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Introduction

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Chapter 1

Introduction: Coming to Terms with Technoscience



Continental Philosophy as a Research Program

In contemporary philosophy of science, continental approaches such as dialectics, phenomenology and psychoanalysis tend to be underrepresented compared to analytical and sociological ones, but the reverse is also true. Whereas continental philosophical discourse tends to focus on author studies, the urgency of coming to terms with contemporary technoscience often remains unrecognised.¹ This volume builds on the conviction that a mutual exposure and confrontation between continental philosophy and contemporary technoscience is urgent and beneficial for both.

This volume presents the oeuvres of a number of prominent continental thinkers (Hegel, Marx, Engels, Teilhard, Bachelard, Heidegger, Lacan, Althusser), but my exposition will be guided by the question how their work can help us to develop a continental philosophical approach to technoscience today. In other words, the key objective of this volume is to develop a diagnostic of the present, while special attention is given to methodological issues: *how to practice continental philosophy of technoscience in a contemporary setting?* The focus is on the *how* and on the *now*. The aim is to provide a scaffold for students and scholars (especially early stage researchers) who aim to explore the vicissitudes of technoscience against the backdrop of its societal context. Whereas in author studies the focus tends to be on *differences* between various continental positions, continental philosophy of technoscience will be presented here as an evolving *research program* to which multiple authors have contributed and continue to contribute. While being sensitive to the specificities of the positions involved, they nonetheless share a common ground.

Although the writing of this book involved a substantial amount of reading (“reading aloud”, as Althusser once phrased it), it is at the same time the result of experience and practice. From the start of my scholarly activities, I have worked in

¹ Don Ihde (2000) already noticed a “lack of concern among continental philosophers concerning technoscience” (p. 59), and a focus on canonical texts by canonical authors (i.e. author studies).

interdisciplinary settings, practicing philosophy in close dialogue with researchers active in other fields (from biomedicine, molecular life sciences and brain research up to genomics, synthetic biology and environmental science). As a result, the views and claims presented in this volume are not solely the outcome of prototypical philosophical activities such as reading primary authors, supervising doctoral theses or engaging in discussions with philosophical colleagues at scholarly meetings and conferences. To come to terms with contemporary technoscience, proximity is crucial and I experienced the added value of presenting lectures to students in technoscientific fields, of developing research proposals together with researchers from technoscientific disciplines, and even of management activities (as director of a research institute, as principal investigator in interdisciplinary European projects and as scientific director of an interdisciplinary research program). Therefore, this text is the result of a dialectical interaction between *reading* philosophy and *practicing* it, between studying philosophy and studying technoscience.

Let me briefly outline the meaning of the key terms “continental philosophy” (the “subject” pole) and “technoscience” (the “object” pole). To start with the latter: contemporary science is referred to as “technoscience” because contemporary research is an *inherently technological* endeavour. Rather than seeing technology as “applied science”, scientific knowledge (even on a theoretical level) is a *technological praxis*, a technology-driven way of interacting with nature. The precise origin of the term “technoscience” is already a controversial issue in itself (Barnes, 2005; Hottois, 2018). The term has been attributed to Gaston Bachelard (1934/1973) but, as Gilbert Hottois (2018) rightly points out, Bachelard never literally uses the term, – although in various passages he comes very close to doing so. In *The new scientific spirit*, for instance, Bachelard argues that the rationality of contemporary experimental science is a *technical* rationality (1934/1973, p. 9), so that scientific phenomena are technical phenomena, while scientific facts are technical facts (i.e. artefacts). Similar views are presented in later publications. Modern experimental science is a “technical science”, under the sway of “technicity” (Bachelard, 1953, p. 197). Modern science is radically *reformed* and *enhanced* by the precision of modern technology, which is a *transformative* and *creative* technology, prolifically *producing* technological phenomena, so that scientific discoveries are technical discoveries (1953, p. 43) and scientific experience is a profoundly technical mode of experience. Scientific culture is a technological culture and Bachelard notices a “remarkable convergence” between molecular and computation technologies (p. 175).

Gilbert Hottois began using the term “technoscience” during the 1970s to arouse philosophers of science from their “linguistic slumber” (Hottois, 1979), but during the 1980s he became more reserved as he noticed that the term incites multiple passionate (both technophobe and technophile) reactions (Hottois, 2018) due to the “contamination” of science by big science management and global capitalism (Bensaude Vincent & Loeve, 2018). The term continued to proliferate, however, notably via the work of other influential authors such as Jean-François Lyotard (1979), Bruno Latour (1987), Donna Haraway (1997) and Don Ihde (1991). Whereas critics discard it as a buzzword, practicing scientists are reluctant to adopt it (Bensaude Vincent & Loeve, 2018). In this volume I use the term to emphasise the

inherent technicity of contemporary science, while agreeing with Hottos that technoscience is a practice which is direly “in need of a conscience” (Hottos, 2018, p. 133). Technoscientific research is research in the design mode and densely populated by enabling machines, bent on reshaping the world atom by atom (Bensaude Vincent & Loeve, 2018, p. 174): knowing by intervening and making (so that *homo faber* and *homo ludens* join *homo sapiens*). Philosophy of science and philosophy of technology are converging fields, making it impossible to meaningfully address the one without addressing the other. Uncontaminated (“innocent”) terms do not exist in this area, moreover. Should we revert to using *science* instead of *technoscience*, for instance, we are bound to discover that “science” is likewise a signifier that is severely tainted, disqualifying other research fields (notably in the social sciences and the humanities) as *less* or even un-scientific, while obfuscating the societal and cultural dimension of research.

