

The Coordination Problem: A Challenge for Transcendental Phenomenology of Science

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Global life expectancy has doubled since 1900. We successfully landed several remote-controlled vehicles on a planet 225 million kilometers away from Earth. Our currently deepest look into space reaches around 13 billion light-years. Considering facts such as these, it is hard to deny that science is one of the—if not *the*—most successful human enterprises. Science has transformed our lives and our conceptions of reality, and it has a rich history of freeing humanity from prejudice and dogma. From a philosophical point of view, however, science has also always been a source of puzzlement. A question that has taken up special prominence in the recent literature concerns the ontological interpretation of scientific theories as well as the epistemic attitudes we ought to take regarding these theories. As it usually unfolds, the so-called *scientific realism debate* centers around questions such as these: Does the predictive, explanatory and technological success of science give us reason to believe that our best current theories approximate the goal of telling a literally true story about the deep structure of reality? Or should we be more modest in that we only expect theories to yield knowledge of the observable layers of reality? Or are these questions ill-posed in a way that makes them impossible to answer right from the outset?

Although the main arena of the scientific realism debate is analytic philosophy of science, the issues at stake are no less relevant for phenomenologists. Thus, it is no surprise that several

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authors have addressed the question as to how philosophers with phenomenological leanings should position themselves in the ongoing disputes about the correct interpretation of scientific theories. I have also contributed to this discussion by arguing that, first, scientific realism is incompatible with the most fundamental tenets of phenomenology and that, second, Husserl's stance towards the interpretation of scientific theories resembles Bas van Fraassen's constructive empiricism.² Before engaging with Emiliano Trizio's criticisms of my views as well as with his counterproposal, I want to begin with summarizing the position I have advocated in my original 2012 article.

The Epistemological Background

To my mind, a productive way to conceive of phenomenology is to think of it in terms of a radicalized form of empiricism.³ Like classical empiricism, phenomenologists try to steer clear of speculation and excessive system building by grounding claims to knowledge in *experience* through which the things themselves always appear. Unlike classical empiricism, however, phenomenologists do not presuppose an unduly narrow concept of experience that delimits the sphere of rational discourse to what reveals itself to the five senses. In a way that is reminiscent of William James's later works,⁴ phenomenologists seek to respect the richness of human experience without thereby falling prey to the dangers of baseless speculation and an overstated trust in our inferential machinery. It is this basic stance that also forms the background of Husserl's "Principle of all Principles" which famously reads that "every originary presentive intuition is a legitimizing source of cognition, [that] everything originarily [...] offered to us in

² Harald A. Wiltsche, "What is Wrong With Husserl's Scientific Anti-Realism?" in *Inquiry* 55:2 (2012), 105-30; henceforth cited as "What is Wrong?"

³ See Philipp Berghofer and Harald A. Wiltsche, "Phänomenologie," ed. Martin Grajner and Guido Melchior, *Handbuch Erkenntnistheorie* (Stuttgart: J.B. Metzler, 2019), 35-42.

⁴ William James, *Essays in Radical Empiricism*, ed. Ralph Barton Perry (Mineola: Dover, 2003).

‘intuition’ is to be accepted simply as what it is presented as being, but also only within the limits in which it is presented there.”⁵ As I have argued in more detail elsewhere,⁶ the Principle covers two interrelated theses, one about the architecture of knowledge and one about the nature of epistemic justification. I will briefly describe each thesis in turn.

On the one hand, the claim that “every originary presentive intuition is a legitimizing source of cognition” expresses a view that is standardly called “moderate foundationalism”.⁷ According to this view, the structure of any body of knowledge is foundational in the sense that (a) every piece of knowledge is either direct or indirect, and that (b) all pieces of indirect knowledge depend on one or more pieces of direct knowledge. Although the dependency relation between direct and indirect pieces of knowledge is rather weak (allowing, for instance, that degrees of justification also depend on non-foundational factors such as the coherence between beliefs), the Principle still requires that if there is indirect knowledge, then, at least in principle, it must be traceable to some direct knowledge as a foundation for it.

On the other hand, the claim that “everything originally [...] offered to us in intuition is to be accepted simply as what it is presented as being” expresses an internalist view of direct justification according to which the source of epistemic justification is internal to a person’s subjective acts.⁸ More concretely, epistemic justification must be analyzed in terms of a specific quality of givenness, namely the quality of being given *originarily*. Originary givenness is the distinctive phenomenal character of acts that present their objects directly or “in the flesh”. These acts are contrasted with empty or signitive acts in which the intended

⁵ Edmund Husserl, *Ideen zu einer reinen Phänomenologie und phänomenologischen Philosophie. Erstes Buch. Allgemeine Einführung in die reine Phänomenologie*, ed. Karl Schuhmann, Husserliana III/1 (The Hague: Martinus Nijhoff, 1976), 51; English translation: *Ideas pertaining to a Pure Phenomenology and to a Phenomenological Philosophy. First Book: General Introduction to a Pure Phenomenology*, trans. Fred Kersten (The Hague: Martinus Nijhoff, 1983), 44-5. Henceforth cited as *Id 1* with English and German page references, respectively. Wherever it has been deemed necessary, the translation has been modified without notice.

⁶ Harald A. Wiltsche, “Husserl on rationality,” in *European Journal of Philosophy* 30:1 (2022), 169-181; henceforth cited as “Rationality”.

⁷ Philipp Berghofer, “Why Husserl is a moderate foundationalist,” in *Husserl Studies* 34 (2018), 1-23.

⁸ See, for more details, Harald A. Wiltsche, “Intuitions, Seemings, and Phenomenology,” in *Teorema* 34:3 (2015), 57-78.

object is merely meant without being directly given. This distinction between signitive acts and acts that give their objects originarily is also the background of the conception of fulfillment which forms the centerpiece of Husserlian epistemology.⁹

Like everything else in phenomenology, the Principle of All Principles must be seen in the wider context of Husserl's theory of consciousness and intentionality. An early but nonetheless fundamental insight is that one and the same object can be intended very differently, depending (a) on the kinds of acts through which these objects are intended and (b) on how the intended objects present themselves to the intending subject. Regarding (a), phenomenologists distinguish between different *intentional qualities* or *noetic acts* through which the same object can be meant as, say, imagined, perceived, or loved. However, the epistemically more relevant distinction concerns (b): Compare the situation of me judging that my bike is in the office while sitting in the cafeteria with the situation of me judging that my bike is in the office while standing right in front of it. Although intentional quality and matter are the same in both scenarios, it is only the direct acquaintance with the bike (i.e., my standing right in front of it) that warrants the judgment about my bike's whereabouts beyond all reasonable doubt. What sets the second scenario apart is that "[we] experience how the *same* objective item which was 'merely thought of' in symbol is now presented in [originary] intuition."¹⁰ Phenomenologists call this experience the experience of *fulfillment*. Fulfillment, that is, the registered congruence between the object as it is emptily intended and the object as it is given in originary intuition, is the ideal limit towards our judging strives. If this congruence not only takes place, but is also

⁹ Edmund Husserl, *Logische Untersuchungen. Zweiter Band. Zweiter Teil. Untersuchungen zur Theorie und Phänomenologie der Erkenntnis*, ed. Ursula Panzer, Husserliana XIX/2 (The Hague: Martinus Nijhoff, 1984); English translation: *Logical Investigations. Volume 2*, trans. J.N. Findlay (London & New York: Routledge, 2001), pp. 181-334. Henceforth cited as *LI 2* with English and German page references, respectively. Wherever it has been deemed necessary, the translation has been modified without notice.

