



The Empirical and the Holistic Turn: A Hegelian Dialectics of Technoscience Revisited

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Abstract

My effort to address the comments made by the two distinguished scholars (to “negate their negations” as it were), consists of three steps. I will start with a brief resume of Hegel’s dialectical logic, to provide a scaffold for the debate. Subsequently, I will address the comments made. In the case of Hans-Jörg Rheinberger, I will focus on his reference to Althusser. In the case of Bart Gremmen, I will focus on the dialectics of biology (on biology as an inherently dialectical science), notably on his reference to Mendel. Finally, I will address the tension between the conceptual and the empirical dimension of philosophical scholarship.

Keywords Hegel’s dialectical logic · Althusser’s philosophy of science · Dialectical biology · Gregor Mendel · The empirical turn in philosophy

1 Introduction

I am very honoured by the careful manner in which two distinguished colleagues, Hans-Jörg Rheinberger and Bart Gremmen, read and commented on my paper. The ensuing dialogue is a dialectical exercise in its own right. The concept presented in my initial paper (the first moment, M_1) will undoubtedly profit from exposure to these comments and criticisms (M_2), for it is only by addressing and (hopefully) overcoming them, that a more validated position can be achieved (M_3). My efforts to “negate their negations” consist of three successive steps. First, rather than discussing minor details, most of the comments concern dialectics *as such*. Therefore, I will first present a concise summary of Hegelian dialectics, building on Hegel’s so-called “minor logic” (Part One of his *Encyclopaedia*), rather than on Part Two (his philosophy of nature, as in my initial paper), serving as a scaffold for addressing the comments made.

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2 Hegel's Dialectical Logic

For Hegel (1830/1986), philosophy is *science*, i.e. hard, methodological work, in close collaboration with the natural sciences (“Hand in Hand mit den Wissenschaften”; *Vorrede*, p. 15). Until the eighteenth century, Hegel points out, the science-philosophy divide as we still know it today was inexistent. It was a matter of perspective, as philosophy adopted an oblique perspective, but on the basis of active involvement. If we consider this the starting point (M_1), the current situation of separation, alienation and opposition (“*Entzweiung*”) between philosophy and the natural sciences is the “negation” (M_2): something that must be overcome, by systematically incorporating the experiences of scientific research into philosophy, while making philosophical questioning an inherent part of science. Thus, a higher level of comprehension (“sophistication”) may be reached (“negation of the negation”, M_3). And yes, this entails a teleological dimension insofar as, if this can be achieved, some progress has been made.

Dialectics thus fosters dialogue, *not* in response to an imperative coming from outside, but fuelled by an inherent will to overcome one-sidedness. During the alienation stage, science is bound to fall victim to metaphysical biases. I gave a particular example of this in my paper, indicating how, during the 1980s and 1990s, genomics as a global research enterprise was haunted by the (metaphysical) conviction that we *are* our genes. The inherent tendency of such programs, however, is to push their guiding convictions to the extreme (towards genetic *determinism*), a tendency which unwittingly strengthens the opposite position (the contrasting emphasis on the importance of environmental factors), until the contradiction is superseded and both positions become incorporated into a comprehensive view, seeing life as an interactive process (“*Wechselwirkung*”) between nature and nurture (between genomes and environments). In a similar manner, pre-Darwinian catastrophism and gradual (Darwinian) evolutionism managed to converge into the theory of punctuated equilibrium. The negation of the negation sets in as soon as we realise that the validity of each position is partial (that the one is the “truth” of the other, as Hegel phrases it). That which is barred or negated, is bound to resurge, albeit initially in the form of accumulating anomalies and frustrations.