The signifier “continental philosophy” is no less controversial. Although this term began its career as a pejorative label and remains difficult to define, a common profile or family likeness may nonetheless be discerned among adherents (cf. Critchley, 2001; Glendinning, 2006; Gutting, 2005; Sim, 2000). Continental authors share a certain style of thinking, a common set of intellectual challenges and ideas. Although the authors themselves (and the scholars studying their work) often highlight their differences with other (previous or contemporary) thinkers, this emphasis on dissension may obfuscate the common discursive ambiance in which they all dwell, engaged as they are in a “lively, dialectical relationship with the world” (Anderson et al., 1968).

A number of convictions shared by continental thinkers can be summarized as follows (Zwart et al., 2016). First of all, although technoscience has an enormous (and indeed, enormously disruptive) impact on the global world, for continental philosophers technoscience is not the only reliable or meaningful access to reality. There are other revealing ways of experiencing and disclosing human and natural phenomena, such as religion, various societal practices, or art. Moreover, continental thinkers see technoscience as profoundly historical, expressing and reflecting the zeitgeist of an epoch, co-evolving with cultural, political and economic developments. Also, continental philosophers see technoscience not primarily as a theory or a discourse, but first and foremost as a transformative *practice*, a form of labour, not only exploring, but also interacting with and refurbishing the world. Continental philosophers implicitly or explicitly endorse the claim that the basic objective of philosophy is to develop a diagnostic of the present, against the backdrop of a broad temporal horizon, and resulting in a prognostic of the future. Finally, they agree that we currently witness an epoch of profound disruption, of political and scientific turmoil, affecting all realms of culture, so that the current ecological and political crises reflect a metaphysical transition. The objective of philosophy is not only to assess the dynamics of this transition, but also to actively contribute to its unfolding and to address the societal challenges entailed in it. In other words, a philosophical diagnostic (as a collaborative endeavour) entails a will to intervene into the development of technoscience and its implications for society at large.

Developing a continental perspective on contemporary technoscience requires proximity, in combination with critical distance. Philosophy “of” technoscience should preferably be practiced as philosophy *in* technoscience. Philosophers should *be there*, should familiarise themselves with practical contexts of technoscientific labour. At the same time, these contexts of discovery are not assessed from an “empirical” (e.g. sociological or ethnographical) perspective, but from a philosophical angle, from an “oblique” perspective, combining dialogue with reflection (Zwart, 2017a). Speaking about philosophy *and* technoscience, the (seemingly innocent) conjunction “and” suggests a deceptive dichotomy. There is more philosophy at work *in* contemporary technoscience than scientists (and philosophers, for that matter) tend to be aware of, and our vocation is to bring this inherent philosophy to the fore, questioning it from a position of proximity, in dialogue with the practicing scientists involved. I see this as a mutual learning practice, a dialectical interaction of dialogue and reflection. The claim made in this volume is that, although continental approaches are underrepresented in mainstream philosophy of science, they entail crucial insights for understanding technoscience as it evolves on a global scale today. Notably, the authors discussed in this volume develop important perspectives concerning the *technicity* of technoscience.

Focus is inevitable and this volume notably presents (and highlights the contemporary relevance of) three continental philosophical approaches, namely dialectics (Hegel, Marx, Engels), psychoanalysis (Freud, Bachelard, Lacan), and phenomenology (Bachelard again, Heidegger and Teilhard). At the object pole, technoscience is an astonishingly broad field, from artificial intelligence via molecular biology up to astrophysics. Whereas other scholars are exploring intriguing connections between, for instance, Hegelian dialectics and cybernetics, artificial intelligence and surveillance technologies, or between phenomenology and the evolution of technological systems (Coeckelbergh, 2020; Hui 2016, 2019; Van Tuinen, 2020), the focus of this volume is on recent developments in *life sciences* research, e.g. molecular and computational biology, genomics and synthetic biology, although some attention is given to astronomy and quantum physics as well. Again, rather than on hermeneutical or exegetic quandaries, the focus is on methodological challenges: how to *practice* philosophy of technoscience today? How can dialectics, psychoanalysis and phenomenology provide methodological hints and guidance for *practicing* philosophers in various settings? The question is not, for instance, how Hegel relates to Kant, Fichte or Spinoza, or something like that, or how Heidegger (implicitly or explicitly) positions himself vis-à-vis Husserl, but rather on what we can learn from Hegel and Heidegger for understanding contemporary life sciences research. I will now briefly introduce the continental approaches presented in this volume.