¹⁰ Husserl, *LI 2*, 206/566.

registered by a cognizing subject, then we are dealing with what Walter Hopp aptly calls “knowledge at its best.”¹¹

In a similar sense in which there is no tone without a pitch, intentional matter and quality are moments that cannot exist independently from another. However, it is also important to realize that specific types of acts and their objects do not meet accidentally. While it is contingent whether there is a bike in my office, the same cannot be said of the type of experience that is required to have a justified belief about the bike’s current location. Bikes are among the objects whose essence it is to be located spatially and temporarily. Immediately and reliably grasping their presence requires an act of perception and not an act of, say, daydreaming. For every kind of object there is an appropriate type of experience without which the object in question will not be accessible to the experiencing subject. However, the decision about which type of experience is suitable for which kind of object is not something that lies within the subject’s discretion. It is determined by the very nature of the object at stake.

There is one last aspect of Husserl’s position which needs to be mentioned. As we have seen, phenomenological epistemology is built around the idea that the direct cognitive contact with the intended objects sets the standard for what counts as knowledge. However, isn’t there something almost paradoxical about putting so much emphasis on fulfillment and originary givenness if it is at the same time true that we live most of our conscious lives in the mode of signification? Science is a particularly telling example in this respect: How promising is it to build an entire epistemology on the direct givenness of objects if most scientific objects we claim to have knowledge about (from dinosaurs over spiral nebulae to DNA) are never originally given to us at all? As I have indicated in my original 2012 article¹² and then

¹¹ Walter Hopp, *Perception and Knowledge. A Phenomenological Account* (Cambridge: Cambridge University Press, 2011), chapter 7.

¹² Wiltsche, “What is Wrong?” 109.

explained in more detail later,¹³ it is here that Husserl's theory of rationality must be taken into account. To make a long story short: It would be a mistake to think of fulfillment and originary givenness as that which *de facto* distinguishes knowledge from mere belief in each case of a particular claim to knowledge. Rather, fulfillment and originary givenness are to be seen as overarching *ideals* that are normatively binding, especially if the respective objects are intended in the mode of signification. On this view, then, there is nothing wrong with the common epistemic practice to accept judgments about objects that are not originally given to us. For these judgments to be rational, however, it must be possible in principle to have fulfilled intentions regarding these objects. Let us now, with these considerations as a backdrop, consider the main argument in my 2012 article.

Against Scientific Realism

A general assumption in my 2012 article was that the transcendental-phenomenological attitude is not the proper place for the scientific realism debate.¹⁴ The reasons for holding this view were rather simple: The transcendental epoché and reduction are methodological tools which are designed to temporarily put out of action the general thesis of the natural attitude, that is, the constant anonymous presupposition of a pre-existing reality. The aim of such an operation is to initiate a shift of attitude that redirects our theoretical interest from the "what" of experience to the "how" and thus to the structures of transcendental consciousness that underlie the constitution of all kinds of objectivities that, in their entirety, make up the natural attitude. This, however, is precisely why the scientific realism debate, as it is standardly understood, falls outside the purview of transcendental phenomenology: Instead of inquiring into how the

¹³ Harald A. Wiltsche, "Review of Lee Hardy: *Nature's Suit*," in *Husserl Studies* 31 (2015), 175-82; Wiltsche, "Rationality".

¹⁴ Wiltsche, "What is Wrong?" 126-7.

natural attitude is constituted in the first place, the discussion about scientific realism, in its typical fashion, concerns the ontological commitments we might reasonably have in different sub-sections of the natural attitude.¹⁵

It is important to note that this way of locating the scientific realism debate is by no means inconsistent with Husserl's own views on the matter. In the *Crisis*, Husserl is perfectly clear that the epoché "is articulated in a multiplicity of steps" and that "[c]learly required before everything else is the epoché in respect to all objective sciences."¹⁶ As Husserl goes on to explain, the point of this pre-transcendental epoché is to abstain from "all participation in the cognitions of the objective sciences, [from all] critical position-taking which is interested in their truth or falsity."¹⁷ Like it is always the case with the epoché and reduction, the outcome of the act of bracketing is not to deny or actively doubt science or any of its accomplishments. The goal is rather to take a step back to gain a clear view of the presuppositions that underlie our cognitive involvements with our environments and that go unnoticed in the normal course of scientific practice. An example I used in my 2012 article was the "observation" of a lithium atom through an electron microscope. While the belief that this "observation" is epistemically on par with the veridical perception of lifeworld objects might seem warranted from the pragmatic perspective of the microscopist, the performance of the first epoché helps to sharpen

¹⁵ It has become common in the "mainstream" debate to "understand [scientific realism] in terms of three dimensions: a metaphysical (or ontological) dimension; a semantic dimension; and an epistemological dimension" (Anjan Chakravartty, "Scientific Realism," in *Stanford Encyclopedia of Philosophy* (2017), <https://plato.stanford.edu/archives/sum2017/entries/scientific-realism/>). Furthermore, it is widely acknowledged that, after the downfall of more semantically oriented attempts to replace the theoretical language of science with operational definitions, "[t]he debate took a distinctively epistemic turn" (Stathis Psillos, "Scientific Realism with a Humean Face," in: *The Continuum companion to philosophy of science*, ed. Juha Saatsi & Steven French (London & New York: Continuum, 2011), 75-95, here 85.). The way I framed the scientific realism debate in my 2012 article loosely follows this trajectory: Remaining neutral on the relation between phenomenology and metaphysical realism, I conceived of the scientific realism debate as an epistemic discussion within the natural attitude.

¹⁶ Edmund Husserl, *Die Krisis der europäischen Wissenschaften und die transzendente Phänomenologie. Eine Einleitung in die phänomenologische Philosophie*, ed. Walter Biemel, Husserliana VI (The Hague: Martinus Nijhoff, 1962), 138; English translation: *The Crisis of European Sciences and Transcendental Phenomenology. An Introduction to Phenomenological Philosophy*, trans. David Carr (Evanston: Northwestern University Press, 1970), 135. Henceforth cited as *Crisis* with English and German page references, respectively. Wherever it has been deemed necessary, the translation has been modified without notice.

¹⁷ *Ibid.*

our attention for the implicit presuppositions that underlie such a construal. We come to realize how different instrumentally aided perceptions and naked-eye observations are, and that these differences have far-reaching consequences for our interpretation of scientific theories.¹⁸

Assuming the scientific realism debate to lie outside the purview of transcendental phenomenology, the epistemological argument in favor of a sophisticated version of scientific anti-realism is straightforward: On my reading of Husserlian epistemology,¹⁹ the rationality of believing *P* is strongly dependent on the motivated possibility of having fulfilled intentions towards *P*. Moreover, in my 2012 article I took it for granted that “a scientific theory must be the sort of thing that we can [...] *believe or disbelieve*” and that “a typical object for such attitudes is a proposition, or more generally a set of propositions a body of putative information about what the world is like, what the facts are.”²⁰ If one then adds that the world scientific theories purport to describe is empirical (and not ideal, like, say, mathematical monists would have it²¹), and that it is part of the essence of physical things to be “the possible object of a straightforward percept,”²² to be “essentially *capable of being perceived*,”²³ then agnosticism concerning unobservables seems inevitable. Or to put the same point in a different way: If the rationality of our doxastic attitudes is strongly dependent on the possibility of having fulfilled intentions towards what we believe or disbelieve, then, phenomenologically construed, theory acceptance cannot involve more than *empirical adequacy*. This is to say that the only requirement for theory acceptance is that the theory has one model with empirical substructures such that the empirical substructures match the observable world.

¹⁸ Wiltsche, “What is Wrong?” 109-114. See also: Bas Van Fraassen, *Scientific Representation: Paradoxes of Perspective* (Oxford: Oxford University Press, 2008), chapter 4.

¹⁹ Wiltsche, “Rationality”.