A similar dialectical pattern can be discerned at the subject pole of the knowledge production process. Here, progress is made, Hegel argues, because, in the course of history, contemplation (the position of the Master) increasingly gives way to “Tätigkeit”: to interactivity with nature, through experimental work (the position of the Servant), employing research devices (initially referred to as “philosophical instruments”, §7). Thus, dialectics acknowledges the crucial importance of scientific labour (“*Arbeit*”) and its core result: *experience* (§9, p. 52). Natural sciences offer a stimulus (“*Reiz*”) to overcome the self-satisfying convictions of abstract thinking, challenging philosophers to incorporate validated insights, while philosophy provides a stimulus for scientists to reconsider the one-sidedness of the (metaphysical) convictions that are guiding their research. Thus, the drive to interact comes from both sides. While philosophers consider the experiences of science, the natural sciences are working their way towards philosophy (“*entgegenarbeiten*”, §12, p. 57). Overcoming the initial position of the Master, i.e. abstract metaphysical speculation (M_1), is like a disruptive fall from grace. Initially, much is lost, but labour (the sweat on our brow) is the only way to overcome the disconcerting gap (M_2) between the rational and the real. Therefore, hard work is required (use your hands! §38, p. 109) to foster reconciliation (§24, M_3).

In order to produce genuine insight, our will to know must therefore shift from contemplation towards analysis (“*Zerlegung*”), even if this (paradoxically) means: damaging (negating) the object of our research. Moreover, rather than claiming that nature “in itself” (the thing in itself) is inaccessible to us, philosophy and science (conceptual work and empirical research) must join forces to come to terms with the *noumenal* realm (the invisible world, strictly speaking, of proteins, nucleotides, subatomic particles and the like), for ultimately, the noumenal real is rational.

Dialectics is the inherent logic of thinking and being, and it is by the conscious employment of its principles that thinking becomes science, because the same dialectic can be seen at work in natural and historical processes (§81). Indeed, everything that surrounds us may be viewed as an instance of dialectics (“Alles, was uns umgibt, kann als ein Beispiel des Dialektischen betrachtet werden”, §81). We see dialectics at work in stellar and meteorological phenomena as well as in the development of germs into mature organisms. In natural systems, proportionality (equilibrium) may temporarily give rise to disproportionality (e.g. excessive growth) until the crisis is overcome and equilibrium is restored (§109). In other words: for Hegel, everything is a syllogism. A plant, for instance, is a syllogism because, starting from a general concept (the germ), a process of division and differentiation sets in – the German word “*Urteil*” resonates with “*Teilung*” – until this process is “concluded” (“*schließen*”, “*Zusammenschließen*”) in the maturing plant. A similar syllogism can be discerned in inorganic, chemical processes, where we start with (neutral, general) substances (*das Allgemeine*: A), which are subsequently exposed to and brought into interaction with a *particular* environment (*das Besondere*: B), until the process is brought to its conclusion (“*Abschluss*”) by the formation of a concrete product, a chemical compound (*Einzelheit*: E). For Hegel, all natural processes are syllogisms. Biological or chemical experiments are syllogisms studied in isolation, while real (outdoors) nature is a *cycle of syllogisms* (§181, p. 332), a cyclical system of interactive syllogisms. The syllogism (“*Schluss*”) constitutes the bridge between subjective dialectics (the logic of thinking) and objective dialectics (the dialectics of nature). The standard format of a syllogism reflecting a natural process is: $A \rightarrow B \rightarrow E$, where a generic substance (A) realises itself into a concrete entity (E) via exposure to particular circumstances (B). This syllogism can also be discerned in an experimental design. Let this suffice as a short resume of Hegel’s dialectics. I will now proceed to address the comments made.

3 Addressing Rheinberger’s Comments

As Hans-Jörg Rheinberger rightly points out, the oblique perspective adopted by dialectics suspends the focus on the object (the *intentio recta*) in order to reflect on technoscience as a technology-driven praxis: on the conditions of existence of technoscientific objects and on the guiding convictions (“philosophemes”) that are being enacted in this type of research. His comments are quite seductive, I must confess, in the sense that they provide a powerful stimulus to reflect on my own practice as a practicing philosopher, “living with scientists”, as Rheinberger phrases it, while using Althusser’s monograph on the “spontaneous philosophy” of scientists (Althusser 1967/1974) as an isthmus or mediator between Hegelian dialectics and the present, as he suggests. Therefore, let me likewise start with an autobiographical anecdote.

