Hub Zwart

Psychoanalysis of Technoscience

Philosophy and Psychology in Dialogue
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Symbolisation and imagination

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Series Preface: Philosophy and Psychology in Dialogue

In 1879, Wilhelm Wundt founded the first laboratory for psychological research in Leipzig: the birth or "primal scene" of psychology as an independent research field. By transforming into an experimental discipline, psychology emancipated from philosophy and during the twentieth century (the era of behaviorism, cognitive psychology and neuroscience), the distance between psychology and philosophy significantly increased. While psychology evolved into an experimental research practice of immense proportions, conducted in laboratories worldwide, philosophy drifted into the margins of academic life. Currently, however, we experience a drive towards dialogue and convergence. Philosophy has taken an empirical turn and is becoming increasingly interested in the tools and methods of psychology as a social science, while both aim to be more than academic pursuits and aspire to address real-life challenges and urgent issues of human and social existence.

1900 was a decisive year (an *annus mirabilis*), for science as such, but also for the relationship between philosophy and psychology. Max Planck discovered that light and other forms of energy are discharged, emitted and absorbed in discrete packets which he called *quanta*. The work of Gregor Mendel was rediscovered: the start of what came to be known as the century of the gene, while the discovery of the electron by Joseph John Thomson in 1897 and of the virus by Martinus Beijerinck in 1898 was also part of the constellation. The quantum concept paved the way for elementary particle physics, anti-matter and the Large Hadron Collider at CERN (where the hunt for the inexorable Higgs-boson was launched), while the rediscovery of Mendel inaugurated the birth of genetics, thereby setting the scene for the rise of molecular biology and the sequencing of the human genome.

In 1900, the landscape of philosophy and psychology was drastically reshaped as well. The publication of Husserl's *Logical Investigations* marked the birth of phenomenology as a movement (both in philosophy and in psychology), while Sigmund Freud's *The Interpretation of Dreams*, formally published in 1900 as well (although it actually appeared in 1899), heralded the commencement of psychoanalysis: an intellectual event destined to have a tremendous impact, not only on psychotherapy, but on the humanities as well. Meanwhile, in St. Petersburg, Ivan Pavlov discovered the conditioned reflex. As indicated, however, during the decades to follow, philosophy and psychology diverted from one another. While philosophy split into "continental" author studies and "analytical" problem solving, psychology evolved into "human resource management", as Jacques Lacan phrased it. Time has now come to reconsider their common ground.

This series builds on the conviction that, to address the complex societal and cultural challenges we are facing today, philosophers and psychologists must work together. To understand the disruptive and transformative impact of science and technology in a globalising world, methods and concepts of both philosophy

and psychology are necessary, as complementary (rather than as incompatible) approaches. More specifically, this series aims to contribute to a revitalisation of research traditions which evolved in the boundary zone between philosophy and psychology and still have a significant potential for contributing to a transdisciplinary diagnostic of the present, such as phenomenology and psychoanalysis. Whereas philosophy of science is shifting its focus increasingly to the "context of discovery" (where new technologies generate new forms of experience and affect the way in which knowledge is actually fabricated), an assessment of the socio-cultural meaning of new technologies requires a detailed consideration of their impact on the life-world. We need to re-open the dialogue between empirical and normative areas of research. A research field such as economics, for instance, is not only about patterns of behaviour and consumer choices, but also about responsibility and integrity. In the area of politics and governance, the clashes between global economic trends and local identities call for a coalition of social sciences and humanities approaches. And food production is not only about health and risks, but also about equity and identity, sustainability and global justice.

Special interest will be given to efforts to use "genres of the imagination" in coming to terms with the challenges of the present. We are interested in scholarly publications which see novels, movies, poetry and theatre as imaginative laboratories, where emerging societal and technoscientific scenarios are probed, enacted and assessed.

This monograph is the first publication in the series. It envisions a psychoanalysis of technoscience, not only by studying science directly, but also via "triangulation", i.e. by comparing scientific breakthroughs with literary highlights, thus fleshing out a "comparative epistemology" with the help of three cases studies: the palaeoanthropology of Eugène Dubois, the conditioning experiments of Ivan Pavlov and the vicissitudes of virology as a major twentieth century research field.

