. Thus in a 1912 article summarizing Cohen's work, "*Herman Cohen und die Erneuerung der Kantischen Philosophie*," [Hermann Cohen and the Rejuvenation of Kantian Philosophy] Cassirer acknowledges Cohen's focus on natural science, but notes that to understand Cohen's work "one must see anew the entire epoch in which Cohen's studies of Kant began" and against which his criticism was focused (Cassirer 1912, p. 253). Once understood correctly, Cassirer's article suggests, Cohen's work will transform a relation of science and society that was already both central and problematic to late nineteenth-century German society.

This epoch, Cassirer writes, was one in which the problems of humanity and philosophy were supposed to be determined solely by the specific sciences, yet the understanding of these sciences and their relation to reality was "naïve." The absolute domination of the naturalism of the period was seen even in those who appeared to oppose it, such as Schopenhauer, who retains, in Cassirer's words, "the language of the natural sciences in a completely naïve manner utterly lacking in the capability for criticism, particularly in regard to physiology" (1912, p. 254; 1994d, pp. 413–446). Conversely, even writers who appear to be cautious in their use of science were in Cassirer's view distorting its importance in the other direction. Hermann von Helmholtz uses the language of science with much greater precision, but, Cassirer writes, he "applies it in a manner that far exceeds the limits of its real applicability" (1912, p. 254). Elsewhere Cassirer

would single out Gustav Fechner and Du Bois-Reymond for overextending scientific explanation (1953, pp. 122ff., 159ff., 302). Similarly even Frederick Lange, a co-founder of the Marburg School, remains, in Cassirer's view, bound to the false premise that the "psychophysical organization" of the organism, or man, determines the essence of humanity. A problem, Cassirer says, that "undoubtedly raises the question of human knowledge more than it solves it" (Cassirer 1912, p. 254). The only path out of such false readings of science lies in redefining the meaning of scientific reality, and this process will hinge on the "method of thought" contained in the infinitesimal method and the anticipation of perception (Cassirer 1912, pp. 260–261).

Cassirer's article alerts us to the pervasive role of naturalism and a false reading of science in the late-nineteenth century, even in thinkers who appeared to be aloof from any reading of science whatsoever. Indeed, from Cassirer and Cohen's perspective every modern philosophy contains a tacit philosophy of science. Conversely, every use of science and the philosophy of science had philosophical importance (Cassirer 1994c, p. 16). The ultimate reasons for this were that science in the modern period had, whether acknowledged or not, become enmeshed with questions of the nature of reality itself on the ontological, social, and epistemological levels (Cassirer 1999). If not acknowledged, a misreading of science could corrupt even claims that appeared completely removed from it, such as, notably, those of "culture" or "nation."

#### **The Context of the Marburg School's Philosophy of Science in Wilhelmine Germany, Part Two: Science, Politics, and Administration in the *Kaiserreich***

If Cohen intended the core ideas of his *Infinitesimalmethode* to some degree as part of an epistemological criticism of the place of science in his time, the question remains of why this criticism was not more directly stated. One key to this were the changes in the political climate between when Cohen's text first appears in 1883 and the time of Cassirer's assessment in 1912, an era that witnessed a surge of interest in progressive politics in Germany. The historical challenge of reading Cohen and Cassirer's philosophies is in part to recognize the limitations on their speech that would have been evident to contemporaries, in order that we can understand how such readers would 'decode' or interpret the implications of their philosophy. These limitations changed over time, even as certain fundamental aspects remained fixed.

These fixed aspects can roughly be divided into five themes—several of which we have touched on—which we can survey before looking at the changing context of the Marburg school. The first of these was the role of

both Cohen and Cassirer, like all German academics, as state bureaucrats, with all of the attendant government oversight (Ringer 1990, pp. 7, 34ff). The pressures for conformity were strong in a system in which, as one state minister declared in 1898, it was an axiom of Prussian policy that professors are both to teach and “to fill youth with respect for the monarchy and the constitution and . . . our state institutions” (McClelland 1980, p. 294).<sup>5</sup> The second complexity arose from this bureaucratic definition, and this was the role of the state, particularly the Cultural Ministry, in determining the direction of academic departments and schools. In the case of the Marburg school, it was of the greatest importance that the head of the cultural ministry from 1882 to 1908 was Friederich Althoff, who had a profound interest in readjusting the German academic system away from its emphasis on the classics and humanities and towards the new realities of the German state in the age of the “second industrial revolution” (that of chemicals, electrical components, and steel) (von Brocke 1991; Sieg 1991, p. 304; Sieg 1994; Ringer 1990, pp. 51ff.). This favorable proclivity was balanced out by a countervailing third theme affecting the fate of the Marburg school, namely the conflict of classical philosophy with the new field of experimental psychology that was arising in its midst. A fourth aspect affecting the reading of the Marburg school was its progressive political orientation within a highly conservative national faculty. Finally, as noted earlier, Cohen as well as Cassirer were caught in the difficult role of being a German-Jewish philosopher within a German context that favored either Protestantism or positivist agnosticism.

The most evident change in Germany affecting the Marburg school in the decades preceding the First World War was the rise of progressive politics. The success of the social democratic party is indicative: whereas the socialist party was still illegal in 1883, with legalization in 1890 it sent 35 representatives to parliament, but by 1912 had 110 representatives—fully one quarter of the parliament. Such changes would have an enormous effect on Cohen’s personal fate, since the moderate revisionist wing of the socialists ground its progressive agenda in part on the philosophy of the Marburg school. The basis for this connection was first established when the co-founder of the Marburg school, F. A. Lange, clearly connected his work to the socialist movement through his text (1865) *Die Arbeiterfrage: Ihre Bedeutung für Gegenwart und Zukunft* [The Worker Question: Its Meaning for the Present and Future] (Pascher 1997). The moderation of socialist politics under the Erfurt program, crafted in the wake of

5. Citing “Deutsches Zentralarchiv II, Merseburg, Papers of the Prussian Ministry of Churches, Education, and Medical Affairs” (*Repetorium* 76, Va, Sek. 1, Abt. IV, Nr. 42, Bd. II).