Hegelian Dialectics

Modern dialectics was inaugurated by Georg Wilhelm Friedrich Hegel (1770–1831), whose thinking has been described as a “Matterhorn” to be conquered (Beiser, 2005), a “haunting phantom” (Althusser, 1962/2005), a “formidable spectre” and a “monstrous creature” who continues to speak to contemporary scholars from under the stage (Žižek, 2016/2019). While the fame of many of his critics (Russell, Popper,² etc.) seems rapidly declining, Hegel is more alive than ever. And yet, as Žižek phrases it, the question emerges whether it is still possible to be a Hegelian today (2012/2013). Or, as Catharine Malabou phrases the problematic in her book *The Future of Hegel*: “The philosophy of Hegel: is it a thing of the past?” (Malabou, 1996/2005, p. 1). Although many dramatic and cataclysmic events have happened since Hegel’s death, which he himself could not foresee, his oeuvre continues to address us like an imposing statue. What Hegel did acknowledge (as a thinker of modernity) was the disruptive power of negativity entailed in technoscience, as a technical form of thinking which literally obliterates its object (nature), while the eventual reconciliation (the negation of the negation) is not a restoration, but a novel situation in which the disruptive factor itself (e.g. technoscience) is emphatically included. Although the scholarly literature on Hegel (in the sense of author studies) is immense, a significant part of it addresses Hegel’s position vis-à-vis previous thinkers or contemporaries (Kant, Fichte, Schelling, and so forth). Although I do not deny the value of such scholarship, my reading of Hegel evidently commences from a different question: what can we learn from Hegelian dialectics concerning technoscience now? How to practice dialectics under present circumstances? I will present Hegelian dialectics as a challenging research program which continues to unfold, and as a methodology to whose further development we may contribute by *practicing* (rather than discussing) dialectics.

Hegel has been called the modern Aristotle (Ferrarin, 2001; Beiser, 2005, p. 57; Pippin, 2019, p. 301) and for good reasons. Aristotle’s thinking provided a model for Hegel because it entailed a comprehensive *Gesamtwissenschaft*, a systematic encyclopaedia of all areas of inquiry. Aristotle was a universal polymath, while his philosophical encyclopaedia of knowledge was developed on the basis of a dialectical approach, providing a research agenda and conceptual lexicon for future scholars. Aristotle’s key concept ἐνέργεια (being-at-work), for instance, concurs with Hegel’s view of natural entities as the realisation or actualisation of an inherent program or concept. For Hegel, Aristotle was ancient philosophy’s most thoroughly dialectical thinker.

The concept of an encyclopaedia of science also links Hegel with Denis Diderot (1713–1784). In his *Phenomenology of the Spirit*, Hegel refers to Diderot’s novel

²Whereas Karl Popper (1963/2002) presents experimental research as a practice of “trial and error” and dialectics as “absurd”, I will argue that experimental research is guided by a dialectical logic which moves from hypothesis via exposure and negation up to negation of the negation (i.e. the development of an integrated, comprehensive view).

Rameau's Nephew as a dialectical artwork, and to its hero as a dialectical character. In collaboration with d'Alembert, moreover, Diderot edited the famous *Encyclopédie*: a decisive philosophical event, indicating a turning-point which concurred with the most famous passage in Hegel's oeuvre: the dialectics of Master and Servant (Hegel 1807/1986). As Hegel explains, whereas the Master merely *contemplates* about nature, the Servant *interacts* with nature in a hands-on, technical and experimental manner, thereby developing a more robust understanding of how nature works. Therefore, scientific research is not only closely entangled with technological developments, but also reflects the emancipation of former "servants" from the constraints of the ideologies of their "masters". Diderot's encyclopaedia was more than a compendium. It disclosed the emerging world of practical research and research practices, introducing new intellectual heroes: the artisans, and their most important product: their contrivances, their machines. Diderot's encyclopaedia reflects how technicity was opening up a new era of research and productivity. To process all this information, an immense amount of work had to be done by Diderot and his many collaborators. They visited and deliberated with artisans in their workshops, in order to explore the undocumented realms of artisanal intellectual activity. The encyclopaedia was a critical endeavour, fostering awareness concerning the methodological challenges involved in processes of knowledge production, aiming to convince its readers of the importance of novel research areas such as experimental chemistry. The encyclopaedia represented a mundane style of thinking, studying emerging worlds, emerging practices, emerging vocabularies.

The title of Hegel's most comprehensive work (*Enzyklopädie der philosophischen Wissenschaften im Grundrisse*), on which he continued to work throughout his lifetime, entails an obvious reference to Diderot's encyclopaedia, one of the hallmarks of the Enlightenment. At the same time, Hegel's ambition to *supersede* Diderot is no less obvious. Instead of an alphabetic arrangement, Hegel produces a *systematic*, conceptual encyclopaedia, from logic via nature to spirit, from Alpha to Omega as it were, seeing the development of thinking as a spiralling process, thereby trying to achieve what Aristotle had done for ancient thinking, and Thomas Aquinas for medieval thinking (in his *Summa Theologica*), but what seemed an impossible ambition under modern conditions. Hegel's encyclopaedia entails critical dialogues concerning a spectrum of research fields (mathematics, astronomy, optics, mechanics, chemistry, biology, psychology and so forth). His encyclopaedia is a *research program*, interminable in principle, but providing an agenda, a method and a lexicon for scholars today.

