

# Chapter 6

## The Physiology of the Sense Organs and Early Neo-Kantian Conceptions of Objectivity: Helmholtz, Lange, Liebmann

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### 6.1 Introduction

“We finally come,” wrote the philosopher Otto Liebmann in 1869, “to Johannes Müller’s doctrine of specific nerve energies, the importance of which for philosophy should not be understated” (Liebmann 1869, 30–1). Müller’s doctrine was a theory about the physiology of the sense organs that he defended most fully in his 1833–1840 *Handbook of Human Physiology*. Müller wanted to explain the fact that the sensations associated with the five human senses have their own characteristic qualities (or “energies” in Müller’s archaic use of the word). Thus the quality of visual sensations differs from the quality of auditory sensations, which differ from the quality of tactile sensations, and so on. He amassed a collection of experimental results demonstrating that this difference could not be explained by differences in the external stimuli that cause the sensations, because, for example, one and the same stimuli – say, sunlight – causes both sensations of light and of warmth, depending on which nerves it stimulates. He posited instead that the sensory nerves associated with each of our five senses have their own specific physiological structure, and that these structures, rather than any properties of external stimuli, determine the different specific qualities of our sensations. Over the next several decades, philosophers like Liebmann would take Müller’s doctrine to have far-reaching consequences for their conceptions of knowledge and objectivity.

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In fact, when we trace the reception of Müller's doctrine among neo-Kantian philosophers in the 1850–1870s, we find a striking example of philosophers and philosophically-minded scientists taking an empirical, natural-scientific theory of the knowing subject, and constructing philosophical theories of knowledge in response to that scientific theory.<sup>1</sup> In particular, they constructed philosophical theories of what the objectivity of knowledge must consist in, if it is to be available to subjects as conceived on Müller's theory. For neo-Kantians like Liebmann and F.A. Lange, and for the philosopher-scientist who partly inspired their Kantianism, Hermann von Helmholtz,<sup>2</sup> the central epistemological insight of Müller's doctrine was this: if the character of a representation is determined by the nature of the subject's sensory or cognitive apparatus, rather than by the properties of mind-independent objects, then just because of that fact, the representation will not resemble mind-independent objects.<sup>3</sup> Helmholtz, Lange, and Liebmann all take this insight to entail a striking philosophical conclusion: on its basis, they all argue that the objectivity of human knowledge cannot consist in its having any relation to a mind-independent world. They thus stake out views of objectivity that are starkly at odds with the views of some of their most high-profile contemporaries, perhaps most significantly, scientific materialists such as Ludwig Büchner, Karl Vogt, and Jacob Moleschott.

But apart from their philosophical interest, these neo-Kantians' arguments are interesting for a more general historical reason. They illustrate an important feature of the intellectual landscape of the German-speaking world following the collapse of Hegelian idealism, and during and after the materialism dispute of the 1850s, a long-running and at times vitriolic controversy about whether advances in natural science were leading to materialism and atheism. The neo-Kantians' arguments illustrate how during that period natural science's broader cultural authority was increasing relative to philosophy's, and philosophy's authority was diminishing relative to natural science's – a situation that provoked no small amount of anxiety among

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<sup>1</sup>My account thus contrasts with that of Daston and Galison (2010), who identify ways that *scientists'* conceptions of objectivity changed in the second half of the nineteenth century in response to *philosophical* conceptions of the subject and subjectivity. I take my account to complement theirs, rather than contradict it, since the history of post-Kantian theories of objectivity is complicated and clearly contains contrasting trajectories of ideas.

<sup>2</sup>Helmholtz, unlike Lange and Liebmann, did not identify himself unambiguously as a neo-Kantian. I treat him here as a neo-Kantian partly because (as we will see in Sect. 6.3) he was at pains to emphasize the Kantian dimensions of his philosophy, and partly because his efforts to articulate a Kantian vision of philosophy set an agenda for philosophers like Lange, who did self-identify as neo-Kantian.

<sup>3</sup>I do not intend to endorse the sweeping epistemological generalization that Helmholtz, Lange, and Liebmann see as the epistemological insight of Müller's doctrine, nor will I attempt much in the way of a defence of their view that Müller's doctrine provides evidence for it. I here accept the generalization provisionally, only in order to uncover and evaluate Helmholtz's, Lange's, and Liebmann's arguments about the consequences it would have, if true, for the concept of objectivity.

philosophers. We can see precisely that situation manifested very concretely in the arguments of philosophers who appropriated empirical results and theories from natural science for use as evidence in philosophical disputes.

I aim to explain how reflection on Müller's doctrine led these neo-Kantians to reject the view that our knowledge's objectivity consists in resembling or being determined by mind-independent objects. To this end, I begin in Sect. 6.2 with a foil for the neo-Kantians, the scientific materialist Ludwig Büchner. Then Sect. 6.3 takes up Helmholtz in the 1850s. There is significant overlap between Büchner's and Helmholtz's views in the 1850s: they agree that natural science is a paradigm of knowledge and that philosophical doctrines must derive some or all of their justification from them; they also agree that the content of our objective knowledge consists in images that resemble spatially-arrayed matter and causal forces in the external world. The important difference between them, for my purposes, is Helmholtz's concern for Müller's doctrine: while Büchner and Helmholtz agree that our sensations of secondary qualities like colour, tone, or smell are subjective, only Helmholtz appeals explicitly to Müller's doctrine to establish this claim. He argues that since on Müller's doctrine the character of our sensations of secondary qualities is determined by our sensory nerves, those sensations do not resemble the external objects that occasion them. Further, since for Helmholtz in this period, representations are objective only when they resemble the external objects that occasion them, it follows for him that our sensations of secondary qualities are subjective.

However, while Müller's doctrine itself concerned only sensations of secondary qualities, it provided a model that Helmholtz, Lange, and Liebmann use to extend its central epistemological insight to other classes of representations. If they could show that other classes of representations are, like sensations of secondary qualities, determined by the subject's sensory or cognitive apparatus, it would follow that those classes of representation do not resemble mind-independent objects. Thus in the 1860s, Helmholtz appeals to Müller's doctrine to argue that representations of spatial structure are not, after all, images of any real spatial structure among external objects (Sect. 6.4). Lange (Sect. 6.5) and Liebmann (Sect. 6.6) make similar arguments not just for representations of spatial structure, but also extend their arguments to our representations of causal structure as well. Thus, Lange and Liebmann argue, since not even representations of primary qualities resemble mind-independent objects, *none* of our representations afford us information about mind-independent objects. Consequently, for Lange and Liebmann, if objective knowledge is to be available to humans, its objectivity can have nothing to do with a mind-independent world. Helmholtz, too, eventually (Sect. 6.7) arrives at the same conclusion. I conclude in Sect. 6.8 by considering briefly why these neo-Kantians' appeals to Müller's doctrine would have made for such powerful arguments against rival post-Hegelian conceptions of objectivity such as Büchner's.