new parliamentary legislation by Karl Kautsky and Eduard Bernstein and introduced in 1891, was developed in close connection with the philosophy of Lange and, to a lesser degree, Cohen. Eduard Bernstein's widely influential *Die Voraussetzungen des Sozialismus* [The Presuppositions of Socialism] effectively displaced the Marxist basis of the socialist party with a Kantian foundation based on Lange (Bernstein 1899, pp. 187ff). By the time of his 1896 introduction to Lange's *Geschichte des Materialismus und Kritik seiner Bedeutung in der Gegenwart* [History of Materialism and Critique of its Meaning in the Present]—a best-seller of its day and a widely visible forum—Cohen would closely link his re-reading of Kant with ethical socialism and claim that: “Kant is the true and actual creator of German socialism” (Lange 1896, p. 112). The direct application of the Marburg school's philosophy to the social democratic movement continued in the work of figures such as Karl Vörländer, Kurt Eisner, and Ernst Reuter (Sieg 1993, pp. 225ff.; Vorländer 1911). Particularly in Vorländer's reading, presented in *Kant und Marx* (1911), it was argued that Cohen's philosophy established the best basis for the modern social democratic party.

A second change accompanied this political shift, and ultimately proves more consequential for understanding the Marburg school: the enormous increase in the power of administrative and bureaucratic reform in Germany, and its close interrelation with scientific and academic institutions. For despite the strides made by the socialist party and progressivism in Germany, political innovation was frequently blocked on the level of party politics by the so-called “sham-constitutionalism” of the German political system (Blackburn and Eley 1992, pp. 98–126, 261–285). Despite this impediment, optimism about progressive change on the institutional and administrative level became perhaps all the more prevalent. The historian and sociologist Alfred Weber vividly suggests this dualism in an autobiographical fragment commenting on the youthful view of Germany he and his brother, the sociologist Max Weber, shared:

Both of us saw since the time of the disempowerment of parliament in 1878 how senseless a real political career was in the now dominant pseudo-constitutionalism [*Scheinkonstitutionalismus*]. By pressing for reforms within Germany's vast administrative apparatus, change could develop from the bottom, or perhaps better, from the ‘middle’ up, and thus by-pass opposition to this process. We limited ourselves therefore to criticism in the newspapers, to discussing and constructively orientated engagement on attempts at economic and social reform (Von Brucke, p. 287).<sup>6</sup>

6. Bundesarchiv Koblenz, Kleine Erwerbungen, Bestand Alfred Weber, Nr. 8 von Alfred Weber diktierte masch. Schr. Kurzbiographie von Sept. 1947.

Much as Weber claimed, this apparatus did indeed often “by-pass opposition” to progressive reform by working from the “middle up,” as is suggested by both the real gains in worker and women’s rights before the First World War and the growing frustration of the lower class with their isolation from this process (Blackbourne and Eley 1992, pp. 261–292). As the historian Kevin Repp notes, Kaiser Wilhelm II’s decrees of February 1890, which promised a progressive vision of “social peace,” served to emblemize for an intellectual “generation of 1890” the potential for progressive advocacy within a bureaucratic and technocratic framework (Repp 2002, pp. 19ff.). Followed by new legislation in 1891 that greatly modernized German working laws, and indeed made them among the most progressive in the world, the era seemed to be one of general modernization and progress. Contrary to our retrospect view, recent historiography stresses that the emerging extremist politics on both sides appeared at this time to the vast majority of Germans as just that—extremist—while the progressive state seemed to provide real hope for advancement to the majority.

It is easy for us to underestimate the power of administrative reform in *fin-de-siècle* Germany, and the promise it presented to the “generation of 1890,” precisely due to the administration’s singular, and dominant, place in German life. As David Lindenfeld notes in *Practical Imagination: German Sciences of the State in the Nineteenth Century*, the actual governance of Germany ran to an unprecedented degree through administrative and bureaucratic channels (Lindenfeld 1997, pp. 205–331). These were in turn closely coupled with academia, either through their involvement in direct leadership or by their influence on German foreign policy and the vast German bureaucracy (Lindenfeld 1997; Jarusch 1990). The American socialist Frederick Howe summarized this relation in a survey of Germany immediately before the Great War in which he found it remarkable how: “Educational institutions are all closely identified with the state . . . the universities and technical schools are consciously allied with the administration of the empire” (Howe 1915, p. 15).

More disturbingly, this administrative control, as the historians Detlev Peukert and Geoffrey Eley have argued, was increasingly coupled with new state concerns about biology and social control, enacted through the judiciary and civil services, and justified foremost by reference to science and scientific experts (Peukert 1989, pp. 102–121). Even the basic concept of “work,” “efficiency” and “workers rights,” Anson Rabinbach has argued, were closely entwined with broader scientific debates on the science of physiology and nature of energy (1992, pp. 1–84, 146–238). As Barbara Harrington and others have noted, in the field of biology as well as in the wider society, progressive and utopian schemes often were pro-

moted through a scientific conduit—even as they were in turn often viewed as potentially pivotal for public policy (Harrington 1996, pp. 1–72)

It was in this context that the Marburg school's critique of science, both the natural and "cultural" science of the day, took place, and it was in this context that both Cohen and Cassirer rose to positions of considerable power within the academic hierarchy. Cassirer, much like the Weber brothers, was very much a product of the "generation of 1890" in his relation to the Marburg school. Indeed, through his relation to Cohen's philosophy and his academic prominence, Cassirer was in the ideal position for a member of this generation to shape German thought and institutions. He was, after all, potentially the individual best situated for popularizing one of the key socialist thinkers of his era and reshaping the contemporary definition of science and progress. Cassirer was also aware, however, of the threat contained in the massive administrative state of Germany. In this light, as Cassirer's 1912 appreciation of Cohen suggests, Cassirer might hope that Cohen's philosophy would check the dangers of the naïve application of natural and cultural science to German society. It will not be coincidental that beginning already in his estimation of Cohen in 1912, as well as in his first book on Leibniz, Cassirer's work will critique scientific definitions of biology and their influence on politics and "cultural science" (Cassirer 1912, p. 261; Cassirer 1902, pp. 355–487). This project culminates in Cassirer's later fourth volume of his *Problem of Knowledge*, where the bulk of the book summarizes the German debate on biology since Kant (Cassirer 1978, pp. 118–217). Both in this specific project and in his general work, Cassirer had every reason to hope that Cohen's functionalism would act as a catalyst for progressive change and critical reflection in German society. Although such hope might in retrospect appear naïve, in its historical context it would have appeared as both a plausible and coherent approach for instituting change.