²⁰ Bas van Fraassen, *Laws and Symmetry* (Oxford: Oxford University Press, 1989), 190.

²¹ See, e.g.: Max Tegmark, “The mathematical universe,” in *Foundations of Physics* 38:2 (2008), 101-150.

²² Husserl, *LI 2*, 285/679.

²³ Husserl, *Id 1*, 99/95-96.

Positivism about Observation?

Before I move on to Emiliano Trizio's take on my 2012 article, I would like to respond to a criticism that has been voiced repeatedly, both in writing and in personal conversations. Jack Reynolds gave this critique a sufficiently clear form in his *Phenomenology, Naturalism and Science*.²⁴ Reynolds begins his discussion by pointing out that scientific anti-realism relies on a "basic distinction between entities that can be directly perceived/observed and those that must be inferred or theoretically postulated to explain some perceived phenomenon."²⁵ This is most certainly true of van Fraassen who claims that simple cases of instrumentally unmediated observation set the epistemic bar for how far our ontological commitments regarding science should go. However, although cases of naked-eye observation are prototypical in this respect, van Fraassen also holds that "observation [is a] subject for empirical science, and not for philosophical analysis."²⁶ According to constructive empiricism, all philosophers need to know is that meso- and macroscopic objects are given to us in observation, and that these objects set the bar for what we can reasonably believe about the world. Whatever else we might want to know about observation will be answered by the individual sciences, not by philosophy.

Van Fraassen's treatment (or, better, non-treatment) of observation has always been considered one of the weak spots of constructive empiricism.²⁷ While some critics have put much emphasis on the role of scientific instruments, others have argued that there simply exists no conceptually unmediated form of observation because, in reality, observation is always and necessarily

²⁴ Jack Reynolds, *Phenomenology, Naturalism and Science: A Hybrid and Heretical Proposal* (London & New York: Routledge, 2018); henceforth cited as "Phenomenology, Naturalism and Science".

²⁵ Reynolds, *Phenomenology, Naturalism and Science*, 63.

²⁶ Bas van Fraassen, *The Scientific Image* (Oxford: Clarendon Press, 1980), 57; henceforth cited as "Scientific Image".

²⁷ See, e.g., Ian Hacking, "Do we see through a microscope?" *Pacific Philosophical Quarterly* 62 (1981), 305-322; Sara Vollmer, "Two Kinds of Observation: Why van Fraassen Was Right to Make a Distinction, but Made the Wrong One." *Philosophy of Science* 67/4 (2000), 355-365; Marc Alspecter-Kelly, "Seeing the unobservable: Van Fraassen and the limits of experience." *Synthese* 140 (2004), 331-353.

theory-laden.²⁸ Yet, neither of these two argumentative strategies are Reynolds' preferred line of attack. Regarding the issue of theory-ladenness, Reynolds agrees that what we observe is always shaped by our habits and expectations. However, he rightly rejects this as a reason to accept a strong notion of theory-ladenness because "habits and expectations are not tacit theories, at least phenomenologically speaking and in ordinary usage."²⁹ Reynolds' real trouble with constructive empiricism lies somewhere else, namely with van Fraassen's *positivism* about observation.

Since Reynolds is never entirely clear on what his notion of positivism entails, I will have to assume that he would agree with the following characterization. On my understanding, to be a positivist about observation means to subscribe to a conjunction of three related sub-theses, namely that (a) perceptual evidence is only about what is actual, that (b) immediate sense-perception is secure evidential ground, and that (c) perception is a passive encounter with physical objects to which the perceiver contributes nothing essential.³⁰ If it is true that van Fraassen is a positivist in this sense of the term, then I agree with Reynolds that van Fraassen's take on observation is irreconcilable with virtually every phenomenological theory of perception, from classical to contemporary. If there is anything we can learn from, say, Husserl's theory of horizontal intentionality, then, against (a), that perception is always a composite of actuality and motivated possibility.³¹ From this it follows that, contra (b), the distinctive mode in which physical things present themselves is always that of a "presumptive actuality."³² Finally, and in sharp contradistinction to (c), it is a phenomenological

²⁸ It should be noted that van Fraassen acknowledges theory-ladenness but denies that it commits us to scientific realism. Interestingly, it is in this context that van Fraassen uses a genuinely phenomenological language when he states that "immersion in the theoretical world-picture does not preclude *'bracketing' its ontological implications.*" (van Fraassen, *Scientific Image*, 81)

²⁹ Reynolds, *Phenomenology, Naturalism and Science*, 65.

³⁰ This is also how Shannon Vallor understands the concept: Shannon Vallor, "The Pregnancy of the Real: A Phenomenological Defense of Experimental Realism," in: *Inquiry* 52/1 (2009), 1-25.

³¹ Philipp Berghofer & Harald Wiltsche, "The Co-Presentational Character of Perception," in: *The Philosophy of Perception*, ed. Christoph Limbeck-Lilineau & Friedrich Stadler (Berlin & Boston: de Gruyter, 2019), 303-321.

³² Husserl, *Id 1*, 102/97.

commonplace that perception not only depends on kinesthetic movements but also on the synthesizing activity of the subject by virtue of which the narrow sphere of immediate givenness is transcended. In summary, then, van Fraassen's positivism about observation violates almost everything phenomenologists hold dear.

Building on this negative assessment of van Fraassen's take on observation, Reynolds' overall argument goes as follows: To motivate his partial agnosticism, van Fraassen needs a sufficiently clear demarcation between what is observable and what is not. To draw the line between observables and unobservables, he must rely on a positivist theory of observation. However, once his positivism about perception is rejected, the line between what is observable and what is not becomes blurry. Central notions such as empirical adequacy lose their semantic grip, and constructive empiricism collapses.

Here, I am less interested in whether or to which extent Reynolds' argument affects van Fraassen's position. What interests me, rather, is the questionable move Reynolds needs to make his argument work against my 2012 article. For what happens is that, throughout his chapter on scientific realism, Reynolds accuses me of subscribing to a "positivist style account of perception"³³ without, however, substantiating this allegation in any way. In fact, I am not particularly surprised that Reynolds' verdict isn't backed up textually. Since I failed to find anything positivistic in my original 2012 article (or in any of my other works on perception, for that matter), I must assume that Reynolds accuses me of holding positivist views about perception because, in his mind, the only way to draw a meaningful line between observables and unobservables is to be a van Fraassen style positivist about perception. This, however, is far from being the case, as I want to show now.

It is thanks to the works of classical phenomenologists such as Husserl or Merleau-Ponty that we moved away from conceiving intentionality as a magical arrow that points at individual

³³ Reynolds, *Phenomenology, Naturalism and Science*, 67.

objects in a static, unidirectional way. Intentionality is rather characterized by its horizontal structure and, especially in the case of perceptual experience, by the highly dynamic interplay between what is sensuously given in the flesh and an open manifold of anticipations concerning possible future fulfillments. This is exactly what phenomenologists mean when they say that the distinctive mode of perceptual givenness lies in its perspectivity: For an embodied observer to undergo a successful perceptual episode is to engage in an open-ended series of partial fulfillments through which a distinctive sense of perceptual stability is constituted. However, although it belongs to the very essence of physical thinghood that the thing is never fully given in one blow, it is still true that each and every partial encounter with the thing gives the thing *in the flesh* and not only through something else, something that only *represents* what we are actually intending. *Perspectival givenness is*, to put it in a slogan, *still givenness*, and a series of partial fulfillments still contributes to the kind of *immediacy* that is characteristic of prototypical perceptions.³⁴

As we have seen, and as I have already stressed in my 2012 article, successful perceptual encounters with physical things are “infinite series of potential fulfillments which [, in their entirety,] correspond to the very idea of rational positing.”³⁵ What is crucial for the scientific realism debate, however, is that in the case of unobservables such as quarks, ions or force fields, such “*a series of potential fulfillments cannot even begin.*”³⁶ This does not mean, of course, that the discourse about the theoretical parts of science lacks fulfillment altogether. But the fulfillment we have here is of a qualitatively different, *purely symbolic kind*, and this, I believe, matters for our epistemic stance towards the theoretical superstructures of our models. If I am

³⁴ Phenomenologists are not alone in discussing the specific quality of experiences that give their objects as actually present. Within the analytic literature, this quality is referred to as “presentational feel” (John Foster, *The Nature of Perception* (Oxford: Oxford University Press, 2000), 112), “scene immediacy” (Scott Sturgeon, *Matters of Mind: Consciousness, reason and nature* (London & New York: Routledge 2000, 24), “presentationality” (John Bengson, “The Intellectual Given,” in: *Mind* 124, 2015, 707-760) or “presentational phenomenology” (Elijah Chudnoff, *Intuition* (Oxford: Oxford University Press, 2013)).