## 6.2 A Materialist Conception of Objectivity: Ludwig Büchner

As the dominance of Hegel's speculative idealism ebbed in the 1840s and 1850s, a wave of philosophy claiming the authority of natural science constituted a major backlash against it. Scientific materialists like Büchner, Vogt, and Moleschott made both methodological and metaphysical criticisms of Hegel's speculative idealism.<sup>4</sup> Methodologically, they insisted against Hegel that knowledge derives ultimately from the senses, and thus that natural science, the method of which they took to be systematic empirical observation, is the paradigm of knowledge. Metaphysically, they insisted that what is real is inanimate, purposeless matter, and not any ideal or rational substance that develops teleologically according to its own natural purposes.

Büchner's *Force and Matter* offered a popular, non-technical expression of these views. First appearing in 1855, and aimed at popular and scientific audiences, rather than at professors of philosophy, it went through four editions in two years. In it, Büchner argues that the world ultimately consists of matter and a small number of forces (such as heat, electricity, magnetism, and mechanical force) that inhere in matter (Büchner 1855, Ch. 1/1864, Ch. 1).<sup>5</sup> Matter is spatially extended and force exists in space. On Büchner's view, force and matter are both explanatorily and ontologically basic. That is, natural science, and especially physics, reveals that our best explanations of natural phenomena are explanations that appeal only to the size, shape, and motion of matter, as well as to the forces that inhere in it. Thus for Büchner, natural science provides the authority for the philosophical claim that matter and force are the basic constituents of the world.

Büchner calls the world that consists of matter and force "the objective world" (Büchner 1855, 174, 183/1864, 168, 178–179). Thus for Büchner, "objective" is in the first instance a term that describes the world, and not knowledge. In particular, "objective" refers to the metaphysical fact about the world that it exists independently of our experience of it or our attempts to know it. Büchner thus uses the phrases "objective world" and "external world" interchangeably. (See for example Büchner 1855, 174/1864, 168.)

However, Büchner also uses the term "objective" in the context of *Force and Matter*'s central epistemological argument. Büchner's epistemology is a blunt empiricism, according to which all of our representations derive from the senses. He claims that the senses establish a "determinate relation" to the "external" or "objective" world, and that this relation is the source of all knowledge (Büchner 1855, 163, 174/1864, 159, 168). Consequently, Büchner insists that we have no a priori knowledge. He argues that even our most abstract representations – for example, our purportedly universal ethical and aesthetic ideals – ultimately derive

<sup>4</sup>For a detailed historical account of scientific materialism, see Gregory 1977.

<sup>5</sup>See Büchner 1855, 1–4/1864, 1–4 especially for his arguments that there is no matter without force inhering in it, and no force that does not in here in matter.

from the senses. (These representations seem not to derive from the senses only because the human race has acquired them through an empirical learning process so long that it began in prehistory.) Büchner claims that because these representations derive from the “determinate relation” to “the objective world” that the senses establish for us, they therefore have “objective form” (Büchner 1855, 174/1864, 168). He thus reveals that he thinks representations are objective when they are derived, by means of the senses, from the objective world.

Büchner offers only a very crude account of the sensory and cognitive processes that he thinks gives rise to objective representations, but it nevertheless makes clear what he thinks the contents of those objective representations are. First, he claims that the use of our senses provides us with “external stimulus,” and that the senses “conduct external impressions to the brain, which receives digests, and reproduces them.” Büchner then claims that as this sensory process continues, it gradually produces in us an “internal image of the external world” (Büchner 1855, 172/1864, 166). Büchner’s use of “image” [*Bild*] is significant: it suggests that, on his view, when we successfully represent the objective world, that representational relation is paradigmatically pictorial or visual. That is, our knowledge represents the external world in something like the same way that a portrait represents the person it is a portrait *of*. Thus Büchner thinks that when we have objective knowledge, that knowledge consists in an “internal picture” that resembles the objective world. But further, since that objective world consists fundamentally of matter and force arrayed in space, our paradigmatically objective representations will be images of matter and force arrayed in space. The spatial structures pictured in those images will resemble, or correspond to spatial structures in the external world the way the spatial relations between different parts of a face in a portrait correspond to the spatial relations between different parts of the face of the portrait’s subject.

### 6.3 Müller’s Doctrine and Objectivity: Hermann von Helmholtz

The same year that Büchner’s *Force and Matter* appeared, Helmholtz gave a popular lecture on the occasion of a memorial of Kant. His topic was the physiology of the sense organs and he called the talk “On Human Vision.” He opens by addressing Hegel’s view that pure, speculative reason could answer even questions about the natural world, and what Helmholtz sees as Hegel’s opposition to natural scientific principles conceived as the ground of a theory of nature, an opposition expressed most clearly in Hegelian criticisms of Newton (Helmholtz 1855/1884, 369). Helmholtz laments the fact that these views persist in the philosophy of the 1850s, at least to the extent that some philosophers see an opposition between philosophy and natural science.

Helmholtz wants to reconcile philosophy and natural science, and he proposes physiology of the sense organs as the starting point for that task. He argues that

it offers the philosopher a natural-scientific means of investigating what Kant had called the subjective conditions of knowledge. Helmholtz thus expresses two ideas that would shape the dominant neo-Kantianism of the following two decades: first, that the proper project of philosophy is Kant's project of investigating the subjective conditions that give rise to knowledge; and second, that physiology of the sense organs and experimental psychology offer a natural scientific (and thus the best) way to carry this project out. Consequently, in his Kant lecture, Helmholtz takes himself to have ultimately philosophical motivations for his concern with the physiology of vision.

Central to Helmholtz's lecture is a long discussion of Müller's doctrine of specific nerve energies and related theories, as well as the experimental results he takes to be evidence for them. Helmholtz recounts to his audience that Müller wanted to explain the fact that the five senses have sensations with fundamentally different qualities.<sup>6</sup> While sensations of blue and yellow are different, we can transform one into the other by modifying it continuously: blue blends into green, and green blends into yellow. But we cannot similarly transform our sensation of blue into a sensation of concert A. The qualities of visual and auditory sensations are somehow just different.

Both Müller and Helmholtz think the "old" way to explain these differences is to suppose that different qualities of external stimuli explain the different qualities of our sensations. On this old view, visual sensations are caused by specifically visual stimuli, auditory sensations are caused by specifically auditory stimuli, and so on.