#### **Cassirer's Reception of Cohen, Part One: The Early Works**

Cohen's critical philosophy accomplished what Cassirer took to be the most important political project of his day: a criticism of the false dogmatism of natural and social science, and particularly the popular illusion that they presented a direct picture of the world and human nature (Cassirer 1953, pp. 282–283). In the simplest terms, Cohen's philosophy was meant to combat dogmatism, and particularly the instantiation of dogmatism through natural science, and to defeat naïve beliefs that science had achieved its final truths about either other people or the world. Indeed, in the *Infinitesimalmethode* book, Cohen writes that his technique of the critique of knowledge is intended to prevent all dogmatism (1984a,

p. 6). Broadly sketched, this project could be divided into a two-fold attempt to prevent objective and subjective dogmatism (Marx 1975). The first, objective dogmatism, was the basis of the *Wissenschaftsglaubigkeit* [naïve faith in science] of the period, and held that science was a one-to-one mapping of objective reality that will endure for all time. The second, subjective dogmatism, rose conversely from an anti-rationalism that would forgo any form of proof or justification and justify “intuitive” readings of society and other people. Both dogmatisms assumed an underlying essential, “substantive” unity that underlay experience. For Cohen, the second form of dogmatism was found most clearly and popularly in Schopenhauer’s definition of will. Although agreeing with Cohen’s negative assessment of Schopenhauer, Cassirer was later more concerned about the rise of “life-philosophy” of the sort associated with Klages (Cassirer 1993). Cohen’s work was also, in Cassirer’s reading, intended to substitute for this dogmatism a new philosophical position, his philosophy of origin as a form of process philosophy or difference philosophy.

Cassirer’s first explicitly political text, the wartime book *Freiheit und Form* [Freedom and Form] (1916), is often read as suggesting the political role of the critique of knowledge (Ferrari 1999). In it, Cassirer demonstrated how a specific German path to liberal democratic politics could be developed through a close reading of figures such as Nicholas of Cusa, Leibniz, Kant, Fichte, and Hegel. The irony of the text, as with Cassirer’s *Rektorsrede* twelve years later, is that it argued that western European definitions of liberal democracy—in 1916 the subject of wartime xenophobia—were in fact developed on the basis of ideas intrinsic to the German tradition. Leibniz and Wolff’s functional definition of the subject, for instance, is said to be an influence on Blackstone’s constitutional thought (Cassirer 1994e, pp. 314ff.). This sleight of hand on Cassirer’s part is usually explained as his own best attempt to counter the rising anti-western and anti-liberal tide of Germany by reversing the presupposition that liberal democracy was “foreign” to German tradition.

Although no doubt true, this reading misses the deeper rationale for Cassirer’s argument. Precisely due to its philosophical tradition, Germany had in Cassirer’s view developed a highly fungible definition of subjectivity, objectivity, and, indeed, “reality.” This tradition made the German concept of democracy and equality at once richer and more precarious. A proper understanding of this tradition, particularly of the sort Cassirer thought his functionalism provided, would ground liberalism and equality on a basis that was more tenable in Germany than its British form. A functionalist definition of subjectivity and objectivity would emphasize the manner in which forms of subjectivity and objectivity are the creation of different constellations of law and forms of knowledge. Cassirer summa-

izes this notion of law in a creative re-reading of Fichte in *Freiheit und Form*: “the stability of law doesn’t follow from the being [*Dasein*] of various different subjects, but from the recognition that the necessary validity of a norm of law is itself the *condition* [*Bedingung*] for the [possibility] that the ‘I’ will take itself not as an empirical thing, but as free, self-determining [*sich selbst bestimmende*] reasonable being” (Cassirer 1994e). The influence of this insight, particularly through Hans Kelsen, was significant enough that a well-recognized survey of German law by Siegfried Marck—*Substanz- und Funktionsbegriff in der Rechtsphilosophie* (1927)—would not only explicitly borrow the title of Cassirer’s 1910 text, but also describe the development of law in the previous thirty years as a movement from “the idea of substance to the idea of function” (Marck 1925, pp. 148ff.)

The title of Marck’s book, however, already suggests the continuity of Cassirer’s “political” text of 1916 with his history of science from before the war. For the corollary of Cassirer’s political argument was that such a “constitution”—in the full sense—must also guard against the instantiation of *false* or substantive definitions of subject and object. Such a danger of course existed in German political traditions, but they were just as readily apparent—as Cassirer’s 1912 article on Cohen suggests—through false scientific definitions of subject and object, such as those developing in psychophysics, naïve materialism, or social Darwinism.

Far from being Cassirer’s “first” political text, we can now understand *Freiheit und Form* as the culmination of the project Cassirer began in the Wilhelminian period in his philosophy of science. In his *Substanzbegriff*, Cassirer concludes that the description of subject and object are variable in relation to different “knowledge ideals,” while the *Erkenntnisproblem* series demonstrates this variability historically. In *Substanzbegriff*, the theoretical starting point for this argument is found in the observation that: “If we consult immediate experience unmixed with reflection, the opposition of ‘subjective’ and ‘objective’ is shown to be wholly foreign to it” (Cassirer 1953, p. 272). The relation of “thought and being, the subject and object of knowledge” is nonetheless a fundamental relation that constitutes each era. “This one opposition conceals all others within it and can progressively develop them” (Cassirer 1953, p. 271). The basis of this structure of knowledge is in itself historical and relative, even as it provides access to hypothetical “invariants” (Cassirer 1953, p. 268; Ihmig 1997): “Thus the question is no longer what absolute separation underlies the opposition of ‘inner’ and ‘outer,’ the ‘presentation’ and the ‘object’; the question merely is from what standpoints and by what necessity does *knowledge itself* reach these divisions. . . . The same content of experience can be called subject and objective, according as it is conceived relatively to different logical points of reference” (Cassirer 1953, pp. 272, 275). The ultimate

explanation of how “the same content of experience” can take on different meanings, and thus of how subjective and objective change in time, is found in precisely the form of judgment that Cohen first developed in relation to the problem of the infinitesimal (Cassirer 1994a, p. 18). Thus Cassirer defines the transformation of any particular “fact” of perception or natural science in relation to its context in experience and knowledge as follows:

The particular presentation reaches beyond itself, and all that is given *means* something that is not directly found in itself; but it has already been shown that there is no element in this ‘representation’ which leads beyond experience as a total system. Each particular member of experience possesses a symbolic character, in so far as the law of the whole, which includes the totality of members, is posited and intended in it. The particular appears as a differential, that is not fully determined and intelligible without reference to its integral (Cassirer 1953, p. 300).