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Introduction: a diagnostic of contemporary technoscience

This volume aims to develop a philosophical diagnostic of the present, focussing on contemporary technoscience. The conviction that philosophy should critically assess its own era was brought forward by Georg Wilhelm Friedrich Hegel (1821/1970),[1] perhaps the most "continental" of all continental philosophers. For Hegel, philosophy's objective is to capture the present in thoughts, to articulate its foundational convictions, its "philosophemes", its guiding answers to basic questions such as "What is nature?", "What is truth?" and "What is life?": the *implicit* metaphysics at work in scientific discourse (Hegel 1818/1970, p. 402). The same objective can also be encountered in oeuvres of more recent thinkers, such as Habermas (1985), who saw the present as a critical struggle with the legacy of Enlightenment, and Michel Foucault (1968/1994), according to whom a diagnostic of the present should give a voice to the unsaid, to the reverse side of established knowledge practices: the unconscious dimension of knowledge formations. This same idea (that philosophy should articulate the unconscious dimension of technoscience) was also a core conviction of the French philosopher of science Gaston Bachelard (1884-1962), one of Foucault's teachers (Foucault 1994; Gutting 1989, p. 9). In books such as *Psychoanalysis of Fire*, building on the work of Sigmund Freud and Carl Gustav Jung, Bachelard (1938/1949) aimed to psychoanalyse contemporary technoscience. The signifier "technoscience" was coined by him (Bachelard 1951; 1953) to emphasise the *technicity* of scientific research, i.e. the reliance of scientific knowledge practices on precision instruments and technological contrivances, arguing that science is a "phénoménotechnique", devoted to producing, manipulating and analysing laboratory phenomena (emerging in vitro), rather than exploring lifeworld experiences. The portmanteau term *technoscience* conveys the insight that science and technology are intimately connected, that scientific knowledge requires a technological infrastructure to operate, that science *produces* and *is produced* by technology, and vice versa, not only upstream (in the laboratory world), but also downstream, where technoscience enters the socio-cultural lifeworld of everyday existence. In the modern world, technoscience has become ubiquitous and pervasive (Zwart 2010). This chapter introduces psychoanalysis of technoscience as a subbranch of continental philosophy of science, starting with the work of Sigmund Freud (1856-1939).

The signifier "continental philosophy" began its career as a pejorative term, but now refers to a tradition of authors whose oeuvres reflect a certain family likeness, both conceptually and stylistically, and who (notwithstanding

[1] *Das was ist zu begreifen, ist die Aufgabe der Philosophie … [Sie ist] ihre Zeit in Gedanken erfasst* (Georg Wilhelm Friedrich Hegel 1821/1970, p. 26)

multiple differences and disagreements) inhabit a common intellectual landscape (Critchley 2001; Gutting 2005; Glendinning 2006; Zwart, Landeweerd & Lemmens 2016). Rather than seeing philosophy as a purely academic arm-chair endeavour, continental thinkers tend to see themselves as engaged scholars, and philosophy as an interactive and dialogical research practice, conducted in close interaction with the socio-cultural ambiance.

Continental philosophers share the conviction, moreover, that technoscience is not the only source of insight or access to reality, that there are other revealing ways of experiencing and disclosing the world, such as political or religious practices, or genres of the imagination (art, literature, drama, music, etc.). Furthermore, technoscience (as a form of world disclosure) is seen as profoundly historical, expressing and reflecting the zeitgeist of an epoch, co-evolving with other socio-cultural developments and contributing to a particular style of thinking. Also, continental philosophers tend to see technoscience as a transformative practice: not only exploring, but drastically transforming the world as well. And continental philosophers tend to see their own research practice as a diagnostic of the present, against the backdrop of a broader temporal horizon, so that an assessment of the here and now inevitably involves an anamnesis of the past and a prognostic of the future. Finally, continental philosophy sees the present as an epoch of profound disruption, of political and techno-scientific change: a metaphysical mutation. It not only aims to probe and assess the profile of the current transition, but also to contribute to it, acting as Socratic midwife. Let this suffice as a provisional characterisation. The next question evidently is: "Why psychoanalysis?"

Why psychoanalysis?

According to Freud's famous definition (1922/1940), psychoanalysis is: (a) a method for investigating psychic processes; (b) a method for treating neurotic symptoms; and (c) a meta-psychological anthropology. Psychoanalysis of technoscience belongs to the third category and falls under what Freud refers to as "non-medical applications" of psychoanalysis.