However, Müller amassed a set of experimental results (which Helmholtz confirmed and expanded in his own research) that show this old view is untenable. The results fall into two classes. First, there are results showing how a single kind of external stimulus causes different qualities of sensations, depending on which nerves it stimulates. Helmholtz gives his audience a quotidian example. When "aether vibrations" in the form of sunlight strike the retina, we experience sensations of light. But when they strike the skin, we experience sensations of warmth. The visual and tactile sensations are not caused by different, specifically visual and tactile stimuli (Helmholtz 1855/1884, 377). Second, there are results showing how different kinds of external stimuli cause sensations of the same quality. For example, we have the sensation of a flash of light when we are exposed to a flash of light in the external world – say, lightening, or a bright light hidden behind an aperture that is opened and closed quickly. But as Helmholtz discusses at length in his Kant talk, we also have the sensation of a flash of light if the corner of our eye is struck at just the right spot, or if we have electrodes attached to our forehead and cheek, passing an electric current over our optic nerve. Thus, Müller and Helmholtz argue, there is no one specifically visual quality of stimulus that causes our visual sensations (Helmholtz 1855/1885, 380).

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<sup>6</sup>For a more detailed account of Müller and his doctrine of specific nerve energies, see Boring 1929/1957: Ch. 5.

In contrast with the “old” theory that different qualities of sensations are caused by different qualities of external stimuli, Müller posited that each of the five sense modalities has nerves with its own physical structure. The different physical structures of our nerves thus explain the different qualities of the different sense modalities’ sensations. (Helmholtz extended Müller’s theory by positing that the different sense modalities also had nerve fibres with their own specific physical structure.) Müller concluded that the quality of our sensations is determined by the physical structure of our nerves, and not by the external stimuli that cause them. Here, for Helmholtz, is the real epistemological insight of Müller’s doctrine: since the quality of our sensations is determined by the physiological structure of our sense organs, then, precisely in virtue of that fact, our sensations do not resemble the external stimuli that cause them. Rather, our sensations are merely “symbols” that serve as causal indicators of those stimuli’s presence (Helmholtz 1852/1883, 608 and 1853/1884, 19).

For Helmholtz, Müller’s doctrine has enormous epistemological significance. Throughout his Kant lecture, Helmholtz uses the term “object” to refer to things in the external world that stimulate our sensory nerves. Further, during this period, he takes our representations to be objective only when they picture or resemble those external objects. But since Müller’s doctrine states that representations do not resemble the external stimuli that cause them when their character is determined by the subject’s sense organs, for Helmholtz it follows that those representations are subjective. Thus at least since the early 1850s, he used the terms “subjective” to refer to the features of our representations that are determined by the physiological structure of our sensory apparatus, and “objective” to refer to the features of our representations that are determined by properties of external objects. (See for example Helmholtz 1852/1883, 602, 607.)<sup>7</sup> Here, for Helmholtz, is the real contribution that the physiology of the sense organs can make to philosophy. It discovers, for example, how much of our “image of the external world is also determined by the structure of the physical part of our eye” (Helmholtz 1855/1884, 374), and thereby discovers how much of our visual representations are subjective. Ultimately, the physiology of the sense organs separates out our representations’ subjective content from their objective content.

Helmholtz’s Kant lecture and other writings on physiology from the 1850s reveal what he takes the objective content of our knowledge to be. Conspicuously, during this period when Helmholtz discusses Müller’s view that the quality of our sensations is determined by the physical structure of our sensory apparatus, all of his examples are about sensations such as light, tone, and warmth – that is, sensations that he understands to be of secondary qualities. Thus when in the 1850s Helmholtz talks about what he takes to be the subjective element of our representations, he leaves representations of space entirely out of his discussion. It is fitting that he does

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<sup>7</sup>Helmholtz is not alone among neo-Kantians who, prior to the mid-1860s, took the objective elements of our representations to be those determined by properties of external objects. See, for example, Zeller 1862/1877, 492.

so, because he conceives of the physical stimuli that cause our sensations as spatially arrayed arrangements of matter in motion (for example, “aether vibrations”) and as “objects” in the “external world” (where for Helmholtz that phrase refers to a world that is independent of our minds). Thus when he asserts that the physicist achieves a representation of “invisible atoms, motions, and forces” (Helmholtz 1853/1884, 18), he means to assert that physical theories offer us more than mere symbols of the external world, but accurately picture the objects in it.<sup>8</sup>

In fact, the conclusion of Helmholtz’s Kant lecture reveals especially clearly what he takes the content of our objective knowledge to be. He says,

In what way do we first pass outward from the world of sensations to the world of reality? Obviously only through an inference: we must presuppose the presence of objects as the causes of our nerves’ excitation, since there can be no effect without a cause. . . . We see now that we need this principle [that every effect has a cause] before we can have any acquaintance with the things of the external world, we need it in order to gain any cognition that objects are given to us in space, between which objects a relation of cause and effect can obtain. (Helmholtz 1855/1884, 395)

Here, Helmholtz identifies “things in the external world” with objects arrayed in space and subject to causal forces, and he argues that we have knowledge of them precisely because those objects cause us to have representations of them. Since our representations of those external objects are determined by the objects themselves, Müller’s doctrine gives us no reason to deny that our representations resemble them. Thus by Helmholtz’s lights those representations are objective. Hence he maintains that our objective representations are images that resemble an external world consisting of matter and force arrayed in space – an account of the content of objective knowledge that is identical to Büchner’s.

## 6.4 Helmholtz and the Subjectivity of Spatial Representation

However, just over a decade later, in the 1866 third part of Helmholtz’s *Physiological Optics*, he makes significant revisions to his account of the content of our objective knowledge.<sup>9</sup> He rejects his earlier view that our objective representations are images of external objects arrayed in space, and he does so with an argument that, as he presents it, invokes what he takes to be the central epistemological insight of Müller’s doctrine.

The argument begins with Helmholtz rehearsing his earlier claims about sensations of secondary qualities. Sensations are the effects that external objects have on us, but the nature of an effect is determined not only by the nature of its cause, but also by the nature of “the person on whom the effect is produced” (Helmholtz 1867/1925, 19). Thus the quality of our sensations is determined by the nature of

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<sup>8</sup>Thanks to Gary Hatfield for extremely helpful discussion on these points.

<sup>9</sup>My account in this section of the evolution of Helmholtz’s views owes a great deal to Hatfield 1990 and 2011.

our sensory apparatus and, Helmholtz infers, our sensations do not resemble the properties of external objects that caused them. They are not, in that sense, images, but merely “symbols”. But now Helmholtz suggests that this argument applies generally to all “[o]ur human representations, . . . and all representations of any conceivable intelligent creature” (Helmholtz 1867/1925, 19; translation amended). For example, the argument applies to our representations of the shape or spatial structure of a table, just as much as to our representation of its colour. Helmholtz suggests that since our spatial representations are determined by our own sensory or cognitive apparatuses, then precisely in virtue of that fact, our spatial representations do not resemble the spatial structure of external objects, and so by his lights are subjective.