When I began working as a “philosopher in science”, our science building was a monstrous complex of concrete bunkers, with massive walls, built in a style known as

brutalism. Research was carried out in subterranean caverns, where small teams of scientists were studying clawed frogs, cockroaches and anaerobic microbes, quietly observing them through keyholes as it were, fully absorbed in their work. How to prevent becoming the gaze of the other, spying on them (until Sartre's creaking floorboard would reveal my unexpected presence)? Philosophy of technoscience should not be practiced as a form of "espionage" (Heidegger 1927/1975; GA24, p. 227), I argued, turning researchers into research subjects, studying them in a secretive manner, "from behind". Rather, we should study them from a position of close proximity or "neighbourhood" (*Nachbarschaft*), as Heidegger phrased it: through dialogue, by travelling a path together.

This ambition became much easier when our brutalist bunkers were demolished and replaced by a transparent building, with lots of glass and open corridors, reflecting the ongoing transformation of the conditions of knowledge production, fostering interdisciplinary collaboration and transparency. Meanwhile, I had discovered that Althusser's "spontaneous" philosophy of scientists definitely exists, albeit not as something which should be safeguarded (by philosophical interventions) against ideological exploitation. Rather, although I formally entered the science faculty as a professor, I consistently found myself in the position of a disciple, even in my own field. I vividly remember, for instance, one of my first conversations with a prominent scientist who had recently acquired a highly sophisticated and horrendously expensive research contrivance, manageable via computers. My comment, that computers had changed the way in which research is being done, was immediately discarded as "technological determinism". Rather, he carefully explained how computers were evolving components within a complex, interactive network, exemplifying converging and enabling technologies (Althusser's "condensation"), giving rise to a revolutionary situation by affecting the mode of production, whose technological, theoretical, organisational, legal and managerial dimensions were developing at an uneven pace (Althusser's "overdetermination"), while their role could easily shift from calculation device to communication device and back (Althusser's "displacement"). This may again sound like eulogy, but from day one I noticed that philosophers have a lot to learn from scientists, also when it comes to philosophy.

Moreover, because philosophy professors combine research and teaching with management, I soon noticed that the same lesson also applies to the management dimension. I attended a plethora of management meetings over the years, at both sides of the science-philosophy divide, and consistently observed an unsettling difference: whereas science management meetings often excelled in anticipatory visions, global awareness and a sincere willingness to collaborate, similar meetings in philosophy departments often suffered from narrowmindedness, lack of imagination, defensiveness and petty competitiveness. I also noticed that this could be repaired through a particular type of intervention. A quite effective transformative strategy, I observed, is interdisciplinary collaboration, thereby exposing philosophy to the world of science. Whereas, according to Althusser, philosophers allegedly address "the whole", scientists are often the ones well-versed in thinking globally, and more sensitive to the societal impact of their work. While Althusser sees interdisciplinarity as the catchword ("*mot d'ordre*") of the dominant academic ideology, already in the 1970s, I rather experienced interdisciplinarity (embedded collaboration) as mutually beneficial for both sides.

Contrary to Althusser's contention, also cited by Rheinberger, dialectics does not entail the claim that change merely amounts to "the self-realisation of the concept". As outlined above, such an interpretation completely ignores the importance of conflict, contradiction, drama, negativity and otherness in Hegel's thinking. I was intrigued by Rheinberger's comments concerning the temporal dimension, but in retrospect I believe that Hegel had a point

when he questioned evolution, now that the production of genetically modified organisms (or rather: neo-life) by global networks of laboratories is rivalling slow, Darwinian evolution in a revolutionary manner, although viruses evidently still outpace us. At the same time, I fully agree with Rheinberger that philosophy of technoscience should be practiced quite differently from how Hegel worked two centuries ago. I agree that practicing philosophy as a transformative practice necessitates the study of case histories, in all their intricate detail. My paper in *Foundations* was a “discourse on method” if you like, but most of my work indeed involves case histories, precisely for the reason Rheinberger put forward: to pay sufficient attention to the contingencies of scientific practice. Still, a robust theoretical framework is needed to make sense of what we thereby discover, but I will come back to this issue at the end of my dialogue with Gremmen.