For Hegel, a dialectical logic is at work not only in the historical unfolding of human thinking, but also in the dynamics of nature as such, giving rise to processes of becoming and change, via contrasting and apparently contradictory developments. The dialectical method is fundamentally in tune with nature because nature *as such* is inherently dialectical. Dialectics sees research first and foremost as a technology-driven *practice*, I will argue, focussing on the technological means of knowledge production. The dialectical approach was further developed, not only by Karl Marx (1818–1883) and Friedrich Engels (1820–1895), but also by twentieth century scientists such as J.B.S. Haldane (1892–1964) and John Desmond Bernal

(1901–1971), who argued that modern research is an inherently *dialectical* practice, optimally poised to capture the dialectical dynamics of natural processes, even on the bio-molecular level. Dialectics builds on the conviction that, notwithstanding contradictory experiences, the real is inherently rational, so that our inquiries not only allow us to come to terms with the present, but also to anticipate (and actively contribute to the unfolding of) the emerging future, so that technoscience progresses from analysis to proactivity and prediction, combining intellectual with practical ambitions. Dialectics enables reflection and self-reflection on technoscience as an evolving social praxis.

Technoscience evolves from *general* conjectures (theory), via *particular* experimental insights down to *concrete* products and outcomes. Dialectics sees technoscience as a particular form of disclosing nature. It is a critical exposition of technoscientific research practices as they appear on the scene: the path or journey of scientific consciousness, passing through a series of configurations or stations of knowledge towards more comprehensive forms of understanding. For dialectical philosophy, technoscience itself is a phenomenon, and philosophy is a dialectical “phenomenology” of technoscientific experience, discerning the basic logic that guides the journey of scientific consciousness through history. Hegelian dialectics emphasises the *negativity* of technoscience (its tendency to affect, negate and obliterate the object) and is acutely aware of the extent to which technoscience is a hyperactive, performative and transformative way of thinking. We will focus on three particular dialectical themes: (a) Hegel’s view of the chemical process and the origin of life; (b) Hegel’s understanding of planet Earth as a global meteorological system and (c) Hegel’s view on the “end” of evolution.

Dialectical Materialism

Although strictly speaking they themselves never used the term, *dialectical materialism* refers to the work of Karl Marx and Friedrich Engels, although many other authors have contributed to this strand of dialectical thinking, up to this day. After a period of marginalisation, which coincided with the “triumph” of neo-liberalism (proclaimed as the “end of history” during the 1990s), dialectical materialism in general and the works of Marx and Engels in particular currently experience a revival, in view of the global crisis unleashed by neo-liberalism, in the form of widespread political and ecological disruption. Against this backdrop, renewed scholarly interest in dialectical materialism focusses explicitly on the disruptive metabolism of the current socio-economic system and the ecological dimension of dialectical thinking. We will focus on the work of Friedrich Engels who, as a result of the “division of labour” between Marx and Engels, developed a dialectics of technoscience and nature, initially in his correspondence with Marx, but more systematically in *Anti-Dühring* (1878/1962) and *Dialectics of Nature* (1925/1962), a collection of notes and manuscripts which he left unfinished. Dialectics, for Engels, is a method for studying the laws of development in nature, society and thought

(1878/1962). Technology enables research while researchers continuously optimise their equipment, so that scientific insight and technological prowess co-evolve. Again, the question is: how to *practice* dialectical materialism of technoscience *today*, in an era of synthetic biology, industrialised research and ecological crisis?

Special attention will be given to Louis Althusser because, in a rather polemical manner, Althusser presents a view which seems juxtaposed to the basic ambitions of this volume. Whereas this volume presents continental philosophy of technoscience as an evolving research program, Althusser posits an (allegedly insurmountable) epistemological and ideological *rupture* between Hegelian dialectics on the one hand and the work of Marx, Engels, Freud, Lacan and similar authors on the other. Since this volume presents Marx, Engels and Lacan as dialectical thinkers, and their oeuvres as radical contributions to an unfolding intellectual endeavour, Althusser's assessment seems to inhibit such a project. Therefore, we must dive rather deep into Althusser's arguments. The conclusion will be that, although Althusser's apodictic thesis concerning an insurmountable rupture ultimately proves unconvincing and self-contradictory, there is nonetheless added value in his work when it comes to developing a dialectical approach to technoscience (resulting in the negation of Althusser's negation if you like). Althusser's analyses not only build on Marx and Engels, however, but also on Freud, Bachelard and Lacan. Therefore, the chapter discussing Althusser will be preceded by an exposition of psychoanalysis of technoscience.

Psychoanalysis of Technoscience

After presenting a Freudian approach to technoscience (referring mostly to *Beyond the Pleasure Principle*, but also to a posthumously published document known as the *Entwurf*), this chapter focusses on the work of Gaston Bachelard and Jacques Lacan. I will point out how both oeuvres actually represent a convergence of psychoanalysis and dialectics.

Gaston Bachelard (1884–1962) occupies a unique position in the history of European philosophy (Aitken, 2005; Bolduc & Chazal, 2005). As a philosopher of technoscience, he emphatically acknowledges the strength, precision, productivity and reliability of technoscientific knowledge compared to every-day experience. Moreover, his epistemology closely follows technoscience as it actually evolves and is actually being practiced. Science is a “phénoménotechnique”, devoted to producing, manipulating and analysing laboratory phenomena (emerging *in vitro*), rather than exploring lifeworld experiences (Rheinberger, 2005; Simons, 2018; Zwart, 2019). At the same time, his awareness of the revelatory force of imagination urged him to develop a poetics of science as well.³ Whereas his noumenology (Bachelard

³For instance, Bachelard explains why palaeoanthropology is intrigued by caves on the basis of archetypal resonances, seeing caves not only as natural wombs or Pleistocene incubators, but also by drawing attention to the affinities between cave, cavern and cranium (“*crâne*” in French: Bachelard, 1948, p. 171; Zwart, 2019, p. 50).