In fact, this argument is too quick, and cannot be Helmholtz’s whole story about why spatial representations are subjective. For Helmholtz, spatial representations are not individual sensations, and thus not individual effects on us of external objects. Rather, spatial representations are interpretations of sensations. They are constellations of sensations assembled by our minds by means of unconscious inductive inferences. (Helmholtz thus calls them spatial *perceptions* to distinguish them from sensations.) Consequently, our spatial representations are not conditioned by our sense organs in the same way our sensations of secondary qualities are. One might think it were possible that while our individual sensations do not resemble the secondary qualities of objects that cause them, our mind nevertheless assembles the sensations into constellations that are spatially isomorphic to arrays of objects in the external world.

Helmholtz rejects this position. The problem is that, while our spatial representations might not be conditioned by our sense organs, they are nevertheless conditioned by our mind’s inductive processes. In the third part of the *Physiological Optics*, Helmholtz explains our inductive inferences as an “urge” of the understanding that he conceives on analogy to the biological function of an organ such as an eye. Thus for Helmholtz, we are biologically disposed to make these inferences, and they are valid because we have no other means of comprehending nature (Helmholtz 1867/1925, 34–5). But now Helmholtz can invoke the epistemological insight he takes from Müller’s doctrine. Inductive inferences and (at their root) our concept of causality are simply our human way of comprehending nature, and thus part of our cognitive apparatus. Since our representations of spatial structure are determined by this cognitive apparatus, they do not resemble any real spatial structure in the external world.

Helmholtz thus gives up his earlier position that our representations of matter and force arrayed in space are images of the external world – that is, that they resemble real spatially-arrayed matter and forces in the external world. He argues instead for a view of our spatial representations that is both more austere and more pragmatic. On his revised view, our representations, including our spatial representations, have only “practical truth” (Helmholtz 1867/1925, 19). Even if those representations do not resemble external objects, they are at least symbols that function as reliable causal indicators of external objects. We can thus use them to make predictions about and “to regulate our movements and actions among” those external objects (Helmholtz 1867/1925, 19).

Thus while our representations are not images that resemble external objects, they nevertheless afford us information about the causal structure of external objects in the following way. Both unconsciously and consciously, we make inductive inferences over sensations, and come to represent lawlike regularities among them. Some of those regularities turn out not to be subject to our will (where Helmholtz understands our will to be the innervation of muscles that bring about movement). For example, every time we have sensations of lightening, sensations of thunder follow it, and there is nothing we can do to make that regularity fail. In that sense, the regularity is a fact that we cannot alter at will. Helmholtz argues that such regularities indicate or provide evidence for the existence of “something independent of our will and imagination, that is, an external cause of our sensations” (Helmholtz 1867/1925, 32). More specifically, Helmholtz maintains that we can infer “from the changing sensations that external objects are the causes of this change” (Helmholtz 1867/1925, 32).

To be clear, Helmholtz is claiming that each of our sensations stands in two different sets of causal relations. First, as we have already seen, within experience we represent lawlike regularities *between* sensations. Thus when we identify sufficiently robust regularities within experience, we say we have identified the cause of the phenomenon in question. But second, Helmholtz is claiming we also recognize that each change in our sensations is the effect on us of an external object. To be sure, neither our sensations of secondary qualities nor the spatial relations among them resemble external objects. But still, for Helmholtz merely the fact that changes in our sensations are effects on us of external objects allows us, in a very limited way and only for lawlike changes in sensation, to “emerge from the world of sensation to the apperception of an external world” (Helmholtz 1867/1926, 32). So within experience we identify robust causal structures in how our sensations change. But since changes in our sensations are caused by changes in external objects, we can infer the existence of causal structures among external objects that are isomorphic to the causal structures we have identified within experience. Thus Helmholtz maintains that our representations afford us information about the causal structure of objects in the external world.<sup>10</sup>

In the *Physiological Optics*, Helmholtz sees a fundamental distinction between our representations of spatial structure and our representations of causal structure. He thinks the character of our spatial representations is determined by our own

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<sup>10</sup>One might reasonably wonder why Helmholtz thinks he can infer that tokens of a single type of causal structure among sensations are all caused by tokens of a single type of causal structure among external objects: after all, the point of Müller’s experiments was to show that a single type of pattern among sensations can be occasioned by multiple, different types of stimuli. Of course, Helmholtz has not forgotten this. Thus, for example, sensations of flashes of light might be occasioned by either a light behind an aperture or by an electric current passed over the optic nerve. But at the same time, the experience of the physiologist doing the experiment consists of representations in two, distinct causal structures: one with representations of her subject sitting in front of the light and the aperture; the other with representations of her subject sitting wired to a battery. Thanks to Alan Richardson for pressing me to clarify this point.

cognitive processes, but our representations of causal structure are determined by the causal structure of objects in the external world. Thus even though Helmholtz now denies that our representations of spatially-arrayed objects are images that resemble external objects, he thinks our representations of causal structure do afford us information about the causal structure of external objects. Consequently, he maintains that those representations of causal structure are our knowledge's only objective content.

To be sure, with this view Helmholtz retreats from his 1850s account of the content of our objective knowledge, but he does not retreat far enough. The problem is Helmholtz's claim to know that each change in our sensations is caused by a change in objects in the external world. What is the basis for his claim to know that causal correlation? He tries to argue that we could know it, because we can infer the existence of mind-independent objects as the causes of our sensations' changes. But his own account of causality and inductive inference rules out the possibility of the required inference. On his view, we make causal or inductive inferences because of an "urge" of our understanding to make our representations comprehensible. Thus for Helmholtz, our causal inferences are warranted simply because they are expressions of this urge. But if the inferences are warranted by our understanding's urge to make our representations comprehensible, those inferences' valid application does not extend beyond the sphere of our representations. Consequently, we cannot use inductive, causal inferences to infer the existence of any mind-independent objects external to or, as it were, behind our representations. Yet that is just how Helmholtz proposes that we infer that they exist.

Given the epistemological insight that Helmholtz takes from Müller's doctrine, it should hardly surprise us that he cannot ultimately maintain that our representations afford us information about the causal structure of the external world. To say that our inductive inferences are determined by an "urge" of the understanding is to say that they are determined by the nature of our cognitive apparatus. But then, invoking the insight of Müller's doctrine, the representations of causal structure that our inductive inferences provide us do not resemble any real causal structures among external objects. So by Helmholtz's own lights, and despite his own claims to the contrary, we cannot know anything about the causal structure of the external world.