By focusing on the problem of the particular’s determination as defined by the infinitesimal, Cassirer can explain how any particular moment of experience, “subjective” or “objective,” is defined in relation to ideal functions in a particular theoretical or historical epoch. These will, of course, include not only mathematic or scientific laws, but laws of ethics or jurisprudence. The “constitution” of a society establishes not only how given subjects should act in relation to one another and objective possessions, but how and what a subject or object is defined as in the first place (Pascher 1997, pp. 92–107; Poma 1997, pp. 103–130). This also will provide a hypothetical starting point for science, indeed for all fields of knowledge, outside the established dogmatisms of subject and object of his own era (Cassirer 1953, p. 309).

Cassirer notes in *Substanzbegriff* that the problem of conceptualization received a new emphasis “when we advance from purely logical considerations to the concept of knowledge of reality” in natural science (Cassirer 1953, p. iv). The full implications of this approach only become apparent with Cassirer’s *Erkenntnisproblem* series. Here it becomes clear that pure relations co-create both “being” and “thought” on a level that will not only transform Cassirer’s reading of science, but also of history (Cassirer 1953, pp. iv, 309). In the introduction to the first volume of the *Erkenntnisproblem*, Cassirer makes it clear that his application of Cohen’s philosophy is to describe how dominant ideas of subjectivity and objectivity were derived from both historical practice and the practice of science. This variability means that knowledge as a whole—broadly construed by Cassirer as the totality not only of the ideals of society but also of its practices in art, sci-

ence, and politics—determines the reality of an era. “In general we have to be clear, that ‘subject’ and ‘object’ are no given or obvious possession of thought, but that every truly creative epoch must first acquire them and must spontaneously impress upon them their meaning” (Cassirer 1994a, p. 8). The ideal functions of society both produce and are products of its practices. “For the self,” as Cassirer wrote in *Substanzbegriff*, “comprehends and constitutes itself only in some form of activity” (1953, p. 342); “being” [sein] and “thought” [denken] interrelate to create new perspectives and possibilities for knowledge, just as the knowledge ideal of a given era first establishes the constellation of being and thought (Cassirer 1994a, p. 9). The two together, in keeping with the *Erkenntniskritik*, explain the immediacy of “experience” as a historically conditioned phenomenon. “The problem of ‘experience’ is not just given,” Cassirer writes, “but is one of the most difficult problems and must be derived from the practices and theories of each age, not only in what it says, but also in its activities” (Cassirer 1994a, p. 10). Cassirer emphasizes that only in natural science can we gain the *methodological* insight into the meaning of each period through its “idea of knowledge” [*Erkenntnisbegriff*] (Cassirer 1994a, p. 11). The importance of science and philosophy for Cassirer will be that both are “symptoms of one and the same intellectual development” (Cassirer 1994a, p. 10). Even to say that philosophy and science “influence” each other suggests that the basic point at stake is overlooked, for they are rather part of the entirety of culture in its interaction (Cassirer 1994a, p. 10).

Taken together, the *Erkenntnisproblem* series and *Substanzbegriff* demonstrate the pivotal role of natural science in constructing philosophical and political reality. The former highlights the leading role of scientific conceptualization in determining the place of “subject” and “object” positions in society, and then demonstrates how these ideals interact with philosophy, political theory, and broader forms of culture. The latter attempts to define the emerging knowledge ideal of the present era, and to critique false assessments of contemporary science. Together, they spell out the implications of Cohen’s approach in the *Infinitesimalmethode* by suggesting how science by definition is implicated in the entirety of a society’s self-understanding.

Ironically, however, Cassirer’s expansive use of Cohen’s figure of the *infinitesimal* in *Substanzbegriff* as a model for understanding determination is matched by his downplaying the literal role of calculus as the embodiment of this judgment (Funkenstein 1986). Earlier in Cassirer’s *Substanzbegriff*, Cohen’s use of calculus in his *Logik* is defended. The logical principle at stake is said to be even more clearly seen in other, newly emergent fields of mathematics:

Cohens' *Logik der reinen Erkenntnis* developed its fundamental thought of the Source [*Ursprung*] in connection with the principles of infinitesimal calculus. Here, in fact, is the first and most striking example of the general point of view, which leads from the concept of magnitude to the concept of function, from 'quantity' to 'quality' as the real foundation. In advancing to other fields of modern mathematics, the logical principle here established gains new confirmation. However different these fields may be in content, in structure they all point back to the fundamental concept of the Source. The postulate of this concept is fulfilled wherever members of a manifold are deduced from a definite serial principle and exhaustively represented by it. The most diverse forms of 'calculus,' in so far as they satisfy this condition, belong to one logical type . . . (Cassirer 1953, p. 99).

Even in praising Cohen's work, however, Cassirer appears to be distancing himself from it. For by broadening the concept of the *Infinitesimalmethode* to include nearly all of modern mathematics, Cassirer also seems to be disallowing the particular prominence of calculus as the key to philosophy (Cassirer 1953, p. 99). The continuous relation of Cohen's *Infinitesimalmethode* to his *Logik*, and with it the idea that the models of natural science *directly* prefigure those of wider society, is unseated. Cohen noticed this transposition of the place of calculus from the earlier drafts of Cassirer's *Substanzbegriff*, and appears to have considered it a sign that the specific importance of calculus was being replaced by a general reading of functional and serial relations. Cohen's central complaint was that the work lacked a proper reading of "the concept of relation . . . as it is a function, and function unavoidably demands the infinitesimal element in which alone the root of the ideal reality can be found" (Schilpp 1973, p. 21). Cassirer appears to agree that the general problem of determination, the judgment of the particular, is developed on the model of the infinitesimal, but he does not hold that only in the infinitesimal element of calculus can "the root of the ideal reality" be found. By generalizing the role of the infinitesimal, Cassirer can use it as a basis for the general form of the theory of knowledge while at the same time establishing a more secure basis in contemporary science for Cohen's philosophy of origin or source.