& Reggio, 2005) aims to explain how technoscience reveals the noumenal (e.g. molecular, atomic and subatomic) dimensions of the real, his poetics attempts to disclose the noumenal (i.e. archetypal) dimension of scientific imagery (Zwart, 2019, p. 35 ff.). Concepts coined by him such as “epistemological rupture”, “epistemological obstacle” and “technoscience” are still widely used, and were adopted by later authors. During recent decades, Bachelard’s impact was primarily noticeable via the work of others, especially his students – Louis Althusser (discussed below) and Michel Foucault (Foucault, 1989; Gutting, 1989, p. 9; Gutting, 2005; Webb, 2005; Schmidgen, 2014; Simons, 2015; Ross, 2018) – but also via his influence on Thomas Kuhn. The latter’s understanding of the history of science in terms of discontinuity and rupture in response to accumulating anomalies (Kuhn, 1962/2000) seems clearly indebted to Bachelard, although Kuhn hardly mentions him (Fragio, 2020; Gutting, 2001; Simons, 2017; Stachel, 2016). And although strictly speaking Bachelard did not coin the term “technoscience” as we have seen (Hottois 2018), he emphatically emphasises the decisive role of technicity in contemporary research (Bachelard, 1934/1973; Bachelard, 1953; Zwart, 2019, 2020d). His oeuvre still tends to be overlooked in mainstream philosophy of science. After being criticised and discarded by prominent voices such as Michel Serres, Elisabeth Stengers and Bruno Latour (Rheinberger, 2005; Simons, 2019), we currently witness a revival of interest, a reappraisal of his work (Bontems, 2019; De Boer, 2019; Kotowicz, 2018; Pravica, 2015; Simons et al., 2019; Smith, 2016; Wulz, 2010), – and for good reasons. As Bachelard explains, while the scientific revolution (during the early modern period) gave rise to what he refers to as the *scientific mindset*, the *technoscientific* revolution (during the twentieth century) resulted in a “new scientific spirit”, a radically new chapter in the phenomenology of consciousness. As indicated, I will notably point out how Bachelard *actively practices* psychoanalysis and dialectics of technoscience, as complementary approaches.

Although Jacques Lacan (1901–1980) is not commonly regarded as a philosopher of technoscience, both in his *Écrits* and in his *Seminars* he developed a sophisticated psychoanalytical perspective, focussing on the connection between knowledge, power and desire. Building on Hegel’s dialectic of Master and Servant, the scientific revolution (which began in the early modern period) is staged as a revolt of the menial (hands-on) Servant against the discourse of the Master (the contemplative metaphysician). During the current *technoscientific* revolution, however, this dynamic assumes a profile of its own. Researcher-servants are staged as craving subjects, intentionally focussed on (or even obsessed by) enigmatic and demanding (“impossible”) objects. Technicity is put to use to isolate, manipulate and control these elusive targets of research (referred to by Bachelard as sur-objects). Thus, technicity allows researchers to become experimental experts: prolific producers of what Lacan describes as “university discourse”. Eventually, the knowledge relationship is bound to falter, however, giving rise to experiences of discontent, so that technoscientific research becomes an “impossible profession”, ridden by tensions and contradictions and resulting in symptoms, ranging from moral conflicts and workaholism down to fraud. In life sciences research, natural entities are literally *obliterated*, i.e. replaced by letters and barcodes. The technicity

of technoscience entails a symbolisation of nature (a reduction of the phenomena of life to digital code). Notably in his Seminars, which commenced in 1953 (the year of the discovery of the molecular structure of DNA), Lacan explicitly focusses on the notion of information, whose astonishing success permeates contemporary science “with the speed of lightning”. How to control the disruptive momentum of our will to control, which is evidently getting out of hand?

Heideggerian Phenomenology

For Heidegger, whose oeuvre (> 100 volumes) contains a plethora of comments on contemporary science, scientific research is inherently technical. What insights can be derived from his work for philosophers questioning technoscience today? Can Heidegger’s thoughts become a source of inspiration for contemporary scholars confronted with automated sequencing machines, magnetic resonance imaging techniques and other technoscientific contrivances? While post-phenomenology is making significant contributions to understanding the social and cultural dimensions of contemporary technologies (Ihde, 2009; Rosenberger & Verbeek, 2015; Van Den Eede, 2011; Verbeek, 2005), notably from the point of view of mediation, my argument will be that a “return to Heidegger” may strengthen post-phenomenology, also in terms of methodology. For although Heidegger himself was notoriously ambivalent when it came to method, especially in his later writings, his oeuvre nonetheless contains important hints for how a philosophical questioning of technoscience could be practiced, such as: paying attention to language (to the words that we use) and taking a step backwards (towards the moment of commencement of the type of rationality at work). Thus, like Vincent Blok (2020) in his recent study, our rereading focusses on “the much-neglected theme of philosophical method”, on Heidegger’s attitude of questioning and confrontation. Three dimensions of contemporary technoscience will be addressed, namely: technoscientific objects (research artefacts), technoscientific sites (laboratories as unworldly environments) and technoscience as a global enterprise (big science). The focus will be on the question how Heidegger’s way of thinking allows us to come to terms with “big” (global) life sciences endeavours (such as genomics and post-genomics) *today*.