Lange would not make this mistake in his account of objectivity.

## 6.5 Objectivity for Humanity: F.A. Lange

Lange's *History of Materialism* appeared in the 1866. The book is in the first instance a critical, if also sympathetic, review of materialist philosophy from the ancient period to Lange's own time. But Lange also articulates positive views of knowledge and the philosophical investigation of it that echo the vision of neo-Kantian philosophy that Helmholtz expressed in his 1855 Kant talk. In fact, Lange defends views remarkably similar to Helmholtz's view in the *Physiological Optics*,

despite the fact that Lange's book appeared the same year as the *Physiological Optics* and was based on lectures he gave years earlier. Yet one difference between Helmholtz and Lange is the latter's pessimism about the possibility of any knowledge of a mind-independent world. He ultimately argues that the physiology of the sense organs confirms Kant's distinction between appearances and things in themselves. That is, he thinks the physiology of the sense organs forces us to take seriously

the hypothesis that the whole system . . . into which we bring our sense-perceptions – in a word, our whole experience – is conditioned by an intellectual organization that compels us to feel as we do feel, to think as we do think, while to another organization the very same objects may appear quite different, and the thing in itself cannot be pictured by any finite being. (Lange 1866, 235–6/1873–1875, 2:4–5/1925, 2:158)

For Lange, this has important consequences for how philosophers should conceive of knowledge's objectivity.

Like Helmholtz in the same year, Lange argues that our representations of space are not images that resemble external objects. And like Helmholtz, Lange draws this conclusion from an argument that invokes what he takes to be the central epistemological insight of Müller's doctrine. He begins with a sketch of Müller's and Helmholtz's argument that the quality of our sensations of secondary qualities is determined by the nature of our sense organs, and not by the external stimuli that cause our sensations. Thus the "fact that certain vibrations of the air or the aether may leave me completely unmoved, that nevertheless others elicit in me the sensations of light, or shade, etc. lies in an organization that precedes experience . . ." (Lange 1866, 255–6). But if the quality of our sensations of, say, tone "is conditioned through our organism," and is not determined by the external stimuli that cause them, then our tone sensations do not resemble those external stimuli. The vibrations in the air caused by a tuning fork "must first come into contact with the auditory nerves of a human or similar being in order to produce tone sensations in consciousness" (Lange 1866, 255–6).

Then Lange immediately extends this argument to spatial representations. He argues that the same reasoning must apply to our representations of the sound waves that cause our tone sensations:

Here one would shrink shamefully away from the importance of these considerations, if one wanted to take the vibration, which is visible or measurable through sound, to be the thing in itself; since the whole representation of waves and oscillations in parts of the air is through and through as dependent on the conditions of our sense of sight and sense of touch as the sensations of sound is dependent on our sense of hearing. (Lange 1866, 256)

According to Lange our representations of spatially-arrayed matter ("waves and oscillations" in the air) depend no less on our sensory apparatus than our sensations of secondary qualities like tone do, and therefore our representations of spatially-arrayed matter do not resemble things in the external world. With this claim, Lange commits himself to the empirical hypothesis that some physiological or psychological processes determine the character of our spatial representations. Just as with Helmholtz in the *Physiological Optics*, Lange cannot claim that our sense

organs determine the character of our spatial representations in exactly the same way they do for our sensations of secondary qualities. Like Helmholtz, Lange thinks our spatial representations are complex products of sensory and cognitive processes, as opposed to individual sensations, which are simple.<sup>11</sup> (Unlike Helmholtz, who in the *Physiological Optics* has a well worked out account of how our spatial representations are produced by unconscious inductive inferences, in the first edition of *History of Materialism* Lange has no detailed hypothesis about the specific nature of physiological or psychological process that produces spatial representations.)

Since for Lange our spatial representations are complex products of sensory and cognitive processes, if a creature had sufficiently different sensory and cognitive processes, it would represent space differently than we do.<sup>12</sup> Thus for Lange, since our spatial representations are determined by our sensory and cognitive processes, they do not resemble the spatial structure of external objects. Or as he puts it in his Kantian jargon, our spatial representations are only appearances, and do not resemble things in themselves.

This much of Lange's account, at least in its outlines, is consistent with the account of the content of objective knowledge that Helmholtz gives in the *Physiological Optics*. Also similar to Helmholtz, Lange thinks our causal inferences are warranted because we are biologically disposed to make them. On Lange's view, "the concept of cause is rooted in our organization . . ." (Lange 1866, 263/1873–1875, 2:45/1925, 2:212), that is, we are physiologically disposed to structure our representations as causes and effects. Lange sees this account of causality as squarely within the vision of Kantian philosophy that Helmholtz expressed in his 1855 Kant lecture. Lange thinks that his account of causal inference follows Kant's in that both explain the warrant for our causal inferences by appeal to a concept of causality that is required for any possible experience and that is, in that sense, a priori. Also, Lange thinks it will ultimately be physiology that provides the full account of this concept of causality and its operations:

Perhaps some day the basis of the concept of cause may be found in the mechanism of reflex action and sympathetic excitation; we should then have translated Kant's pure reason into physiology and so made it more easily conceivable. (Lange 1866, 263/1873–1875, 2:44/1925, 2:211)<sup>13</sup>

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<sup>11</sup>In the first edition of the *History of Materialism*, this view of our spatial representations becomes clear only in Lange's argument against the crude nativist hypothesis that our representation of space is a "ready-made form" that we fill with sensations. Lange insists to the contrary that our representations of space are produced and shaped by physiological and psychological processes (Lange 1866, 254).

<sup>12</sup>This is an argument that Lange repeats and expands significantly in the second edition of *History of Materialism*. See Lange 1873–1875, 2:429/1925, 3:226. There he argues that, for example, the fact that our (human) space has three dimensions need not hold for other, differently constituted beings.

<sup>13</sup>I note without pursuing it that Lange, here and elsewhere, explicitly commits himself to a vision of Kantian theory of knowledge that is thoroughly naturalistic. Thus while there is a circularity involved in pointing to causal processes to explain the epistemological basis of causal inferences, he is committed to thinking that it is a benign circle.