#### **Cassirer's Reception of Cohen, Part Two: The Metaphor of Calculus in Cassirer's Later Works**

The fundamental importance and meaning of Cohen's model of the infinitesimal for Cassirer can be seen in the way it continues to play a central role in his philosophy even after Cassirer moves from the philosophy



of science to a phenomenology of symbolic forms (Capiellères 1997; Seidengart 1994). Despite the vast change in his “theory of knowledge” from one concerned with “problems of truth” to “problems of meaning,” this continuity is clearly visible from the very beginning of his *Philosophy of Symbolic Forms* (1921–1927) (Cassirer 1993b, p. 81). Summarizing the value of Kant for a theory of knowledge using Cohen’s scheme, Cassirer essentially summarizes the importance of the model of calculus as we have sketched it out so far:

The element of consciousness is related to the whole of consciousness not as an extensive part to a sum of parts, but as a differential to an integral. Just as the differential equation of a moving body expresses the trajectory and general laws of its motion, we must think of the general structural laws of consciousness as given in each of its elements, in any of its cross sections—not however in the sense of independent contents, but of tendencies and directions which are already projected in the sensory particular. This precisely is the nature of a content of consciousness; it exists only in so far as it immediately goes beyond itself in various directions of synthesis. The consciousness of the moment contains reference to temporal succession; the consciousness of a single point contains reference to space as the sum and totality of all possible designations of position; and there are countless analogous relations through which the form of the whole is expressed in the consciousness in particular. The ‘integral’ of consciousness is constructed not from the sum of its sensuous elements (a, b, c, d . . . ) but from the totality, as it were, of its differentials of relation and form ( $dr_1, dr_2, dr_3, dr_4 . . .$ ) (1955a, pp. 104–5).

Cassirer goes beyond this rehearsal of Cohen’s reading of Kant, however, in using the theme of the infinitesimal in his dense, and crucial, description of symbolic pregnancy [*Prägnanz*], the theorem that is to explain how we perceive any symbol at the limits of epistemology and ontology, individual and social perception. Symbolic pregnancy will explain for Cassirer how matter and form collude in the immediacy of perception to create not just different objects, but different forms of meaningful experience. Cassirer writes: “No conscious perception is merely given, a mere datum, which need only be mirrored; rather, every perception embraces a definite ‘character of direction’ by which it points beyond the here and now. As a mere perceptive differential it nevertheless contains within itself the integral of experience (1957, p. 203). The most fundamental implications of this philosophical trope forms the principle that allows Cassirer to define

different modes of experience through functions of expression, representation and signification.

Cassirer is often criticized for pursuing an “ontic” science and philosophy in the new age of ontology, but his philosophy and history seek to explain both the *horizon* of meaning ontology claims for itself and why this horizon can never be definitively described. The project of a pure “ontology” is for Cassirer impossible since it is always open to a critique of the form now known as the “linguistic turn”—expression of ontological meaning, as with epistemological truth, will always be inflected by the medium in which it is presented. Cassirer explicitly makes this argument not against his famous opponent Martin Heidegger, but against the ontology of Nicolai Hartmann. In a 1927 critique of Hartmann, Cassirer writes that the entire project of a philosophical ontology is particularly susceptible to the form of “language critique” of the type popularized by Fritz Mauthner (Cassirer 1993b, p. 148). As Jürgen Habermas has written, one of the ironies of the later Davos debate with Heidegger was that Heidegger was deaf to Cassirer’s complaints not because of Cassirer’s out-of-date “neo-Kantianism,” but because Heidegger’s own “linguistic turn” would not occur until years after the debate (Habermas 1997, p. 99). “Being in the new metaphysics is, in my language,” Cassirer says at Davos, “no longer Being of a substance, but rather the Being which starts from a variety of functional determinations [*Bestimmungen*] and meanings. And the essential point which distinguishes my position from Heidegger’s appears to me to lie here” (Heidegger 1997, p. 206; Heidegger 1991, p. 294). Whereas Heidegger can be understood as using the Marburg school’s definition of continuity to present a schema for an existential structure of care, Cassirer claims that this structure only has meaning in a particular use, and thus as part of a specific moment of history. Any moment of experience is thus still overdetermined by a series of functions within a “polycontextual” world. Whether Cassirer or Heidegger adequately grasps their opponent’s respective philosophy is too broad of a topic to address here. What can be seen, however, is that Cassirer’s earlier functional critique of any claims to an absolute foundation to experience is translated directly into the new context using several of the key themes initially developed in Cohen’s *Infinitesimalmethode*.

### Conclusion

Cohen’s *Infinitesimalmethode* was formulated in terms of the specific history and philosophy of natural science at least in part to appeal to the widest possible audience and to address the most pertinent issues of its era, while at the same time fitting within the relatively narrow range of political acceptability of the German academic establishment. As Cassirer’s 1912 ret-

pective on Cohen argued, Cohen's work focused on what he took to be the key problem of his era: the false naturalization and hypostatization of natural science. Even as he chose to address his philosophy through one of the most acceptable channels of concern in Wilhelmine Germany, the primacy of natural science, his goals were quite different than those contained in the mainstream scientific and pseudo-scientific writings in Germany. Cohen sought to instill an irrevocable skepticism towards a deterministic or "substantial" definition of natural science, even as he hoped to explain the success and possibilities of natural science on a new level—a level that he believed would open on to a new definition of the human future.