4 Addressing Gremmen’s Comments

Although our wordings slightly differ, Gremmen’s summary of the lemma on dialectics in the *Stanford Encyclopedia of Philosophy* captures Hegelian dialectics quite adequately. When applied to science, Gremmen argues, Hegelian dialectics consists of three moments: a “seemingly stable definition” (first moment, A) which gives way to “the experience of one-sidedness or restrictedness” (second moment, B) but eventually necessitates a grasping of “the unity of the first two moments” (the third moment, E). This triadic pattern also allows me to organize my rebuttals to his critique.

As to the first moment (A), Gremmen criticizes me because, while describing the initial concept of life as something “integral and whole”, a “seemingly stable definition or determination of the concept of life in moment A is absent”. In other words, although I claim that “life in moment A is understood and described in a general way ... the content of the concept in moment A is missing”. I disagree with Gremmen’s analysis here. My description of the first moment evidently *does* entail a “seemingly stable definition of the concept of life”, and “the concept” is therefore far from missing. In my genomics example, for instance, I indicated how genomics research programs were designed in accordance with a definition of life, namely the conviction that the essence of life is DNA: we *are* our genome. Initially, this served as a relatively “stable” interpretation, albeit far from uncontroversial.

The second moment resulted from the discordance between what these genomics programs (based on this concept) expected to find, and what they actually found. I mention this because Gremmen subsequently argues that I allegedly fail to “describe a one-sidedness or restrictedness [in the determination of] the concept of universal life”. Yet, what is important to emphasise is that, according to Hegelian dialectics, the one-sidedness or questionability of the initial concept is revealed during the *second* moment. And in order for this disruptive experience to be possible, genomes have to be sequenced (“taken apart”): the second moment, when particular procedures are employed to verify the initial concept, resulting in failure. Thus, in contrast with the original intentions, genomics programs culminated in the experience that life is much more than only DNA. And this gave rise to a transformation, also on the conceptual level, for life was now drastically redefined: as *interaction* (“Wechselwirkung”) between genome and environment, nature and nurture. The genome still represents an important moment (the genome is the “program”), but is now incorporated in a more sophisticated understanding of life, which requires a more comprehensive approach.

As to the second moment (B), Gremmen criticizes my understanding of “Zerlegung”, e.g. my understanding of the analysis of living organisms such as trees. First of all, Gremmen argues that my description of an understanding of the tree as-it-presents-itself-to-us belongs “to the field of phenomenology and not to biology”. And he also raises the question whether there is “a field in biology which studies life as something universal?” I concede that the term “universal” is an inadequate translation of what Hegel is referring to here: a holistic approach, not yet differentiated into multiple specialised expert views on entities such as trees. And I also agree that understanding the tree “as it presents itself to us” requires a phenomenological stance. My argument, however, is that we should not fall into the trap of *opposing* phenomenology to biology. Rather, there are moments in the history of biology (or its predecessor: natural history) when such a stance is actually adopted, when biology *itself* is phenomenology, when life is studied *as it presents itself to us* in a careful, descriptive and non-transformative manner. The work of Maria Sybilla Merian on insects, or the work of Albrecht von Haller, Jean-Jacques Rousseau and Johann Wolfgang von Goethe on plant forms, may be mentioned here as canonical examples, but it also applies to the work of Goethe scholar Franz Thomas Bratanek, Gregor Mendel’s colleague in the monastery at Brno, whose “green aesthetics” studied plants as parts of the-landscape-as-a-whole (Zwart 2008, p. 214 ff.). The claim could be made that Aristotle likewise envisioned living nature as it presents itself to us, but he also already initiated the subsequent process of “Zerlegung”, by dissecting marine animals for instance.