From Dialectics to Phenomenology and Back

In *The Human Phenomenon* and other writings, Pierre Teilhard de Chardin (1955/2015) studies consciousness from a deep time historical and evolutionary perspective. He drastically broadens the temporal horizon of philosophical reflection by connecting deep history with the precarious present and the emerging future. Humans are presented as the moment in time when evolution becomes conscious of itself. Teilhard’s panoramic oeuvre studies the emergence of consciousness from

proto-consciousness (in primeval life forms) via animal consciousness and human self-consciousness up to the emerging noosphere (the global web of intelligence, information and deliberation). Whereas Hegel's phenomenology of consciousness opts for the so-called axial period ("Achszeit") as the moment of commencement, i.e. the birth of self-conscious reflection in various places on earth (e.g. China, India, the Middle East and Ancient Greece), Teilhard's approach results in a dramatic extension of the temporal horizon, informed by paleo-anthropological research. His dialectical-phenomenological view takes us from anthropogenesis (the origin of humankind) up to the current technoscientific revolution, which profoundly affects our being-in-the-world. Technoscience gives rise to the noosphere (the global web of communication and reflection) but also to neo-life (i.e. the intentional modification of the biosphere in vitro). Teilhard will be presented as a phenomenologist, but also as a profoundly dialectical thinker, who traces the path of natural and technological evolution from equilibrium via disruption and crisis up to restored equilibrium on a higher plateau of complexity and organisation. Like Hegel, Teilhard bridges phenomenology and dialectics, albeit focussing on twentieth century technoscientific developments such as genetics, molecular life sciences research and paleo-anthropology.

As indicated, labels such "dialectics" and "phenomenology" refer to evolving approaches (developed along the way) rather than strictly defined compartmentalisations. What Herbert Spiegelberg says about phenomenology, – that a "point-blank" definition is notoriously difficult to provide (Spiegelberg, 1965, p. 1) – applies to the other approaches presented in this volume as well. Nor is it possible (or desirable) to straightforwardly identify the authors discussed in this volume with *one particular* approach. Although Hegel, for instance, represents dialectics, his most famous book is actually entitled *Phenomenology* (presenting a phenomenology of the experience of consciousness as it progresses through various dialectical stages). Bachelard is initially listed as a protagonist of psychoanalysis, but he can be considered a phenomenologist as well, notably in his later works, while in Chap. 4 we will argue that, ultimately, he is a truly dialectical thinker. Something similar will be claimed concerning Lacan, whose return to Freud actually began as (and converges with) a return to Hegel. And while Marx and Engels see themselves as dialectical thinkers, building on the work of "old Hegel", Althusser posits a rupture between Hegelian and Marxist dialectics. In the case of Heidegger, the label "phenomenology" notably applies to his earlier work, while in his later writings the validity of this epithet becomes increasingly questionable. Finally, to the extent that Teilhard de Chardin (author of *The Human Phenomenon*) can be considered a phenomenologist, he is a phenomenologist in the Hegelian (dialectical) rather than in the (apodictic) Husserlian sense. In other words, while we on the one hand present and discuss a series of continental movements (dialectics, psychoanalysis, phenomenology) and on the other hand a series of prominent continental authors (from Hegel up to Teilhard), the link between both series is a dynamical (dialectical) rather than a static and compartmentalised one. More precisely: this volume presents a dialectical movement from Hegelian dialectics via dialectical materialism and

psychoanalysis up to phenomenology, as a circular or *spiralling* movement, so that Teilhard's phenomenology inevitably links up with dialectics again.

Convergence

After being widely endorsed and applauded, dialectics, phenomenology and psychoanalysis have been questioned or even discarded for various reasons. Hegelian dialectics because its conceptual repertoire was seen as too abstruse and arcane to be of use for understanding concrete instances of technoscience (a verdict which will be explicitly challenged in this volume). Dialectical materialism has been discarded because of its connection with Stalinism, and Heideggerian phenomenology because of its connection with Nazism (Denker & Zaborowski, 2020). The approaches presented in this volume seem superseded by more recent strands of research, such as critical theory, post-phenomenology, Deleuzian post-structuralism, and gender studies. The basic objective of this volume is to argue that, notwithstanding the value of these recent developments, something has been lost as well, so that this volume constitutes an exercise in retrieval. Yet, rather than a dogmatic restatement of established positions, the question is *how* these continental perspectives enable us to face emerging global challenges in an era of ecological disruption and technification of nature. And I also will address the question how to respond to recent forms of criticism revolving around haunting legacies including androcentrism (or phallogentrism), egocentrism and Eurocentrism? Androcentrism builds on a questionable binary of Same and Other (Butler, 1990; Irigaray, 1985; Stoetzler, 2005), seeing philosophy and technoscience as dominated by male heroes, the work of "great men" (Zwart, 2008, 2020c), while the Eurocentric bias prevents us from developing an inclusive trans-continental perspective (Kimmerle, 2010; Tibebu, 2010). Rather than as a privilege of exceptionally gifted Master-thinkers, reflection must be seen as a deliberative and distributed endeavour (global thinking). I will point out how, after decades of specialisation and technocracy, we currently witness an episode of technoscientific convergence, between knowledge institutes and across disciplines, as technoscience aims to become more sensitive and responsive to social expectations and concerns. Through transdisciplinary collaboration and the development of interactive methodologies, technoscience aims to enable contemporary societies to address urgent global challenges. How to analyse this trend from a continental perspective? What should be the role of philosophy in such a context?⁴

⁴This volume aims to provide a synthesis, and parts of it are revised versions of previous publications: e.g. Chap. 2 (Zwart, 2017a; Zwart, 2017b), Chap. 3 (Zwart, 2020a) and Chap. 6 (Zwart, 2020b).