Cassirer's reception of Cohen allows us to see that the core of Cohen's argument was not, in fact, its precise description of calculus, but its general pertinence as a functionalist model for understanding modern scientific conceptualization. Once the critical component of this model as a process or "functionalist" philosophy was understood, it was equally viable as a tool in social and cultural science, law, and history. Cassirer's early work follows Cohen in seeking to open to criticism the manner in which contemporary definitions of subject and object, and indeed of experience generally, are constructed. The importance of such a project is clear when placed within the broader setting of Wilhelmine Germany, in which the administration of knowledge, and its translation into specific research and social forms that in fact defined subjects and objects, was gaining unprecedented prominence. Cassirer's *Erkenntnisproblem* provided a historical study of how definitions of the form and content of natural science frequently cascade through all of a society's philosophy and politics. It is not surprising that he would be deeply concerned with the consequences of this process in his own time. In his *Substanzbegriff*, Cassirer attempted to outline the leading edge of natural science and to draw from it a new functionalist philosophy. Although couched strictly as a philosophy of science, in light of his later work it seems likely that Cassirer saw this text within the framework of Cohen's larger ambitions of ensuring the construction or "constitution" of a modern "subject" that entailed maximum freedom, and a corresponding modern definition of "objects" that was open to future criticism and permutation. What neither Cohen nor Cassirer anticipated, however, was that following the First World War Europe's optimistic reading of natural science as the leading sector and most humane element of human thought would itself collapse. Although this now appears obvious, it is critical to avoid historical bias and see how in the Wilhelmine era the fusion of the philosophy of science with a political project may have seemed imminent with the hopeful future of Germany.

## References

- Bernstein, Eduard. 1899. *Die voraussetzungen des Sozialismus und die aufgaben der Sozialdemokratie*. Stuttgart: J. H. W. Dietz.
- Beyerchen, Alan. 1988. "On the Stimulation of Excellence in Wilhelminian Science." Pp. 139–169 in *Another Germany: A Reconsideration of the Imperial Era*. Edited by Jack R. Dukes and Joachim Remak. Boulder: Westview Press.
- Berkeley, Bishop George. 1734. *The Analyst, or a Discourse Addressed to an Infidel Mathematician*. London: J. Tonson.
- Blackbourn, David and Eley, Geoffrey. 1992. *The Peculiarities of German History: Bourgeois Society and Politics in Nineteenth Century Germany*. New York: Oxford University Press.
- Capellères, Fabian. 1997. "Fonction et système: sur le paradigme de l'intégrale et de la dérivée dans le concept de 'forme symbolique.'" Pp. 337–261 in *Ernst Cassirer 1945–1995: Science et culture*. Edited by N. Janz.
- Cassirer, Ernst. 1902. *Leibniz' System in seinen Wissenschaftlichen Grundlagen*. Marburg: N.G. Elwert'sche Verlagsbuchhandlung.
- . 1906. "Der kritische Idealismus und die Philosophie des 'Gesunden Menschenverstandes.'" *Philosophisches Arbeiten*, Vol I, No. 1. Edited by Hermann Cohen and Paul Natorp. Giessen: Töpelmann.
- . 1912a. "Hermann Cohen und die Erneuerung der Kantischen Philosophie." *Kant-Studien* XVII (3):252–273.
- . 1912b. "Das Problem des Unendlichen und Renouviere's 'Gesetz der Zahl.'" Pp. 85–98 in *Philosophische Abhandlungen, Herman Cohen zum 70. Geburtstag dargebracht*. Berlin: Bruno Cassirer.
- . 1929. *Die Idee der Republikanischen Verfassung: Rede zur Verfassungsfeier am 11. August 1928*. Hamburg: Freiderichsen, De Gruyter and Co.
- . 1931. "Kant und das Problem der Metaphysik: Bemerkungen zu Martin Heideggers Kant-Interpretation." *Kant-Studien* XXXVI: 1–26.
- . 1943a. "Herman Cohen, 1842–1918." *Social Research*. 10:219–232.
- . 1943b. "Newton and Leibniz." *Philosophical Review*, 52: 366–391.
- . 1953. *Substance and Function & Einstein's Theory of Relativity*. Translated by William Curtis Swabey, Marie Collins Swabey. New York: Dover Publications.
- . 1955a. *The Philosophy of Symbolic Forms, Volume 1: Language*. Translated by Ralph Mannheim. New Haven: Yale University Press.
- . 1955b. *Philosophy of Symbolic Forms, Volume 2: Mythical Thought*. Translated by Ralph Mannheim. New Haven: Yale University Press.

- . 1956. *Determinism and Indeterminism in Modern Physics*. Translated by O. Theodor Benfey. New Haven: Yale University Press.
- . 1957. *The Philosophy of Symbolic Forms, Volume 3: The Phenomenology of Knowledge*. Translated by Ralph Mannheim. New Haven: Yale University Press.
- . 1961. *The Logic of the Humanities*. Translated by Clarence Smith Howe. New Haven: Yale University Press.
- . 1965. *An Essay on Man: An Introduction to a Philosophy of Human Culture*. 1st ed. New Haven: Yale University Press.
- , ed. 1966. *G.W. Leibniz: Hauptbrieffen zur Grundlegung der Philosophie*. 3rd ed. Hamburg: Felix Meiner.
- . 1978. *The Problem of Knowledge: Philosophy, Science and History since Hegel* (Vol. 4 of *Das Erkenntnisproblem*). Translated by William H. Woglom, Charles Handel. New Haven: Yale University Press.
- . 1981. *Kant's Life and Thought*. Translated by James Haden. New Haven: Yale University Press.
- . 1990. *Substanzbegriff und Funktionsbegriff: Untersuchungen Über die Grundfragen der Erkenntniskritik*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- . 1994a. *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit—Erster Band*. 2nd ed. Darmstadt: Wissenschaftliche Buchgesellschaft.
- . 1994b. *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit—Zweiter Band*. 3rd. ed. 4 vols. Vol. 2. Darmstadt: Wissenschaftliche Buchgesellschaft.
- . 1994c. *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit—Dritte Band Die Nachkantischen Systeme*. 2nd ed. 4 vols. Vol. 3. Darmstadt: Wissenschaftliche Buchgesellschaft.
- . 1994d. *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit—Vierter Band: Von Hegels Tod bis zur Gegenwart*. 4 vols. Vol. 4. Darmstadt: Wissenschaftliche Buchgesellschaft.
- . 1994e. *Freiheit und Form: Studien zur Deutschen Geistesgeschichte*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- . 1999. *Ziele und Wege der Wirklichkeitserkenntnis*. Edited by John Michael Krois and Klaus Christian Köhnke. 20 vols. Vol. 2, *Nachgelassene Manuskripte und Texte*. Hamburg: Meiner Verlag.
- Cassirer, Toni. 1950. *Aus meinem Leben mit Ernst Cassirer*. New York: (privately issued).
- . 1981. *Mein Leben mit Ernst Cassirer: Erinnerungen von Toni Cassirer*. 2nd ed. Hildesheim: Gerstenberg Verlag.
- Cohen, Hermann. 1925. *Kants Theorie der Erfahrung*. 4th ed. Berlin: Bruno Cassirer.