Further, Lange recognizes that this account of the warrant for our causal inferences has an important consequence. If our causal inferences are determined by a physiological disposition to structure our representations as causes and effects, then our causal inferences are warranted only within the domain of our representations, and our representations of causal structure do not afford us information about causal structures among external objects. Nor can we use causal inferences to infer the existence of external objects as the causes of our sensations, and thus Lange thinks we cannot ultimately know that those objects exist. (Lange thinks the concept of causality can furnish us with the *concept of* mind-independent objects that cause our sensations. But his stated view is that for all we can know, our concept of those objects might be empty.<sup>14</sup>) Here is an important point of disagreement between Helmholtz and Lange. In the *Physiological Optics*, Helmholtz wants to claim that at least our representations of causal structure are determined by the causal structure of external objects, and thus that we can know that external causal structure. But for Lange, since we cannot infer that our sensations are caused by external objects, we cannot claim that the causal structure we represent is determined by the causal structure of external objects. Thus we cannot claim that our representations of causal structure afford us knowledge of the causal structure of external objects.

This view of knowledge has significant consequences for Lange's account of objectivity. Helmholtz's criterion of objectivity is that the objective representations are those that resemble, or at least afford us information about, properties of objects in the external world. While Helmholtz thinks that by those lights only our representations of causal structure are objective, Lange denies even that. He concludes that no part of our knowledge affords us any information about the external world. By Helmholtz's lights, Lange has whittled the content of our objective knowledge down to nothing. Consequently, Lange must deny either that we have any objective knowledge, or that the objective elements of our knowledge are those that afford us information about external objects.

Lange takes the second route. He calls the idea that objective knowledge represents the external world "absolute objectivity" (Lange 1866, 234/1873–1875, 2:3/1925, 2:156), and he argues that the physiology of the sense organs forces philosophers to give that idea up (Lange 1866, 235–6/1873–1875, 2:4–5/1925, 2:158). However, Lange reasons that even if all of our representations – "in a word, our whole experience" – are determined by our physiological and psychological organization, some elements of our representations will at least be common to all humans, precisely in virtue of their common physiological and psychological structures. On Lange's view these common physiological and psychological structures ensure that at least some elements of our representations will be universally valid in Kant's sense, that is, intersubjective. Since this universal validity is a consequence

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<sup>14</sup>It is not clear that Lange consistently maintains his own stated view that he cannot (causally) infer the existence of mind-independent objects. See Edgar (2013) for a more detailed account of Lange on these points. However, whatever ambiguities his views have on these points, they do not appear in his discussions of objectivity, so I ignore them here.

of human beings' shared physiological and psychological structures, it is universal only for humans (and sufficiently similar beings). Lange thus conceives of this universal validity as biologically conditioned and species-specific.<sup>15</sup> Lange calls it "objectivity for humanity", and he thinks it is the only objectivity available to us.

Lange's concept of objectivity thus constitutes a decisive break from Helmholtz's. No longer is the criterion of objectivity that objective elements of our representations resemble or afford us information about properties of external objects, since on Lange's view there are no such elements. He denies even that any elements of our representations are determined by properties of external objects. Thus for Lange, objectivity simply has nothing to do with the mind-independent world.

## 6.6 Nature as a Phenomenon of Consciousness: Otto Liebmann

During the same period, Liebmann defended a similar view of objectivity. In his 1865 *Kant and his Epigones* and 1869 *On the Objective Viewpoint*, he argues for an idealism according to which all of nature is nothing more than a phenomenon of consciousness. In *The Objective Viewpoint*, he wants to show how Müller's doctrine demonstrates one of the premises he needs to establish that idealism, thereby providing natural scientific support for the view. But at the same time, his principal aim in *The Objective Viewpoint* is to develop a "critical" account of objective sight as visual awareness of matter arrayed spatially in the external world – that is, to show how this account of objective sight is consistent with his idealism (Liebmann 1869, iv).

To begin, Liebmann thinks Müller's doctrine confirms Locke's thesis that sensory qualities do not resemble mind-independent objects (Liebmann 1869, 6–7, 32, 130). But Liebmann argues that Müller's doctrine leads to a further conclusion, namely, to the idealist thesis that nature is a phenomenon of consciousness and therefore that our representations of nature afford us no information about a mind-independent world. He argues that Müller's conclusion that sensory qualities do not resemble objects in the external world must be extended to the physiologist's picture of sensory processes themselves. The physiologist appeals to external stimuli exciting sensory nerves that are connected to a nervous system and a brain. But, Liebmann argues, our representation of that physical and physiological system is itself composed of sensory qualities – for example, the set of tactile feels included in the content of our representation of external matter, and the patterns of light and

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<sup>15</sup>For Lange's explicit discussion of the species-relative nature of our objective knowledge, see 1872–1875, 2:539–40/1925, 3:336.

colour that constitute our visual representation of the brain.<sup>16</sup> On Liebmann's view, Müller's doctrine entails that these representations too do not resemble any mind-independent objects (Liebmann 1869, 134–6):

Accordingly, it is actually a wholly biased, mistaken view if a man believes that he inhabits an illuminated, coloured, noisesome world; rather, it lives in him, in his consciousness, and in the consciousness of all subjects that are, like him, sentient and understanding. (Liebmann 1869, 140)<sup>17</sup>

Thus, Liebmann wants to conclude, none of our representations are determined by or resemble a world that exists beyond them.

In fact, this argument provides only partial support for Liebmann's idealism. As Helmholtz and Lange understand, Müller's doctrine on its own does not entail that our representations of spatial and causal structure do not resemble real spatial and causal structure of mind-independent objects. That is why they both develop further arguments modelled on Müller's for their denials that our representation of spatial structure resembles the real spatial structure of external objects. Liebmann's argument, as he states it, neglects the possibility that our representations of external stimuli exciting nerves and sending signals to the brain might resemble the real spatial or causal structure of that process, even if the pinkish-grey hue of our image of the brain does not correspond to anything beyond our representations. Thus despite Liebmann's apparent suggestion that his idealism is nothing but the epistemological consequences of Müller's doctrine worked out consistently, that cannot ultimately be all there is to his argument.

Indeed, it is not all there is to his argument. Liebmann does deny that our representations of spatial and causal structure resemble any real spatial or causal structures in the mind-independent world, but his reasons for these denials are fundamentally different than Helmholtz's and Lange's. In particular, Liebmann's reasons do not depend on positing physiological or empirical-psychological processes that determine our representations of spatial and causal structure. For Liebmann, our representations of space, time, and causality are Kantian "forms of knowledge", and he argues that they are ordering relations that the mind (he typically says "spirit", "intellect", or "understanding") uses to interpret sensations (Liebmann 1869, 108). He argues further that, as ordering relations the mind uses to interpret sensations, they cannot themselves be derived from sensations (Liebmann 1869, 109). (He thus maintains that our spatial representations are innate in a way

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<sup>16</sup>Lange suggests a nearly identical argument a few years later (Lange 1873–1875, 2:423/1925, 3:219).