References

- Althusser, L. (1962/2005). “Contradiction et surdetermination (notes pour un recherche),”/ “contradiction and Overdetermination: Notes for an investigation”. In *For Marx*. Verso.
- Anderson, J., Kockelmans, J., & Schrag, C. (1968). Editorial. *Man and World*, 1, 3–9. <https://doi.org/10.1007/BF01252589>
- Bachelard, G. (1934/1973). *Le nouvel esprit scientifique*. Presses universitaires de France.
- Bachelard, G. (1948). *La terre et les rêveries du repos*. Corti.
- Bachelard, G. (1953). *Le matérialisme rationnel*. Presses Universitaires de France.
- Bachelard, G., & Reggio, D. (2005). Noumena and microphysics. *Angelaki: Journal of the theoretical humanities*, 10(2), 73–78. <https://doi.org/10.1080/09697250500417225>
- Barnes, B. (2005). Elusive Memories of Technoscience. *Perspectives on Science*, 13(2), 142–165.
- Beiser, F. (2005). *Hegel*. Routledge.
- Blok, V. (2020). *Heidegger's concept of philosophical method: Innovating philosophy in the age of global warming*. Routledge.
- Bolduc, J. S., & Chazal, G. (2005). The Bachelardian tradition in the philosophy of science. *Angelaki: Journal of the theoretical humanities*, 10(2), 79–87. <https://doi.org/10.1080/09697250500417258>
- Bontems, V. (2019). *Bachelard*. Les Belles Lettres.
- Butler, J. (1990). *Gender trouble: Feminism and the subversion of identity*. Routledge.
- Coeckelbergh, M. (2020). *AI ethics*. MIT Press.
- Critchley, S. (2001). *Continental philosophy: A very short introduction*. Oxford University Press.
- De Boer, B. (2019). Gaston Bachelard's philosophy of science: Between project and practice. *Parrhesia*, 31, 154–173.
- Denker, A., & Zaborowski, H. (Eds.). (2020). *Jenseits von Polemik und Apologie: Die “Schwarzen Hefte” in der Diskussion* (Heidegger-Jahrbuch 12). Karl Alber.
- Fragio, A. (2020). Similarities, differences, and missed connections between Thomas S. Kuhn, Gaston Bachelard and the continental historiography of science. *Journal of History of Science and Technology*, 14(2), 94–111. <https://doi.org/10.2478/host-2020-0016>
- Ferrarin, A. (2001). *Hegel and Aristotle*. Cambridge University Press.
- Foucault, M. (1989). Introduction. In G. Canguilhem (Ed.), *The normal and the pathological*. Zone.
- Glendinning, S. (2006). *The idea of continental philosophy: A philosophical chronicle*. Edinburgh University Press.
- Gutting, G. (1989). *Foucault's archaeology of scientific reason: Science and history*. Cambridge University Press.
- Gutting, G. (2001). *French philosophy in the twentieth century*. Cambridge University Press.
- Gutting, G. (Ed.). (2005). *Continental philosophy of science*. Wiley.
- Hui, Y. (2016). *The question concerning technology in China: And essay in cosmotechnics*. Urbanomic Media.
- Hui, Y. (2019). *Recursivity and contingency*. Rowman & Littlefield.
- Ihde, D. (2000). Technoscience and the ‘other’ continental philosophy. *Continental Philosophy Review*, 33, 59–74.
- Ihde, D. (2009). *Post-phenomenology and Technoscience: The Peking University lectures*. State University of New York Press.
- Irigaray, L. (1985). *Speculum of the other woman*. Cornell University Press.
- Kimmerle, H. (2010). Hegels eurocentrische filosofiebegrif. In H. van Rappard & M. Leezenberg (Eds.), *Wereldfilosofie. Wijsgerig denken in verschillende culturen* (pp. 43–59). Amsterdam.
- Kotowicz, Z. (2018). *Gaston Bachelard: A philosophy of the surreal*. Edinburgh University Press.
- Kuhn, T. (1962/2000). *The structure of scientific revolutions*. The University of Chicago Press.
- Malabou, C. (1996/2005). *The future of Hegel: Plasticity, temporality and dialectic*. Routledge.
- Pippin, R. (2019). *Hegel's realm of shadows*. University of Chicago Press.
- Popper, K. (1963/2002). What is dialectic? In *Conjectures and refutations: The growth of scientific knowledge* (pp. 419–451). Routledge.