³⁵ Wiltsche, “What is Wrong?” 123.

³⁶ *Ibid.*

right in holding that scientific instruments are no substitutes for the immediacy that is characteristic of perceptual experience,³⁷ then this is strong indication that a realist interpretation of unobservables clashes with a phenomenological conception of rationality. With any eye to Reynolds' criticism, then, it becomes clear that one can very naturally draw a distinction between observables and unobservables without buying into a misguided positivism about perception. Let us now move on to an even more recent take on the issue.

Trizio Against Anti-Realism (and Realism)

In his book-length study *Philosophy's Nature: Husserl's Phenomenology, Natural Science, and Metaphysics*, Emiliano Trizio has also weighed in on the issue of scientific realism. As far as his take on my 2012 article is concerned, Trizio's employs two argumentative strategies: On the one hand, he puts significant weight on the exegetical level and tries to stay as close as possible to the exact letter of Husserl's writings. On the other hand, Trizio counters the core argument in my 2012 article on systematic grounds by giving the entire debate a distinctively transcendental twist. In what follows, I will comment on both strategies in turn.

Although I do admire the confidence with which Trizio disqualifies alternative readings of Husserl as "incorrect"³⁸ or even "completely wrong,"³⁹ I must confess that my optimism about there being *one true* reading of Husserl is more restrained. As much as I value Husserl's methodological innovations, his painstakingly detailed descriptions, and his tireless efforts to provide a solid foundation for philosophy, I do not always find Husserl's prose to be a model of clarity, precision, and internal coherence. While this, in my view, does not diminish the overall value of his oeuvre, it does have consequences for my self-conception as an interpreter

³⁷ Ibid., 114-118.

³⁸ Emiliano Trizio, *Philosophy's Nature: Husserl's Phenomenology, Natural Science, and Metaphysics* (London & New York: Routledge, 2021), 129; henceforth cited as "Philosophy's Nature".

³⁹ Ibid., 112.

of Husserl's thought. Even if I were to restrict myself to the works that have been published during Husserl's lifetime, I would still find the idea of deciding philosophically relevant issues mainly on exegetical grounds otiose.⁴⁰ And taking the full breadth of Husserl's work into account, the problems with identifying the master's voice multiply. Yet, even if there was a way to cut through the thicket of forty thousand or so manuscript pages, this would not, I contend, change much regarding the rather special case of the scientific realism debate. Although, admittedly, there is evidence suggesting that Husserl was more interested in the contemporary science of his day than is commonly assumed,⁴¹ the fact that the name "Einstein" is mentioned less than ten times in the entire *Husserliana* edition speaks volumes (pun intended) about Husserl's willingness to engage with the science of his day.⁴² To be sure, this is not meant to imply that phenomenology isn't a useful framework for the interpretation of science. All I am saying is that, since a sufficiently sophisticated treatment of contemporary (i.e. post 19th century) science is unfortunately missing from Husserl's oeuvre,⁴³ and since the issue at hand cannot be dealt with exclusively from the philosophical armchair, our stance in the scientific realism debate is strongly underdetermined by Husserl's texts.

What, then, about Trizio's systematic arguments against my 2012 article? To get a better sense of the basic direction of Trizio's criticism, let us start with taking another look at the main argumentative route I took in my 2012 article:

⁴⁰ To mention just one example, I have recently tried to explicate Husserl's condition of rationality, as it is introduced in part four of *Ideas I* (Wiltsche, *Rationality*). Although the condition of rationality is crucial for Husserl's overall epistemology, his own formulation is so fraught with ambiguities and logical difficulties that serious interpretational work is necessary to make Husserl's condition of rationality work. Here, like in many other cases, it would simply be impossible to decide philosophical disputes merely on exegetical grounds.

⁴¹ Mirja Hartimo, "Husserl's scientific context, 1917-1938. A look into Husserl's private library," *The New Yearbook for Phenomenology and Phenomenological Philosophy*, 16 (2018), 317-337.

⁴² The fact that Trizio also considers "Husserl's silence on the issue [of modern physics] embarrassing" (Trizio, *Philosophy's Nature*, 193, my emphasis) suggest that he would not disagree with this assessment.

⁴³ The most extensive treatment of actual physics is the famous Galileo paragraph in the *Crisis*. Although I do agree with the general line of Husserl's approach (Harald Wiltsche, "Mechanics Lost: Husserl's Galileo and Ihde's Telescope," *Husserl Studies*, 33/2 (2017), 149-173; henceforth quotes as *Mechanics Lost*), these forty pages do not come close to give a sufficiently systematic outline of how a genuinely phenomenological philosophy of science would look like.

- (1) The rationality of believing *P* is strongly dependent on the motivated possibility of having fulfilled intentions towards *P*.
- (2) Since a physical thing is defined as “a possible object of a straightforward percept,”⁴⁴ the possibility of having fulfilled intentions about it depends on its in-principle observability.
- (3) Scientific theories aim at a description of physical reality.
- (4) Mature scientific theories commonly invoke things that are unobservable in principle.
- (5) Since, qua (3), these unobservables would be physical, but since, qua (1) and (2), the rationality of having beliefs about physical things depends on their in-principle observability, beliefs about unobservables are not rational and cannot be part of theory acceptance.

Unlike Reynolds, Trizio doesn't take the concept of observation as the linchpin of the discussion. And unlike Berghofer,⁴⁵ Trizio doesn't turn the scientific realism debate into an epistemological argument about the scope of our inferential machinery. Rather, Trizio's move is as refreshing as it is surprising, for he chooses (3) as his preferred target of criticism. The heart of his proposal is “that atoms and ions cannot be perceived because they are small, but because, *qua categorical unities of thought*, they cannot be correlates of any act of perception whatever, and this for unfringeable eidetic reasons.”⁴⁶ It is the emphasized clause that is of crucial importance here: According to Trizio, “[t]he things that surround us and their properties can be seen and touched, while a conjunction, a copula, a number, a triangle, or a vector field

⁴⁴ Husserl, *LI 2*, 285/679.

⁴⁵ Philipp Berghofer, “Transcendental Phenomenology and Unobservable Entities,” *Perspectives*, 7/1, 2017, 1-13.