<sup>17</sup>Also:

But the whole is and remains a sensible phenomenon within our consciousness, constituted out of subjective sensations, disciplined, interpreted, spatially arrayed, and objectified by irrefutable rules of our understanding, which we obey without knowing why. It thus has no absolute, but only a relative being; it exists only on the presupposition of our sensibility, in virtue of our intellectuality in our consciousness. (Liebmann 1869, 140–1)

that both Helmholtz and Lange are at pains to deny in the 1860s.) For Liebmann, these forms of knowledge are rules of the mind without which we could have no empirical knowledge at all.

Liebmann's conception of these forms of knowledge as rules without which no empirical knowledge would be possible has two important consequences. First, the forms of knowledge are unexplained explainers. While (as we will see below), they explain the possibility of objective representation for Liebmann, he insists that they admit of no explanation themselves. Rather, they are "the final, ultimate explanatory ground" of objective representation (Liebmann 1869, 108). It would be consistent with this view to argue against Helmholtz and Lange that physiology of the sense organs cannot provide any explanation of these forms of knowledge, since as an empirical science, physiology presupposes and depends on just those forms. Liebmann thus maintains that philosophers cannot investigate or explain these forms empirically.

Second, Liebmann thinks that his conception of our representations of space, time, and causality entails that we cannot claim that they resemble any features of a mind-independent world. Since, on his account, these forms of knowledge are merely rules of the mind without which empirical knowledge would not be possible, Liebmann thinks we must restrict their valid application to the sphere of our representations. Thus they do not validly apply to a mind-independent world (Liebmann 1869, 140–1).<sup>18</sup> Consequently, Liebmann takes himself to rule out the possibility that our representations of external stimuli exciting our sensory nerves and sending signals to our brain resemble any real spatial or causal structures in the mind-independent world.

Because Liebmann thinks we cannot explain our representations of space, time, and causality by physiological or any other natural scientific means, he cannot fully accept Helmholtz's view that physiology of the sense organs provides natural scientific means of carrying out Kant's project of investigating the subjective conditions of knowledge. But he nevertheless maintains that Müller's doctrine of specific nerve energies is significant for philosophy precisely because it demonstrates one of the premises he takes himself to need in order to establish his thesis that all of nature is nothing but a phenomenon of consciousness: namely, that the sensory qualities our mind orders according to spatial, temporal, and causal relations do not resemble mind-independent objects. For Liebmann, Müller's doctrine thus provides a measure of natural scientific support for his denial that any element of our representations is determined by or resembles properties of a mind-independent world (Liebmann 1869, 31–2, 130).

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<sup>18</sup>Further, like Lange, Liebmann recognizes that if our causal reasoning is valid only within the sphere of our representations, we cannot validly claim that our sensations are the effects on us of mind-independent objects. Consequently, Liebmann argues that most we can conceive of the relation of our sensations to mind-independent objects is that an unknowable X (the mind-independent object, the Kantian thing in itself) stands in an unknowable relation to our mind. He calls that unknowable relation the "transcendental factor" in experience (Liebmann 1869, 152–3).

Yet in addition to this idealism, Liebmann also takes “objective sight” to mean visual awareness of matter arrayed in space in an external world. His principal aim in *The Objective Viewpoint* is thus to develop an account of objectivity that is consistent with both that view of objective sight and his idealism’s denial that our representations afford us information about mind-independent objects. Central to that account of objectivity is Liebmann’s treatment of the concept of an *external world* as itself a spatial representation, and thus a representation that admits of explanation by appeal to our ability to represent space (and time and causality). On this view, “without the a priority of the spatial forms of intuition, the subject could never come to have a representation of anything external” (Liebmann 1869, 109).

On Liebmann’s account, we start with sensations that Müller’s doctrine tells us are subjective in the sense that their qualities are determined by the nature of our sense organs and not by properties of external objects. He argues that the forms of our knowledge – our representations of space, time, and causality – are responsible for transforming those sensations into objective sight. Liebmann explicates his view that the forms of knowledge are ordering relations for sensations by arguing that they constitute a spatio-temporal-causal array onto which our mind (necessarily, without voluntary control) projects our sensations of secondary qualities. The array consists in part of three spatial dimensions. On Liebmann’s view, when our mind projects sensory qualities onto determinate points on this spatial array at a determinate point in time, and then represents those qualities’ locations changing over time according to necessary causal laws, we thereby represent concrete material (that is, extended) objects interacting causally with one another in space. For Liebmann, these objects are “external” just in virtue of the fact that they are arrayed in a three-dimensional space (Liebmann 1869, 18–20).

Since for Liebmann our representations are objective when they are of objects arrayed in space in the external world, he does not, like Lange, define objectivity as universal validity or intersubjectivity. Still, he thinks the universal validity of objective representations is a direct consequence of his account of objectivity. Representations of concrete material objects arrayed in space in an external world will be shared by “all subjects that are . . . sentient and understanding” (Liebmann 1869, 140). That is, they will be universally valid for humans and any other beings with relevantly similar forms of knowledge.

Finally, while Liebmann, like Helmholtz, understands representations to be *objective* when they are of objects in the external world, the similarity between their views is superficial. Helmholtz in the 1850s and 1860s identifies the external world with a mind-independent world, a world beyond our representations. But Liebmann rejects exactly that identification. For him, the external world is the spatial (and temporal and causal) world, a world represented in consciousness in virtue of the fact that our mind projects our sensations onto an array that itself is nothing but a form of knowledge. In contrast, for Liebmann the mind-independent world is the world of things in themselves, which on his idealism is completely unknowable. Consequently, like Lange and in contrast with Helmholtz in the 1850s and 1860s, Liebmann severs any connection between the concepts of objectivity and a mind-independent world.

## 6.7 The Laws of the Actual: Helmholtz's Mature Conception of Objectivity

However, Helmholtz would follow suit within a decade. In an 1878 address called "The Facts in Perception," he withdraws his claim that any part of our representations, including our representations of causal structure, is determined by or affords us any information about a mind-independent world. He no longer maintains the argument – which was inconsistent with his own account of the basis of causal inference – that we can infer the existence of a world beyond our representations as the cause of our sensations. Consequently, he demotes the claim that such a world exists to the status of hypothesis. Helmholtz prefers that hypothesis to the alternative hypothesis that there is no external world, but he sees no way to disprove that alternative, and so acknowledges that his preference never amounts to knowledge (Helmholtz 1878/1977, 137).<sup>19</sup>

However, while Helmholtz no longer thinks we can infer the existence of external objects as the causes of our sensations, he still maintains that we can represent causal relations *within* experience. Indeed, he maintains that these causal relations are not mere hypotheses, but that they constitute the content of our knowledge (Helmholtz 1878/1977, 138). He argues that lawlike relations between representations, just because they are repeated often enough, are reinforced in our memory, while idiosyncratic, nonlawful changes in our representations are washed away. In this way, we come to have an image of the lawlike in experience (Helmholtz 1878/1977, 131).