- Pravica, S. (2015). *Bachelards tentative Wissenschaftsphilosophie*. Passagen Verlag.
- Rheinberger, H.-J. (2005). Gaston Bachelard and the notion of phenomenotechnique. *Perspectives on Science*, 13(3), 313–328.
- Rosenberger, R., & Verbeek, P. P. (2015). A field guide to post-phenomenology. In R. Rosenberger & P. P. Verbeek (Eds.), *Post-phenomenological investigations: Essays on human-technology relations* (pp. 9–41). Lexington Books.
- Ross, A. (2018). The errors of history. *Angelaki*, 23(2), 139–154. <https://doi.org/10.1080/0969725X.2018.1451524>
- Schmidgen, H. (2014). The life of concepts: Georges Canguilhem and the history of science. *History and Philosophy of the Life Sciences*, 36(2), 232–253. <https://doi.org/10.1007/s40656-014-0030-1>
- Sim, S. (Ed.). (2000). *Contemporary continental philosophy: The new scepticism*. Routledge.
- Simons, M. (2015). Beyond ideology: Althusser, Foucault and French epistemology. *Pulse: A Journal of History, Sociology and Philosophy of Science*, 3, 62–77.
- Simons, M. (2017). The many encounters of Thomas Kuhn and French epistemology. *Studies in History and Philosophy of Science*, 61, 41–50. <https://doi.org/10.1016/j.shpsa.2017.01.004>
- Simons, M. (2018). The Janus head of Bachelard's *phénoménoteknique*: From purification to proliferation and Back. *European Journal for Philosophy of Science*, 8(3), 689–707.
- Simons, M. (2019). Surrationalism after Bachelard: Michel Serres and *le nouveau nouvel esprit scientifique*. *Parrhesia*, 31, 60–84.
- Simons, M., Rutgeerts, J., Masschelein, A., & Cortois, P. (2019). Gaston Bachelard and contemporary philosophy. *Parrhesia*, 31, 1–16.
- Smith, R. (2016). *Gaston Bachelard: Philosopher of science and imagination*. SUNY.
- Spiegelberg, H. (1965). *The phenomenological movement: A historical introduction, volume 1*. Nijhoff.
- Stachel, J. (2016). History of science: The French connection. In A. Blum, K. Gavroglu, C. Joas, & J. Renn (Eds.), *Shifting paradigms: Thomas S. Kuhn and the history of science*. Max Planck Institute for the History of Science.
- Stoetzler, M. (2005). Subject trouble: Judith Butler and dialectics. *Philosophy Social Criticism* 2005, 31(3), 343–368. <https://doi.org/10.1177/0191453705051709>
- Tibebu, T. (2010). *Hegel and the third world: The making of eurocentrism in world history*. Syracuse University Press.
- Teilhard de Chardin, P. (1955/2015). *The human phenomenon (translation: Sarah Appleton-weber)*. Sussex Academic Press.
- Van Den Eede, Y. (2011). In between us: On the transparency and opacity of technological mediation. *Foundations of Science*, 16, 139–159. <https://doi.org/10.1007/s10699-010-9190-y>
- Van Tuinen, S. (2020). Philosophy in the light of AI. *Angelaki*, 25(4), 97–109. <https://doi.org/10.1080/0969725X.2020.1790838>
- Verbeek, P.-P. (2005). *What things do: Philosophical reflections on technology, agency and design*. Pennsylvania State University Press.
- Webb, W. (2005). Microphysics. *Angelaki*, 10(2), 123–133. <https://doi.org/10.1080/09697250500417332>
- Wulz, M. (2010). *Erkenntnisagenten: Gaston Bachelard und die Reorganisation des Wissens*. Kadmos.
- Žižek, S. (2016/2019). *Disparities*. Bloomsbury.
- Žižek, S. (2012/2013). *Less than nothing: Hegel and the shadow of dialectical materialism*. Verso.
- Zwart, H. (2008). Understanding the human genome project: A biographical approach. *New Genetics & Society*, 27(4), 353–376.
- Zwart, H. (2017a). The oblique perspective: Philosophical diagnostics of contemporary life sciences research. *Life Sciences, Society & Policy*, 13, 4. <https://doi.org/10.1186/s40504-017-0047-9>
- Zwart, H. (2017b). From the nadir of negativity towards the cusp of reconciliation: A dialectical (Hegelian-Teilhardian) assessment of the anthropocenic challenge. *Techné: Research in Philosophy and Technology*, 21(2–3), 1–24. <https://doi.org/10.5840/techne20176565>

- Zwart, H. (2019). *Psychoanalysis of technoscience: Symbolisation and imagination* (Series: Philosophy and psychology in dialogue). LIT Verlag.
- Zwart, H. (2020a). Friedrich Engels and the technoscientific reproducibility of life: Synthetic cells as case material for practicing dialectics of science today. *Science & Society*, 84(3), 369–400.
- Zwart, H. (2020b). Coming to terms with Technoscience: The Heideggerian way. *Human Studies*. <https://doi.org/10.1007/s10746-020-09554-3>
- Zwart, H. (2020c). Revolutionary poetry and liquid crystal chemistry: Herman Gorter, Ada Prins and the interface between literature and science. *Foundations of Chemistry*. <https://doi.org/10.1007/s10698-020-09381-5>
- Zwart, H. (2020d). Iconoclasm and imagination: Gaston Bachelard's philosophy of technoscience. *Human Studies*, 43, 61–87. <https://doi.org/10.1007/s10746-019-09529-z>
- Zwart, H., Lemmens, P., & Landeweerd, L. (2016). Continental philosophical perspectives on life sciences and emerging technologies (editorial). *Life Sciences, Society and Policy*, 12(8). <https://doi.org/10.1186/s40504-016-0041-7>

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