⁴⁶ Trizio, *Philosophy's Nature*, 130; my emphasis.

cannot.” These latter “objectivities are given only through categorical acts; they are grasped by the ‘intellect,’ not by the senses.”⁴⁷ The essential point of Trizio’s proposal, then, is that the “world of science” is composed of such ideal objectivities, which is also why statements about unobservables do not involve “*any straightforward existence claims*.”⁴⁸ Summarizing his overall position, Trizio writes that

“the difference between the thing of perception and the thing of physics admits of no degrees because it is founded upon essentially different intentional acts, namely, perceptive and intellectual/idealizing acts. And this distinction has nothing to do with the aforementioned continuum of entities so dear to philosophers of science, ranging from the most ordinary to the most recondite. In conclusion, one could say that, for Husserl, *pace* van Fraassen, atoms and ions are, precisely, *theoretical entities* [...]”⁴⁹

Before I go on to comment on Trizio’s suggestion, I would like to take a closer view on how it affects the argument in my 2012 article. As I have pointed out earlier, the scientific realism debate is commonly understood as a discussion about the epistemic stance(s) we should take regarding different classes of putative objects within the natural attitude. For the discussion to unfold in the usual way, it must thus be assumed that the object classes under consideration—observables on the one hand, unobservables on the other—fall into the same ontological category, namely the category “physical thing.” This, however, is precisely what Trizio denies. On his view, observables and unobservables do not populate the same ontological plane, which is why it is altogether misguided to assess them by the same epistemic standards such as the principle of rationality expressed in (1). By making this move, Trizio undermines the selective

⁴⁷ Ibid., 120.

⁴⁸ Trizio, *Philosophy’s Nature*, 169; my emphasis.

⁴⁹ Ibid., 131.

agnosticism I have advocated in my 2012 article. Instead of construing of atoms and ions as putative physical things whose in-principle unobservability prevents them from being the targets of positive or negative doxastic attitudes, Trizio sees them as idealities that are, ontologically speaking, more similar to numbers and geometrical objects than they are to tables and chairs.

So, what do I think of Trizio's argument? I think he is right, at least as far as the basic direction of his argument goes. Since my positive reaction to Trizio's proposal might come as a surprise to some, I want to begin by highlighting two interrelated aspects that I found increasingly unsatisfactory about my own proposal ever since the paper appeared in 2012. First, although I am still convinced that a van Fraassen style anti-realism is closer in spirit to phenomenology than full-blown realism, the restriction to empirical adequacy as the only relevant epistemic virtue turns the theoretical part of science into a black box whose inner workings must remain mysterious. However, and this is the second aspect, there exist several phenomenological treatments of science that tell illuminating stories about theory development without mirroring the traditional realist pattern of inferring truth from success. Merleau-Ponty's discussion of quantum mechanics in his late essay "Modern Science and Nature" is one such example,⁵⁰ London's and Bauer's phenomenological interpretation of the measurement problem (which influenced Merleau-Ponty) is another.⁵¹ Of similar if not even greater importance is the treasure trove of Hermann Weyl's oeuvre: his phenomenological critique of Riemannian geometry as the mathematical backbone of General Relativity and the subsequent discovery of gauge

⁵⁰ Maurice Merleau-Ponty, *Nature. Course notes from the Collège de France* (Evanston: Northwestern University Press, 2003), 81-122; see also: Michel Bitbol, "A Phenomenological Ontology for Physics: Merleau-Ponty and QBism", in: *Phenomenological Approaches to Physics*, ed. Harald Wiltsche & Philipp Berghofer (Cham: Springer, 2021), 227-242.

⁵¹ Fritz London & Edmond Bauer, "The theory of observation in quantum mechanics", in: *Quantum theory and measurement*, ed. John Archibald Wheeler & Wojciech Hubert Zurek (Princeton: Princeton University Press, 1983), 217-259; see also: Steven French, "From a Lost History to a New Future: Is a Phenomenological Approach to Quantum Physics Viable?", in: *Phenomenological Approaches to Physics*, ed. Harald Wiltsche & Philipp Berghofer (Cham: Springer, 2021), 205-225; henceforth cited as "Lost History".

invariance,⁵² his interpretation of the coordinate system “as the necessary residuum of the annihilation of the ego”⁵³ or his description of how mathematical models can act as cognitive lenses for the constitution of experimental reality⁵⁴ are all examples of how much further phenomenology can go in its attempt to illuminate scientific theorizing. Although, so far, I did not explicitly retract my earlier view on the matter, it was exemplary analyses such as these that pushed me more and more into the direction that Trizio also seems to advocate.⁵⁵

So, where does this leave us? The first thing to note is that, as far as I can see, the negative part of my 2012 article still stands: Scientific realism, as it is usually understood in the mainstream literature, is no option for phenomenologists, and the two most common arguments—the argument from instrumentation and the argument from mutation—don’t do much to change this. However, instead of seeing this as a reason to join forces with van Fraassen’s constructive empiricism, I agree with Trizio that “phenomenology and [much of contemporary] philosophy of science [...] address the question of the epistemic value of physical theory in radically incompatible ways,”⁵⁶ and that, as Steven French has also emphasized, a phenomenological “interpretation [of physical theory] will not fit neatly into the space defined by the axes of the realism-antirealism debate.”⁵⁷ Thus, instead of narrowing the scientific realism debate to the pre-transcendental question of the ontological commitments we might reasonably have in

⁵² Thomas Ryckman, *The Reign of Relativity. Philosophy in Physics 1915-1925* (Oxford: Oxford University Press, 2005), chapters 5 and 6; henceforth cited as “Reign of Relativity”.

⁵³ Hermann Weyl, *Philosophy of Mathematics and Natural Science* (Princeton: Princeton University Press, 1949), 75; see also Harald Wiltsche, “Physics with a human face. Husserl and Weyl on realism, idealism, and the nature of the coordinate system”, in: *The Husserlian Mind*, ed. Hanne Jacobs (London & New York, 2022), 468-478.

⁵⁴ Arezoo Islami & Harald Wiltsche, “A Match Made on Earth: On the Applicability of Mathematics in Physics”, in: *Phenomenological Approaches to Physics*, ed. Harald Wiltsche & Philipp Berghofer (Cham: Springer, 2021), 157-177, here: 170-174; henceforth quoted as *A Match Made on Earth*.

⁵⁵ For instance, I argue in a recent paper with Arezoo Islami that “[t]he objects of modern mathematized physics are not adopted from the world of everyday experience, but are constituted in a fundamentally different way” and that “[v]iewing nature in a mathematized manner is the result of a quite peculiar process of constitution which essentially involves mathematics and which can be further explicated phenomenologically” (Islami & Wiltsche, *A Match Made on Earth*, 167). Building on my earlier work on Galilean mechanics and kinematics (Wiltsche, *Mechanics Lost*), we argue that Galileo’s real accomplishment was to introduce a new way to *constitute reality*, a way that essentially consists in the practice to “*mathematize all of reality by intending it through ideal-mathematical noemata*” (Islami & Wiltsche, *A Match Made on Earth*, 173).

⁵⁶ Trizio, *Philosophy’s Nature*, 143.

⁵⁷ French, *Lost History*, 217.

different sub-sections of the natural attitude, it is indeed more productive to take a genuinely transcendental stance to and to understand the “world of science [as a particular] declination of the one original world manifesting itself in experience.”⁵⁸ The point, then, is to see “[p]hysical nature as a correlate of the theoretical attitude,”⁵⁹ which is to say that, phenomenologically construed, both the manifest and the scientific image of reality are “intentional performances of a subject who has taken up the naturalistic attitude.”⁶⁰ Or, to put it in yet another way: Once a transcendental-phenomenological attitude is adopted, modern physical science can be understood as an intentional practice in which mathematical models act as cognitive filters to constitute reality in radically new and ever-changing ways. It is only from this perspective that we can finally grasp what Trizio has in mind when he calls the objects of science *theoretical entities*: Chairs, planets and elephants cannot populate the same ontological plane as atoms, ions and force fields because their constitutional histories are too different to lump them together under the same ontological or epistemic umbrella. It is the task of a genuinely phenomenological philosophy of science to explicate the differences between these constitutional practices, and thus to arrive at a transcendently clarified and ultimately self-conscious understanding of the scientific enterprise.