What is psychoanalysis of technoscience? First of all, psychoanalysis submits contemporary technoscientific discourse to a symptomatic reading, analysing it with *evenly-poised attention* and from an *oblique perspective* (Zwart 2017a). Psychoanalysis is not primarily interested in protons, genes or galaxies, but rather in the ways in which these are disclosed and discussed, focussing on the symptomatic terms, the metaphors and paradoxes at work in technoscientific discourse. Symptomatic features thus encountered may reflect instances of inhibition or resistance. Thomas Aquinas already stated that, whereas human intentionality is normally directed towards external reality (the object), critical reflection requires a change of perspective, an *intentio obliqua*. Rather than on objects, the oblique perspective focusses on the rapport between subject and object, on the ways subjects allow the world to reveal itself.

This is related to a second methodological principle, namely the acknowledgement that our interactions with the world are not primarily guided by curiosity or world-openness (as is traditionally supposed), but first and foremost by resistance. Human intentionality is inhibited and constrained by the fear of being overwhelmed and consumed by the threatening Real. Our desire to know (our *cupido sciendi*) is driven by a desire for control. Rather than being unbiased, our interactions with the world are fuelled by desire and inhibited by mechanisms of defence (resistance, suppression, denial). In other words, the knowing subject is hampered by obstacles that must be overcome to satisfy epistemic desire. This also applies to normal standardised research practices: psychoanalytically speaking, they tend to be inhibited and constrained. In normal science, the input from outside that is allowed to enter the knowledge system is filtered. Only small samples of reality are able to enter laboratories (as knowledge clearings). There are moments in the history of science, however, when inhibitions are suddenly overcome.

These epistemic events, these moments of truth, deserve our special attention. A third methodological principle therefore is the focus on beginnings, on moments of commencement, on the birth of a new paradigm (Zwart 2000), on *primal scenes* or primal events: dawns of day when resistance is suddenly broken and the desire to know suddenly erupts and thrives, so that, for a brief moment, the world appears in a new light. This may give rise to a new way of doing science, a new way of looking at and inter-*acting* with the world: an epistemological rupture. For modern science, primal scenes are connected with revolutionary initiatives, initiating new knowledge practices and associated with scientific "heroes" such as Copernicus, Galilei, Newton, Mendel, etc. As Goethe phrases it in *Faust*: *Im Anfang war die Tat*.

A final methodological principle can be referred to as triangulation (Zwart 2015a; 2016a). In order to assess a particular research practice, we need an additional (third) perspective, besides the subject and the object of science. We must confront scientific discourse with an alternative viewpoint. If technoscientific research practices are driven by resistance and desire, how to bring these subliminal mechanisms to the fore? To do this, technoscientific discourse must be exposed to a different stage, a different *Schauplatz* as Freud (1900/1942, p. 541) formulated it. In order to trace unconscious motives and inhibitions, a therapist may consult a patient's drawings or dreams. A psychoanalysis of technoscience likewise requires an exercise in *triangulation*. These contrasting scenes may be provided by novels. For instance, if we want to understand fin-de-siècle palaeoanthropology and its desire to find the "missing link", the methodological principle of triangulation requires us to consult novels about missing links. And if we want to understand the desire to control the physiology of an organism via conditioning, our methodological principle requires us to consult novels about conditioning. Triangulation entails the mutual exposure of technoscientific research practices with imaginative experiments conducted by literary authors. These methodological principles (evenly-poised

attention, the focus on resistance and primal scenes and the use of triangulation) will now be discussed in more detail.

The anatomy of resistance

According to Sigmund Freud, the human psyche is bent on maintaining homeostasis. We are reluctant to change and unprecedented challenges are faced with the intention to neutralise or incorporate them. Whereas traditional philosophy emphasises world-openness and curiosity as basic features of human consciousness and intentionality and as starting points for knowledge production, psychoanalysis rather emphasises the epistemic role of resistance as a mechanism of defence. This, Freud argues, is underscored by human anatomy (Freud 1920/1940). Rather than being open to the world, our bodies protect and immunise us from the threatening Real. We are covered by protective skin (which is covered with artificial protective layers known as cloths), while our sense organs are miniature apertures whose primary purpose is to provide protection against overstimulation (*Reizschutz*). This tendency of living organisms to insulate themselves from the outside world already applies to micro-organisms, coaxed inside their cell membranes. Our vulnerable bodies protect themselves against overstimulation, but this applies to our psyche as well. Protection against external stimuli is a life task at least as important as sensitivity and receptivity (Freud 1920/1940, p. 27). Our sense organs are like little antennae that select small samples of exteriority, allowing us to assess minute quantities of input. Our primary objective is to safeguard our psychic integrity from intrusive traumas. According to Freud, this same mechanism explains human reluctance to accept new insights (fairly disconcerting and unsettling at times) produced by technoscience. Only small samples of information can be processed and the current tsunami of technoscientific knowledge simply seems too overwhelming.