The same applies to the example given by Gremmen himself: the work of Gregor Mendel. According to Gremmen, Mendel employed special techniques of artificial pollination, allegedly “without violating the plant”, but I disagree with this claim. Yes, rather than questioning nature in an aggressive manner, Mendel applied softer skills, such as painstaking brushwork. His work implied caressing rather than torturing nature, carefully moving his paintbrush among the delicate petals in order to fertilize his plants. Indeed, Mendel proved that nature reveals her secrets when she is *stroked* (Mawer 1998, p. 61). Nonetheless, his method came down to “castrating”, “de-sexing” and “emasculating” his plants. Even in Mendel’s experiments there was the element of negativity or violence (Zwart 2008, p. 204). But it may require a *theory* (e.g. Hegelian dialectics) to actually *see* this (θεωπέω means “to see”).

During the analysis stage (B), biology increasingly tends to divert from phenomenology, differentiating into particular methodologies. From now on, scientists no longer study trees as such. Even Linnaeus, in the context of his practice of classification, began to take living entities apart, until we end up with items such as cellulose. We are impressed by the precision of science, Hegel argues, but at the same time concerned that something is lost, so that scholars like Goethe begin their quest for a less disruptive, more holistic alternative. Sooner or later, this drive (to return to holism) will become discernible in mainstream experimental research as well, where researchers realise that, in order to understand life, analysis and reductionism can only temporarily satisfy their will to know. Sooner or later, the discrepancy between *in vitro* and *in vivo*, between lab environments and outdoors environments, must be overcome.

This is what scientists try to realise during the third moment, which represents a resurgence of holism (a holistic turn), although the whole now emerges as something very concrete (E). The synthetic cell, for instance, is a *concrete* exemplification of how life works: a “concrete universal”. Synthetic cells are both universal (general) and concrete: universal because they aim to mimic the functioning of cells as such (rather than a particular type of cell), and concrete because this will inevitably result in a very specific version of a synthetic cell, competing with other, rival versions developed elsewhere on the globe.

Here, Gremmen criticises me, however, by arguing that synthetic cell projects cannot be considered as convincing exemplifications of this third moment, because research into the origin-of-life has a much longer history. First of all, it is important to emphasise the difference between synthetic cell research and origin-of-life research. Although both fields evidently overlap in practice, their intentionality differs. Synthetic cell research does *not* have the intention to mimic the genesis of life. Quite the contrary, its aims to by-pass the contingencies and time-consuming detours of natural evolution. In addition, we should not consider the three dialectical moments as temporal demarcations. Rather, what we are faced with is a cyclical process, spiralling from past to present. There evidently have been earlier synthetic turns, earlier efforts to produce synthetic life. Besides the cases mentioned by Gremmen (Oparin, Miller and Urey) many other examples could be given. The signifier “synthetic biology” was already coined by Stephane Leduc in 1912, for instance, who grew crystals in solutions to mimic and explore organic forms (Zwart 2019, p. 2). And even earlier, in 1905, the physicist John Butler Burke was exposing petri dishes containing bouillon to radium in order to produce artificial life-like forms, inspired by his conviction that radium could generate life. The drive to achieve a synthetic turn, and to move from analysis (the second moment) to synthesis (the third moment) is always there, but the point is that these efforts become increasingly sophisticated, convincing and concrete, so that the discrepancy between artificial cells (in vitro) and living cells (in vivo) tends to diminish after every dialectical cycle—even if such efforts continue to fail in the end.

In his conclusion, Gremmen proposes to bypass “the complex philosophy of Hegel” and to “focus on the practice of science instead”. If we consider a general and conceptual philosophy of science as the first moment, the empirical turn can be considered the second moment: confronting these theories with the ways in which technoscience is actually practiced. In principle I support this turn, unless it is pushed to its extreme, namely when an opposition is staged between philosophical and empirical approaches, or when philosophy is even completely replaced by sociology of science and STS. Nothing wrong with empirical science studies as such (they constitute an important moment in the comprehensive approach I advocate), until it amounts to a marginalisation or elimination of philosophy as a research field. My paper therefore outlines a third moment, an alternative turn, combining the strength of both positions by presenting a *philosophical* way of studying scientific practice.

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