The Problem of Coordination

As we have seen, Trizio’s suggestion is to re-conceptualize the relation between the lifeworld and the world of science from a transcendental perspective: The point of his proposal is that “[w]ithin the absolute being of transcendental intersubjectivity, both ‘worlds’ are just constitutional layers of *the* world, they are both transcendent constituted poles.”⁶¹ Yet, even if

⁵⁸ Trizio, *Philosophy’s Nature*, 217.

⁵⁹ *Ibid.*, 172.

⁶⁰ *Ibid.*, 273.

⁶¹ *Ibid.*, 139.

one accepts this basic trajectory, there are still several concerns of varying degrees of magnitude. In what follows, I will focus on the most pressing of these, a problem to which I will refer as the *problem of coordination*.

The heart of the issue is easy to explain: As we have seen, prescientific and scientific nature (henceforth referred to as N_p and N_s) are the correlates of two different attitudes or constitutional practices (henceforth referred to as A_p and A_s). While it seems safe to assume that N_p is standardly available to (almost) every competent adult human, the availability of N_s depends on a stock of background knowledge and on a mathematical and specifically physical skillset that is necessary to take up A_s . Now, the crucial question that arises from the perspective of a subject for whom both A_p and A_s are available concerns the relation between N_p and N_s . To make this more vivid, imagine that Audrey perceives a stick that is halfway submerged in water so that her senses present the stick as bent. While Audrey has learned to deal with such cases within the common context of N_p , it is due to her physics degree that she also knows how such perceptual illusions come about: Audrey has the necessary knowledge and skills to constitute N_s as a “world” in which photons propagate at different velocities through different media, thus hitting the photoreceptor cones on her retinae at different times. Relying on Snell’s Law, Audrey can even compute the exact refraction angles and use her calculations to make precise, falsifiable predictions about the behavior of objects within N_p . The problem of coordination arises if Audrey starts to wonder how N_p and N_s are related to each other.

At first glance, it could seem that there isn’t much of a problem: In order for Audrey to come to a full phenomenological understanding of N_p and N_s as the constitutional correlates of A_p and A_s , she must be able to perform the transcendental epoché and reduction. However, since the very act of performing the epoché and reduction implies a complete inhibition of the general thesis of the natural attitude, Audrey will no longer focus on the “what” of N_p and N_s but merely on their constitutive “how”. All a transcendently attuned Audrey seems to be able to do is to

analyze the intentional structures underlying A_p and A_s and to conceive of them as two kinds of intentional performances that result in the constitution of N_p and N_s , respectively. However, even if this is a correct interpretation of how Audrey interprets N_p and N_s while being in the transcendental attitude, there are still questions to be asked if Audrey returns from her transcendental-reflective stance and seeks to make sense of her own cognitive life in a more unified but still coherent way. In my view, the following three questions stand out: *First*, how can it be that computations which are exclusively based on objects within N_s prove to be successful when applied to objects within N_p ? *Second*, how can the behavior of objects within N_p be of central epistemic importance for our doxastic attitudes regarding N_s ? *Third*, why is it that the degree to which models from N_s can account for processes within N_p depends on whether the constitution of N_s relies on, say, Euclidean geometry and Galilean transformations or Riemannian geometry and Lorentz transformations? In what follows I will discuss three strategies to deal with these questions. If my analysis is correct, none of these strategies solve the coordination problem in a satisfactory manner.

Strategy 1: Phenomenological Quietism

The first strategy is to advocate *phenomenological quietism*, a position that comes in a moderate and a radical version. According to moderate quietism, it is impossible to deal with any of the aforementioned questions from a transcendental-phenomenological viewpoint because the performance of the epoché and reduction restricts us to an exclusive focus on the constitutional “how” of A_p and A_s . Yet, we can address the three questions from before once we step out of the transcendental attitude and regain a naturalistic perspective onto reality. Radical quietism, on the other hand, goes one step further and dismisses the coordination problem as meaningless without further qualification. According to this view, all we can say

about the relationship between N_p and N_s , or about the relations between different (e.g., relativistic and pre-relativistic) versions of N_s is that they are the results of different intentional performances of the transcendental Ego. Every attempt to force these intentional performances into further interpretational molds runs the risk of reifying what are essentially nothing but constitutional practices of a transcendental subject.

Although both answers to the coordination problem have been suggested in the literature,⁶² neither is compatible with the position Trizio seems to envision. The problem with moderate quietism is that it frames the scientific realism debate in pretty much the same way “mainstream” philosophy of science does, namely as a purely pre-transcendental discussion about the right epistemic attitudes regarding objects of N_p and objects of N_s , respectively. However, given Trizio’s insistence that “phenomenology and [contemporary] philosophy of science [...] address the question of the epistemic value of physical theory in radically incompatible ways,”⁶³ this way to frame the discussion seems to be at odds with Trizio’s distinctively transcendental approach. Yet, radical quietism is even less of an option: Not only is it the case, as we shall see, that Trizio has more to say about the relations between N_p and N_s than just that they are intentional correlates of A_p and A_s . On closer inspection it also turns out that radical quietism raises a problem that I have already addressed earlier: If we agree that it is an unsatisfying aspect of van Fraassen style anti-realism that it turns the theoretical side of science into a black box whose inner workings cannot be further elucidated, then this should also count as a strong argument against more radical versions of quietism.

⁶² While my own 2012 article can be seen as a form of moderate quietism, Joseph Rouse’s deflationary take on the topic qualifies as a form of radical quietism. According to Rouse, “[scientific] realism is not an *issue* at all [because] the question of what really exists, or whether the real is immanent of transcendent to consciousness, are prephilosophical questions, belonging to the ‘natural attitude’” (Joseph Rouse, “Husserlian Phenomenology and Scientific Realism,” *Philosophy of Science* 54/2 (1987), 222-232, here: 223). In a way that is reminiscent of Arthur Fine’s “Natural Ontological Attitude”, Rouse seems to assume that the issue of scientific (anti-)realism simply dissolves once a transcendental perspective has been taken up.

⁶³ Trizio, *Philosophy’s Nature*, 143.

Strategy 2: Transcendental Optimism

The second strategy is to advocate a position that I will call *transcendental optimism*. Transcendental optimism claims that when looking at the relationship between N_p and N_s from a transcendental point of view, the intentional performance A_s as well as its constitutive result N_s must be judged as being “epistemically superior”⁶⁴ to A_p and N_p . Although Trizio is clear that transcendental phenomenology is not in the business of directly assessing the truth-content of our best confirmed theories, there is textual evidence showing that his overall position still qualifies as transcendental optimism in the aforementioned sense. Consider, for instance, the following passage:

“[T]ranscendental, eidetic phenomenology [...] does prescribe that the aim of natural science is to know the ultimate truth about material nature down to its innermost structure, and that the more a scientific theory is supported by empirical evidence, the more we should believe in it, at least until a better alternative is presented.”⁶⁵

If Audrey took this passage as a guideline for the interpretation of her own cognitive life, the resulting transcendental optimism would commit her to the view that A_s and its correlate N_s are indeed epistemically superior to A_p and N_p . Whatever other merits the latter may have, when it comes to task of “knowing the ultimate truth about material nature down to its innermost structure,” the smart money clearly is on A_s and N_s .

⁶⁴ I put this expression within quotes because one of the main challenges would be to spell out what “epistemically superior” means in this context without immediately falling back into a pre-transcendental, naturalistic stance.

⁶⁵ Trizio, *Philosophy's Nature*, 140. Trizio’s characterization of physics as a discipline that “has both gained a fundamental insight into the essence of material nature and developed the corresponding method” (Ibid., 278) strikes a very similar tone.