One of the reasons why technoscience invokes resistance is that it may endanger our self-image in a rather profound way. According to Freud (1917/1947), this already applied to low-tech research practices such as Copernican astronomy (the heliocentric universe) and Darwinian evolution theory. Both theories, Freud argued, entailed a narcissistic insult because they reveal that we are not as exceptional or central as traditional worldviews suggest. This same tendency, however, also applies to high-tech research practices of the present, such as genomics, microbiology or brain research. Contemporary neuroscience challenges the concept of human autonomy, the idea of human beings as autonomous persons, as *subjects* of experience and existence, by elucidating how neural network develop a functionality and responsivity of their own, beyond our control. Brain research makes the concept of autonomy questionable by emphasising the extent to which these networks are responsible for processes we ourselves (as conscious egos) tend to interpret as decision-making and thinking: processes which prove highly susceptible to technoscientific manipulation, with the help of psycho-pharmaceuticals for

instance. Or, to take another example, contemporary microbiology, building on high-tech contrivances, reveals that Planet Earth is first and foremost a microbial (rather than a human) planet, and that microbes are largely responsible for determining the conditions for life on Earth, by affecting the qualities of the soil, the oceans, the atmosphere and so forth. Moreover, while humans tend to see themselves as autonomous beings (as owners and masters of their own body), microbes not only dominate our external environment, but our internal milieu as well, and contemporary technoscience reveals how not only human health and well-being, but also human cognition is decidedly nourished by our gut microbiota, by the microbiome as a "forgotten organ", composed of bacteria: our microbial "collective unconscious" (Dinan et al 2015).

In other words, contemporary technoscience endorses the portrayal of human self-determination as a by-product of physiological, biochemical and neurological processes, thus undermining our self-image as autonomous beings. As Freud (1917/1947) formulated it, contemporary technoscience reveals that human egos cannot be considered masters in their own house. Dialectically speaking, the body (the former servant) has emancipated, while the former master (the ego) seems superfluous. As Slavoj Žižek (2006/2009, p. 175) phrases it, technoscientific contrivances (gadgets) and pharmaceuticals are de-centring human self-consciousness "from within". Instead of influencing human beings via texts and images (via culture), pills and gadgets purport to influence bio-molecular and neurological processes more directly. This raises the question how to re-affirm human agency and responsibility in an era of technoscience.

A typical response to the challenges coming from technoscience is discontent, a basic mood discussed by Freud as "discontent in civilisation" (Freud 1930/1948). Discontent in technoscience is a paradoxical phenomenon. On the one hand, technoscience is one of the techniques employed to counteract discontent, to satisfy desires, replacing the natural environment with a techno-scientific utopia in which natural restrictions are overcome, while human embodiment is drastically optimised and upgraded, eventually transforming ourselves into "prosthesis gods": a prospect which is bound to elicit a mixed response of enthusiasm and unease (Freud 1930/1948, cf. Zwart 2017b). In other words, technoscience is one of the techniques (besides self-intoxication, pleasure-seeking, artistic creativity, etc.) employed to make human existence more comfortable and less demanding. At the same time, it is clear that technological innovations entail (often quite taxing) challenges of their own. Therefore, rather than being applauded and endorsed, technoscience may give rise to technophobia, to nostalgic longing for a pre-technological, more natural and pastoral past: the desire to return to (or revivify) a lost, ancestral world (Lacan 1959-1960/1986, p. 107). Instead of serving us, technological gadgets increasingly dominate our daily lives. Instead of guiding us to utopia, technoscience may unleash self-imposed suffering and frustration.

Imaginative laboratories

Another methodological principle described above was to focus on beginnings, on moments of commencement, on the birth of new paradigms, on *primal scenes*. In Freudian psychoanalysis, primal scenes involve a scenario of desire, but also of violence (the act as *Attentat*). It is a screen on which phantasies are projected and acted out. A primal scene is basically a myth.

This also applies to primal scenes of technoscience. They are part of the mythology of science, involving scientific heroes. As indicated, in order to analyse them, we must apply a strategy of triangulation, confronting the foundational act (of a research field, a paradigm, etc.) with imaginative flanking scenes. To return to the beginning, we need a different stage, a different *Schauplatz* (Freud 1900/1942, p. 541), provided by art and literature (in the sense of belles-lettres). In other chapters I will focus on literary documents (novels), but here I will use a painting as example.