- . 1928. *Hermann Cobens Schriften zur Philosophie und Zeitgeschichte*, Vol 1. and Vol. 2. Berlin: Akademie-Verlag.
- . 1984a. *Das Prinzip der Infinitesimal-Methode und seine Geschichte: Ein Kapitel zur Grundlegung der Erkenntniskritik*. Edited by Peter Schulthess. 4th Edition. Vol. 5, Part I, *Werke*. Hildesheim: G. Olms.
- . 1984b. *Einleitung mit kritischem Nachtrag zu F.A. Langes Geschichte des Materialismus*. Edited by H. Holzhey. 3rd ed. Vol. 5, Part II, *Werke*. Hildesheim: G. Olms.
- . 1987. “Kant’s Logik der reinen Erkenntnis. 1. Auflage.” In Hermann Cohen, *Werke Bd. 1, Teil 3*. Edited by H. Holzhey. New York: George Olms.
- . 1997. “Logik der reinen Erkenntnis. 4. Auflage.” In Hermann Cohen, *Werke Bd. 6, Teil 1*. New York: George Olms.
- Cohen, Martha and Hermann. 1997. “Das Testament von Hermann und Martha Cohen. Stiftungen und Stipendien für jüdische Einrichtungen.” In *Zeitschrift für Neuere Theologiegeschichte*. Edited by Ulrich Sieg. Volume 4, Issue 2: 251–264.
- Frege, Gottlob. 1967 “Rezension von: Cohens *Das Infinitesimalmethode und seine Geschichte* (1885).” Pp. 99–102 in *Kleine Schriften*. Edited by Ignacio Angelelli. Hildesheim: Georg Olms. First published in *Zeitschrift für Philosophie und philosophische Kritik*, 1885, 87:324–329.
- . 1984. Translation of “Rezension von: Cohens *Das Infinitesimalmethode und seine Geschichte* (1885).” Pp. 108–111 in *Collected Papers on Mathematics, Logic, and Philosophy*. Trans. Black, Dudman, Geach, Kaal, Kluge, McGuinness, and Stoothoff. Edited by B. McGuinness. Oxford: Basil Blackwell.
- Friedman, Michael. 2000. *A Parting of the Ways: Carnap, Cassirer, and Heidegger*. Chicago, IL: Open Court Publishing.
- Funkenstein, Amos. 1986. “The Persecution of Absolutes: On the Kantian and Neo-Kantian Theories of Science.” *The Kaleidoscope of Science. The Israel Colloquium for the History and Philosophy of Science*, 1:329–48.
- . 1993. *Perceptions of Jewish History*. Berkeley: University of California Press.
- Ferrari, Massimo. 1999. “Zur politischen Philosophie im Frühwerk Ernst Cassirers.” Pp. 43–63 in *Cassirers Weg zur Philosophie der Politik*. Edited by Enno Rudolph. Hamburg: Felix Meiner Verlag.
- Gordon, Peter. 1999. “Science, Finitude, and Infinity: Neo-Kantianism and the Birth of Existentialism.” *Jewish Social Studies*, 6.1:30–53.
- Habermas, Jürgen. 1996. “Die befreiende Kräfte der symbolische Formgebung: Ernst Cassirers humanistisches Erbe und die Bibliothek Warburg.” Pp. 79–105 in *Ernst Cassirers Werk und Wirkung: Kultur und*

- Philosophie*. Edited by D. Frede and R. Schmücker. Darmstadt: Wissenschaftliche Buchgesellschaft.
- Harrington, A. 1996. *Reenchanting Science: Holism in German Culture from Wilhelm II to Hitler*. Princeton: Princeton University Press.
- Heidegger, Martin. 1927. *Sein und Zeit*. 17th ed. Tübingen: Max Niemeyer Verlag.
- . 1991. Zur Geschichte des philosophischen Lehrstuhles seit 1866. In *Kant und das Problem der Metaphysik*. Edited by F. W. v. Herrmann. Frankfurt am Main: Vittorio Klostermann.
- . 1997. *Kant and the Problem of Metaphysics*. Translated by Richard Taft. Edited by J. Sallis. Fifth ed. *Studies in Continental Thought*. Bloomington: Indiana University Press.
- Herf, Jeffrey. 1990. *Reactionary Modernism: Technology, Culture, and Politics in Weimar and the Third Reich*. New York: Cambridge University Press.
- Holzhey, Helmut. 1986. *Ursprung und Einheit: Die Geschichte der "Marburger School" als Auseinandersetzung um die Logik des Denkens*. 2 vols. Vol. 1. Basel: Schwabe & Co. AG.
- Howe, Frederic C. 1915. *Socialized Germany*. New York: Charles Scribner's Sons.
- Ihmig, Karl-Norbert. 1997. *Cassirers Invariantentheorie der Erfahrung und seine Rezeption des "Erlanger Programs"*. Hamburg: Felix Meiner.
- . 2001. *Grundzüge einer Philosophie der Wissenschaften bei Ernst Cassirer*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- Jarausch, Konrad H. 1990. *The Unfree Professions: German Lawyers, Teachers, and Engineers, 1900–1950*. Oxford: Oxford University Press.
- . 1982. *State, Society, and Politics in Imperial Germany: The Rise of Academic Illiberalism*. Princeton, NJ: Princeton University Press.
- Kaegi, Dominic and Enno Rudolph, eds. 2002. *Cassirer-Heidegger: 70 Jahre Davoser Disputation*. Hamburg: Felix Meiner.
- Kant, Immanuel. 1965. *Critique of Pure Reason*. Translated by Norman Kemp Smith. New York: St. Martin's Press.
- Kinkel, W. 1912. "Das Urteil des Urprungs." *Kant-Studien*, 17:274–282.
- Köhnke, Klaus Christian. 1996. *Der junge Simmel in Theoriebeziehungen und sozialen Bewegungen*. Frankfurt am Main: Suhrkamp.
- Krois, John Michael. 1982. "David R. Lipton, Ernst Cassirer: The Dilemma of a Liberal Intellectual in Germany, 1914–1933." *Journal of the History of Philosophy*, XX (2):209–212.
- . 1987. *Cassirer: Symbolic Forms and History*. New Haven: Yale University Press.
- . 1994. "Ernst Cassirer, 1874–1945." Pp. 9–43 in *Die Wissenschaftler: Ernst Cassirer, Bruno Snell, Siegfried Landsbut*. Edited