The advantage of transcendental optimism is that it allows us to account for the first and the third horn of the coordination problem in a relatively straightforward way. Considering why computations based on objects within N_s prove to be successful when applied to N_p , the answer is that N_s is better at capturing the “innermost structure of material nature” and that, for this very reason, computations based on N_s are reliable when applied to the material aspects of N_p . Considering why we can better account for N_p when our constitutional practice A_s involves Riemannian geometry and Lorentz transformations rather than Euclidean geometry and Galilean transformations, the answer is that not all ways to constitute N_s are on par, and that in comparison to classical Newtonian mechanics, Relativity Theory represents a superior way of constituting material nature, a way that, again, is better at capturing the “innermost structure of material nature”. Following this basic trajectory, transcendental optimism seems to accommodate the fact that models within N_s excel at accounting for objects, processes and mechanisms within N_p (as long as they belong to the category “material nature”), and that the history of science appears to be a succession of increasingly adequate ways to constitute physical reality.

Where transcendental optimism runs into trouble, however, is with the second horn of the coordination problem, the horn that concerns the epistemic significance N_p has for N_s . The problem, in a nutshell, is this: It is an essential part of Audrey’s scientific practice to apply models from N_s to account for occurrences within N_p . Following Trizio’s advice, Audrey takes her success in doing so as evidence for the belief that her models at least approximate the goal of delivering, as Trizio puts it, the “ultimate truth about material nature down to its innermost structure”. Now, to make things more concrete, let us assume that Audrey relies on Quantum Field Theory (QFT). Impressed by the incredible precision with which QFT accounts for phenomena such as atomic recoil or anomalous magnetic dipole moments, Audrey considers QFT as a constitutional practice that yields a (fallible) glimpse on what the “innermost structure

of material nature” might look like. Note, however, that the evidence for Audrey’s optimistic stance are occurrences within N_p : No matter how far removed from the lifeworld quantum phenomena such as atomic recoil ever may be, what ultimately counts as evidence for Audrey’s doxastic stance regarding QFT are *directly experienceable events in familiar three-dimensional space*, i.e., N_p events such as pointers pointing, interference patterns glowing or Geiger counters clicking. Husserl makes essentially the same point in the *Crisis* when he emphasizes that for “visible measuring scales, scale marking etc. [to count as] the source of verification, [they must be considered] as actually existing things, not as illusions.”⁶⁶ The problem, however, is that if QFT is indeed a good approximation of the “innermost structure of material nature”, as Trizio’s transcendental optimism would have it, then conventional three-dimensional space and the N_p events within it are exactly that, *an illusion*. For, according to QFT, the fundamental physical space is *configuration space*, a much higher dimensional space in which the number of dimensions is determined by the number of modelled particles,⁶⁷ and in which not a single dimension corresponds to any of the three spatial dimensions known from N_p . Note that the problem thus stated is not merely another version of the well-known clash between the Sellarsian “manifest” and “scientific image”. The quandary Audrey finds herself in reaches much deeper and concerns nothing less than the *empirical (in-)coherence* of QFT.⁶⁸ Our evidence for QFT are N_p events with locations in three-dimensional space. Yet, if QFT is understood as a guide to the “innermost structure of material nature”, QFT implies that no such locations exist. Hence, on the transcendental optimist’s reading, QFT undermines its own

⁶⁶ Husserl, *Crisis*, 126.

⁶⁷ Unlike ordinary three-dimensional space, configuration space has three dimensions *for each modelled particle*. Hence the name “3N-dimensional configuration space”, where “N” represents the numbers of particles in the universe.

⁶⁸ “Empirical coherence” is the title under which this problem is discussed within “mainstream” philosophy of physics. Cf., for more details, Tim Maudlin, “Completeness, supervenience, and ontology,” *Journal of Physics A* 40 (2007), 3151; Nick Huggett & Christian Wüthrich, “Emergent spacetime and empirical (in)coherence,” *Studies in History and Philosophy of Modern Physics* 44/3 (2013), 276-285; Alyssa Ney, “Fundamental physical ontologies and the constraint of empirical coherence: a defense of wave function realism,” *Synthese* 192 (2015), 3105-3124; Niels Linnemann, “On the empirical coherence and the spatiotemporal gap problem in quantum gravity: and why functionalism does not (have to) help,” *Synthese* 199 (2021), 395-412.

epistemic foundation because no meaningful connection between N_p events and N_s can be established.

Strategy 3: Lifeworld Foundationalism

Although I do not quite see how the questionable consequences of transcendental optimism can be circumvented without giving up (or at least severely modifying) the claim that science somehow brings us closer to the “innermost structure of material nature”, Trizio seems to suggest a third answer to the coordination problem, the strategy of *lifeworld foundationalism*. The basic idea is well-known from Husserl’s late works, especially from §9 of the *Crisis* and *The Origin of Geometry*: Husserl’s claim there is that modern scientific culture never came to appreciate the role of the lifeworld as a “meaning-fundament”⁶⁹ on which the mathematical machinery behind mathematized science rests. In order for, say, the concept of a frictionless plane to be meaningful at all, there must be a basic acquaintance with real surfaces and with techniques to make these surfaces flatter. It is in this way that the lifeworld of pre-scientific experience is always already presupposed when idealities such as frictionless planes, point masses or perfectly rigid rods are put to use in scientific practice.⁷⁰ Or, to put it in Trizio’s words: “[G]eometry is the sense-fundament of mathematical physics, just as the art of measurement is the sense-fundament of geometry.”⁷¹ Since its inception in the 17th century, however, modern scientific culture remained largely ignorant of the foundational role of the lifeworld, and it does so to this very day. According to Husserl, this disregard of the lifeworld is a “fateful omission”⁷² because it leads to a complete separation between N_p and N_s . The result of this separation is an objectivist construal of science in which mathematical idealities

⁶⁹ Husserl, *Crisis*, 48.

⁷⁰ Wiltsche, *Mechanics Lost*; Trizio, *Philosophy’s Nature*, chapter 5, §4.

⁷¹ *Ibid.*, 242.

⁷² Husserl, *Crisis*, 49.

are taken to be truthful representations of the “one real world behind the phenomena,” thus degrading the status of N_p to that of a mere illusion.

In which sense can lifeworld foundationalism be considered a solution to the coordination problem? One way⁷³ to answer this question is to go back to the earlier discussion about the empirical (in-)coherence of QFT: If theories such as QFT are interpreted along the lines of transcendental optimism, then this has unwanted consequences for the epistemic status of these theories. To repeat: How can N_p events in three-dimensional space count as evidence for a theory that denies that three-dimensional space (or four-dimensional spacetime, for that matter) is part of the “innermost structure of material nature”? If understood transcendental-optimistically, such a theory seems to undermine its own justificatory status by discrediting the very evidence on which the theory rests. Now, one might think that lifeworld foundationalism is a way out of this dilemma: Once we realize that the idealities comprising N_s presuppose N_p as a constant meaning fundament, any attempt to demote the status of N_p from the viewpoint of N_s must appear ill-headed right from the outset.