Echoing the discussion of laws from his *Physiological Optics*, Helmholtz suggests that we can formulate some laws with such generality and completeness that we cannot, by means of our will, bring it about that the laws fail. (There is nothing we can do about the fact that thunder follows lightening.) But in the *Physiological Optics*, Helmholtz took these lawlike regularities to indicate, or provide evidence for, the existence of mind-independent objects that cause our sensations, and he took the objective content of our knowledge to consist in information about the causal structure of those mind-independent objects. Here, lawlike regularities that we cannot alter at will constitute the objective content of our knowledge – but they do so *just because* we cannot alter them at will. That is, Helmholtz no longer thinks that objective representations are those that are determined by or afford us

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<sup>19</sup>In fact, as Liesbet de Kock has recently shown, Helmholtz first clearly articulates his view that our belief in an external world is a mere hypothesis several months before his address "The Facts in Perception" in response to a criticism from J.P.N. Land. Although I cannot here give de Kock's interpretation its due, I note that she gives an account of the development of Helmholtz's views that contrasts sharply with the one I am offering. On her account, Helmholtz's view in 1878 that our belief in an external world is merely a "hypothesis" that can never amount to knowledge does not constitute a substantive break from his earlier views. Rather, on her interpretation, Helmholtz was pushed in 1878 to articulate clearly a pessimism about our knowledge of the external world that he had maintained implicitly at least since the *Physiological Optics* if not before (de Kock 2014, 15–21).

information about mind-independent objects, since he no longer thinks there *are* any such representations. Rather, he now maintains that objective representations are those that are not subject to our will.<sup>20</sup> For Helmholtz, laws that we cannot alter at will constitute “the actual.” He calls these laws the “objectum,” and identifies them with Fichte’s “not-I”, which he knows is a term Fichte used for the objective content of knowledge (Helmholtz 1878/1977, 126, 140).<sup>21</sup> Thus for Helmholtz in “The Facts in Perception,” the laws of the actual constitute the objective content of knowledge (Helmholtz 1878/1977, 140).

This conception of objectivity, according to which the objective elements of our knowledge are those that are not subject to our will, is by no means identical to Lange’s or Liebmann’s. Yet Helmholtz follows them at least in severing any connection between his conceptions of objectivity and a mind-independent external world.

## 6.8 Conclusion

I have argued that reflection on Müller’s doctrine and its epistemological consequences led Lange, Liebmann, and eventually Helmholtz all to reject the view that objective knowledge affords us information about or is determined by mind-independent objects. For these neo-Kantians, Müller’s doctrine thus provides evidence for conceptions of objectivity that have nothing to do with the mind-independent world. Their accounts of objectivity thus stand as examples of how philosophers and philosophically-minded scientists appropriated results and theories from natural science, and marshalled those results and theories as evidence in philosophical disputes. Their accounts of objectivity thus illustrate how, in the context of the post-Hegelian German-language intellectual landscape, the increased authority of natural science relative to philosophy was manifested in concrete argumentative contexts. I conclude by considering briefly why their appeals to natural science would have made for such powerful epistemological arguments in that post-Hegelian context.

Hegel had argued that truths about nature and humanity’s place in it were known by speculative reason, but by the 1850s the backlash against Hegel was in full effect. Both Büchner, the scientific materialist, and Helmholtz, the neo-Kantian, are at pains to emphasize the role they thought natural science should play in philosophical theorizing, and both were at pains to emphasize the anti-Hegelian

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<sup>20</sup>Lorraine Daston and Peter Galison emphasize this conception of objectivity. See Daston and Galison 2007/2010, especially Chs. 4–5. I note here without pursuing it that Helmholtz’s mature conception of objective representations as those that are not subject to our will appears to be just one of several, and not a conception of singular significance or influence – at least among neo-Kantians in the second half of the nineteenth century.

<sup>21</sup>I am indebted to Robert Brain for helpful discussion on these points.

thrust of these views. Later, when Lange and Liebmann followed Helmholtz in appealing to Müller's doctrine to inform their Kantian accounts of knowledge, they similarly emphasized that Müller's was a natural scientific doctrine supported by a growing body of experimental evidence. Thus to the extent that the epistemological consequences of Müller's doctrine resemble philosophical doctrines going back to Kant (and even to Locke), these neo-Kantians presented Müller as providing natural scientific confirmation for ideas that in the seventeenth and eighteenth centuries could only be considered hypotheses.<sup>22</sup>

Lange, more explicitly than Helmholtz or Liebmann, fully exploits the purportedly natural scientific warrant for his conception of objectivity in an argument against rival post-Hegelian conceptions – specifically, those of scientific materialists like Büchner. In the expanded second edition of *History of Materialism*, Lange argues explicitly that the physiology of the sense organs makes the scientific materialist conception of objectivity untenable. He opens his argument with a sweeping account of the philosophical significance of physiology of the sense organs:

We have hitherto seen in every department that it is the scientific, the physical study of phenomena, which is able to throw upon man and his intellectual nature the light of real knowledge, though it may be at first a few scattered rays. Now we come to the department of human inquiry in which the empirical method has celebrated its highest triumph, and in which, at the same time, it leads us to the very limits of our knowledge, and betrays to us at least so much of the sphere beyond it as to convince us of its existence. This is the physiology of the sense organs. (Lange 1873–1875, 3:408/1925, 3:202–3)

Lange goes on to expand his argument from the first edition that Müller's doctrine and further arguments modelled on it entail that no part of our knowledge is determined by or affords us information about a mind-independent world. But here he is loudly calling attention to what he takes to be the source of his argument's authority: "the scientific, the physical study of phenomena", that is, "the empirical method", which when it is applied to the human knowing subject, "celebrate[s] its highest triumph." Lange wants to make clear, especially to the scientific materialist, that (he thinks) his account of objectivity does not depend on any merely speculative, a priori philosophical commitments, but on the materialist's own paradigm of knowledge, that is, natural science. He thus proposes to take full account of Müller's doctrine precisely in order to "see how much of materialism may be retained" in light of it (Lange 1873–1875, 3:410/1925, 3:204). While some materialist doctrines can be retained, Lange thinks, the materialist conception of objectivity cannot be. Since for Lange – as for Helmholtz and, to a degree, Liebmann as well – the physiology of the sense organs, and thus natural science itself, ultimately reveals why the objectivity of our knowledge can have nothing to do with a mind-independent world.

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<sup>22</sup>Helmholtz 1855/1884, 379; 1878/1977, 118–9; Lange 1873–1875, 2:409/1925, 3:202–3; Liebmann 1869, 20.

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