- by H. W. Eckardt. Hamburg 1994: Verlag Verein für Hamburgische Geschichte.
- . 1995. "Semiotische Transformation der Philosophie: Verkörperung und Pluralismus bei Cassirer und Peirce." *Dialektik*, (1):61–72.
- Kuntze, Friederick. 1906. *Die kritische Lehre von der Objektivität: Versuch einer weiterführenden Darstellung des Zentralproblems der kantischen Erkenntniskritik*. Heidelberg: Carl Winter's Universitäts-Verlag.
- Lange, Frederick Albert. 1925. *The History of Materialism and Criticism of its Present Importance*. Translated by Ernest Chester Thomas. 2nd ed. New York: Harcourt, Brace & Company.
- Lembeck, Karl-Heinz. 1994. *Platon im Marburg: Platon-Rezeption und Philosophiegeschichte*. Würzburg: Königshausen & Neumann.
- Lindenfeld, David. 1997. *The Practical Imagination: The German Sciences of State in the Nineteenth Century*. Chicago: University of Chicago Press.
- Lipton, David R. 1978. *Ernst Cassirer: The Dilemma of a Liberal Intellectual in Germany, 1914–1933*. Toronto: University of Toronto Press.
- Maimonides, Moses. 1956. *The Guide for the Perplexed*. Translated by M. Friedländer. New York: Dover Publications.
- Marck, Siegfried. 1925. *Substanz- und Funktionsbegriff in der Rechtsphilosophie*. Tübingen: J. C. B. Mohr.
- Marx, Wolfgang. 1975. "Cassirers Symboltheorie als Entwicklung und Kritik der Neukantischen Grundlagen einer Theorie des Denkens und Erkennens." *Archiv für Geschichte der Philosophie*, 57:188–206; 305–339.
- McClelland. 1980. *State, Society, and University in Germany 1770–1914*. Cambridge: Cambridge University Press.
- Orlow, Dietrich. 2002. *A History of Modern Germany: 1871 to the Present*. Upper Saddle River, NJ: Prentice Hall.
- Pascher, Manfred. 1997. *Einführung in den Neukantianismus*. Munich: W. Fink.
- Paetzold, Heinz. 1981. "Das Problem der Realität in Ernst Cassirers semiotischer Erkenntnistheorie." In *Zeichen und Realität*. Edited by K. Oehler. Tübingen: Stauffenberg Verlag.
- Peukert, J. K. 1989. *Max Webers Diagnose der Moderne*. Göttingen: Vandenhoeck u. Ruprecht.
- Poma, Andrea. 1997. *The Critical Philosophy of Hermann Cohen*. Translated by John Denton. Edited by K. R. Seeskin. *SUNY Series in Jewish Philosophy*. Albany: State University of New York Press.
- Rabinbach, Anson. 1990. *The Human Motor: Energy, Fatigue, and the Origins of Modernity*. Berkeley, CA: University of California Press.



- Repp, Kevin. 2000. *Reformers, Critics, and the Paths of German Modernity: Anti-Politics and the Search for Alternatives, 1890–1914*. Cambridge, MA: Harvard University Press.
- Ringer, Fritz K. 1990. *The Decline of the German Mandarins: The German Academic Community, 1890–1933*. Hanover, N.H.: Wesleyan University Press.
- Ritter, Joachim, ed. 1923. *Historisches Wörterbuch der Philosophie*. Stuttgart: Schwabe & Co. Verlag.
- Schilpp, Paul Arthur, ed. 1973. *The Philosophy of Ernst Cassirer. The Library of Living Philosophers*. La Salle, IL: Open Court.
- Schädelbach, Herbert. *Philosophy in Germany, 1831–1933*. Translated by Eric Matthews. Cambridge: Cambridge University Press.
- Seidengart, Jean. 1994. “Die philosophische Bedeutung des Unendlichkeitsbegriffs in Ernst Cassirers Neukantianismus.” Pp. 442–447 in *Neukantianismus: Perspektiven und Probleme*. Edited by Ernst Wolfgang Orth and Helmut Holzhey. Würzburg: Königshausen & Neumann.
- Sieg, Ulrich. 1991. “Althoff und die deutsche Universitätsphilosophie.” In *Wissenschaftsgeschichte und Wissenschaftspolitik im Industriezeitalter: Das “System Althoff” in historischer Perspektive*. Edited by Bernhard von Brocke. Hildesheim: Gerstenberg Verlag.
- . 1994. *Aufstieg und Niedergang des Marburger Neukantianismus: Die Geschichte einer philosophischen Schulgemeinschaft*. Würzburg: Königshausen & Neumann.
- . 2001. *Jüdische Intellektuelle im Ersten Weltkrieg: Kriegserfahrungen, weltanschauliche Debatten und kulturelle Neuentwürfe*. Berlin: Akademie Verlag.
- von Bruck, Rüdiger. 1980. “Wissenschaft, Politik, und öffentliche Meinung: Gelehrtenpolitik im Wilhelmischen Deutschland (1890–1914).” *Historische Studien*, Heft 435. Husum: Matthiesen Verlag.
- Vorländer, Karl. 1911. *Kant und Marx: ein Beitrag zur Philosophie des Sozialismus / von Karl Vorländer*. Tübingen: Mohr.
- Wolfson, Harry A. 1947. “Infinite and Privative Judgments in Aristotle, Averroës, and Kant.” *Philosophy and Phenomenological Research*, 8 (2):173–187.