As much as I agree that the theory of the lifeworld is one of the most productive ideas in Husserl’s later works, I see at least two problems if lifeworld foundationalism is used to solve the coordination problem. First, with a view to the earlier discussion about QFT, I do not think that lifeworld foundationalism can serve as a defense against the threat of empirical incoherence. To see why, bear in mind that the core message of lifeworld foundationalism is that the idealities comprising N_s presuppose N_p as a constant meaning fundament because the former were initially created out of the latter “through a peculiar sort of mental

⁷³ Another way would be the strong claim that idealizations are truth-conducive and that, accordingly, the idealities comprising our physical models approximate the “ultimate truth about material nature down to its innermost structure”. Yet, Trizio is very clear on the fact that such a view would be hard to reconcile with a phenomenological take on idealization: “The inhabitants of the ‘geometrical world’ do not mirror in any way [...] a fundamental structure [of the word of experience], for the simple reason that, no matter how particularized they might become, geometrical entities always remain general ideal types, ideas in the Kantian sense, and, as Husserl says, they cannot be ‘seen’.” (Trizio, *Philosophy’s Nature*, 229)

accomplishment: idealization.”⁷⁴ Granted, however, that this is the right way to think about the relation between N_s and N_p , lifeworld foundationalism and transcendental optimism turn out to be two ideas that seem to lie in tension with each other at any rate: If N_p is not only the justificatory basis for N_s but if, moreover, the very meaning of the idealities comprising N_s depend on N_p as their meaning fundament, then the interpretation of N_s as an approximation to the “innermost structure of material nature” becomes even more questionable.

My second worry has to do with the fact that, until now, lifeworld foundationalism has remained at a largely programmatic stage. What I mean is this: Looking at the usual examples by means of which most phenomenologists (myself included⁷⁵) introduce lifeworld foundationalism, it soon becomes clear that almost all examples are firmly rooted within the context of classical, sometimes even pre-Newtonian physics: Scholars refer to frictionless planes or simple Galilean models to illustrate how pre-scientific experience and lifeworld practices are always already presupposed when idealities of this kind are constituted. Yet, although I do not question the pedagogical value of this approach, I am wondering whether these examples are sufficient to prove that lifeworld foundationalism is also applicable to the kind of physics we became accustomed to in the 20th and 21st century. Doubts about the scope of lifeworld foundationalism could be fueled by the tremendous increase in technical sophistication in physics: It is easy to illustrate lifeworld foundationalism with, say, Galileo’s model of projectile motion because the connection between the model and the intended lifeworld objects is intuitively recognizable. Although the model consists of abstract entities such as frictionless planes and ideal spheres, and although the model purposefully distorts empirical reality on several levels, Galileo’s mathematical machinery of proportional geometry is still mundane enough to immediately see its roots in N_p . Yes, as Husserl himself saw, physics

⁷⁴ Ibid., 348. Cf., for more details on how idealities such as frictionless planes, rigid rods or point masses are constructed through higher-order acts of idealization: Wiltche, *Mechanics Lost*, section 2.

⁷⁵ Ibid.; Islami & Wiltche, *A Match Made on Earth*.

changed dramatically in the aftermath of the Galilean revolution: Innovations such as the Cartesian coordinate system made it possible to directly translate complex geometrical properties into the formal language of algebra. As a result, complex geometrical problems could be dealt with solely by means of materially undetermined algebraic equations, thus cutting all intuitive ties both between the mathematical model and its empirical target system, and between the mathematical tools and their alleged lifeworld foundations.⁷⁶

Note that examples of this kind can easily be multiplied: When complex numbers were originally introduced in the 16th century, the imaginary unit $i = \sqrt{-1}$ was merely a tool for the inner-mathematical purpose of solving cubic equations. While even 19th century mathematicians such as Augustin-Louis Cauchy still wanted to “completely repudiate without regret $i = \sqrt{-1}$ because we cannot say what this alleged symbol signifies nor what meaning can be given to it,”⁷⁷ the consensus today is that “[t]rying to describe the importance of complex numbers for science is a bit like trying to explain why real numbers are important; they are so important and prevalent it’s difficult to choose specific examples.”⁷⁸

Considering examples such as these, the problem for lifeworld foundationalism should be obvious: Husserl’s thesis according to which the mathematical tools underlying physics require simple lifeworld experiences as their meaning-fundament might be immediately plausible in cases like Galilean proportional geometry. However, whether it is possible to uphold the claim that “idealities [...] must contain in themselves the intentional reference to [...] the world of intuition [and] prescientific praxis”⁷⁹ in cases like complex numbers, linear operators, Borel

⁷⁶ Cf., for more details: Harald A. Wiltsche, “Models, Science, and Intersubjectivity,” ed. Frode Kjosavik, Christian Beyer & Christel Fricke, *Husserl’s Phenomenology of Intersubjectivity. Historical Interpretations and Contemporary Applications* (London & New York: Routledge, 2019), 339-358. Trizio, *Philosophy’s Nature*, 234-241.

⁷⁷ Augustin-Louis Cauchy, “Mémoire sur la théorie des équivalences algébriques substituée à la théorie des imaginaires,” in: *Œuvres complètes d’Augustin Cauchy*, Série 2, tome 14 (1882-1974 [1847]), 93-120, here: 100-101; my translation.

⁷⁸ James Sneyd, Rachel M. Fewster & Duncan McGillivray, “Complex Numbers,” in: *Mathematics and Statistics for Science*, Cham: Springer (2022), 135-156, here: 135.

⁷⁹ Trizio, *Philosophy’s Nature*, 224.

sets, Hilbert spaces or Fourier transforms is far less obvious. What we are dealing with here is mathematical concepts that, first, were not introduced with questions of physical applicability in mind, and that, second, do not seem to be connected to pre-theoretical experiences or practices in any obvious way.

I want to be very clear that my claim is *not* that lifeworld foundationalism cannot be upheld in the case of these or similar other examples.⁸⁰ My claim is merely that phenomenologists of science—myself and Trizio included—would be well advised to move beyond the outdated vision of tiny billiard balls floating around in Euclidean space and to prove the worth of lifeworld foundationalism (and phenomenology of physics in general) by accounting for the much more abstract outlook of contemporary physical theorizing.⁸¹ Doing so will be necessary to show that phenomenology of science is more than the somewhat peculiar attempt to extrapolate Husserl’s ideas to an area about which the master himself had relatively little to say.

Concluding Remarks

Apart from explaining why I do no longer hold the position I defended in my original 2012 article, the primary goal in this paper was to describe what I take to be the biggest challenge for a transcendental-phenomenological take on the scientific realism debate. The coordination problem, as I see it, concerns the questions a theorizing subject encounters when reflecting on the relation between scientific and prescientific nature: Even if the subject is in possession of the philosophical resources to conceive of N_p and N_s as the intentional correlates of two

⁸⁰ The probably most impressive example of the possibility of such an analysis is Tom Ryckman’s now classical treatment of the phenomenological roots of Weyl’s concept of gauge invariance (cf. for details, Ryckman, *Reign of Relativity*).

⁸¹ Although Trizio explicitly states that “integrating the ‘new physics’ [Husserl’s notion] in the universe of phenomenological philosophy is necessary task” (Trizio, *Philosophy’s Nature*, 189-190), he does little to move beyond the somewhat antiquated picture of Newtonian physics.

different attitudes or constitutional practices, she will still wonder how to make sense of those parts of her scientific practice which essentially depend on the ability to let the objects of N_p and N_s interact despite their ontological differences. What is more, the theorizing subject will also wonder how to account for the differences between different ways to constitute N_s (say, based on Newtonian or relativistic physics) without falling back into the old realist habit of inferring truth from success. If my analysis is correct, answers to these questions are still unclear and in need of further inquiry.

Let me conclude with an important final remark. Although Trizio's monograph served as a springboard for the critical analysis in this paper, my dissatisfaction with the available strategies to deal with the coordination dilemma should not primarily be seen as a criticism of Trizio's work. Since there is only so much one can do in one book, it would be unfair to expect a fully developed account that does justice to all issues at stake. I thus hope that my critical assessment is taken as what it is: an invitation to phenomenologists of science to collectively step up our game, and to turn phenomenology into a coherent, productive, and competitive research program in contemporary philosophy of science.