Take the introduction of the heliocentric system: an important epistemic event, the advent of modern scientific thinking, significantly contributing to decentralising the place of humans in the universe. The research strategy adopted in this monograph is to involve a work of art as a "third position", besides the "subject field" (psychoanalysis) and the "object field" (in this case: astronomy). In order to understand Galileo's provocative heliocentric innovation, a psychoanalytic approach will develop a sideways or oblique perspective. This can be done by rereading Bertolt Brecht's famous science drama *Life of Galileo* (1948/1978), for instance, but here I will consult the portrayal of this historical event by Henry-Julien Detouche (painted circa 1900), depicting how Galileo demonstrates his telescope in Venice.[2] This art work captures a specific historical moment: Galileo trying to persuade the representatives of the establishment to study the Moon with the help of a precision instrument: his telescope, instead of with the naked eye. The location of choice for demonstrating this highlight of optical technology is no coincidence of course, because Venice was famous for its glass industry. Psychoanalytically speaking, the representatives of the establishment (the ancient regime, assembled on the right) act as the "fathers", while the Moon (the prohibited object, at a safe distance, partly visible, hiding behind a pillar) represents the archetypal mother figure. In such a constellation, the (extensible) telescope functions as a phallic instrument, purporting to bridge the gap. A telescope can be made smaller and larger, enabling the development of a (hazardous) rapport with the forbidden but alluring "thing" looming in the distance. Unprecedented proximity can suddenly be realised. The art work depicts a paradigm clash: the Ptolemaic universe (the spherical understanding of the universe, represented by the metal model around which the Fathers congregate) versus the modern view, opened up by optics. It is around the telescope as an optical contrivance (rather than around Galileo himself) that the

[2] https://commons.wikimedia.org/wiki/File:Galileo_Donato.jpg

whole scene is centred. The scientific subject (Galileo) is *de*-centred by the technoscientific tool. Galileo is staged as a servant of a new and powerful master: modern technology.

The basic mood of the scene is one of suspicion. The invitation to glance through the telescope (to peer through this optical keyhole into the universe, enabling a close view of a heavenly body) seems quite appealing. Humans may suddenly discern the pristine nakedness of the Moon's surface. There is reluctance as well, however: the contrivance may entail an epistemic bias. What are the strengths and weaknesses of the naked eye compared to the optical contrivance? What is the πρῶτον ψεῦδος, the technological bias entailed in telescopes? Will they open up a new prolific research field, or rather prove misguiding? Human consciousness was not yet familiarised with the idea of studying the heavens through a telescope. The painting depicts a hazardous beginning, a moment of hesitation, a reluctance to commit the act: the *Anfang* of modern astronomy.

Galileo's body language suggests self-confidence. The telescope enhances his sense of power, provides a high-resolution portrayal, overcoming the obstacles imposed on science by distance. Sceptics may argue that the image produced by a telescope is technologically mediated and artificial. Strictly speaking, the new image is an artefact. Should we trust this optical *novum* rather than our own eyes? Will the contrivance prove more reliable than authoritative sources (Aristoteles, Ptolemy, the Bible)? The painting depicts a philosophical experiment, a collision between two paradigms, two ways of producing knowledge, two ways of interacting with the world: the telescope versus the spherical model.

A psychoanalytic concept applicable here is the oedipal triangle. Galileo's desire to know is directed at the forbidden, inviolable object, supposedly beyond his reach. The Fathers have the authority to determine how heavenly bodies are to be studied. Galileo by-passes the obstacles imposed. The fin-de-siècle painting highlights the oedipal complex as an unconscious dimension of early modern astronomy. If we analyse the scientific dispute from an oblique perspective, via exposure to an art work, we notice that Venice was a window into a distant world (the Orient, where Ptolemaic astronomy once flourished) besides a centre for glasswork production. The platform becomes a laboratory where conflicting ideas are put to the test. Psychoanalysis of science requires triangulation between a psychoanalytical *concept* (the oedipal triangle), a scientific *case history* (Galileo's demonstration of the telescope) and a *different scene* (a fin-de-siècle painting).

Carl Gustav Jung and Gaston Bachelard on science

Freud, although trained as a scientist, wrote psychoanalytic treatises about artists (Leonardo, Michelangelo, Dostoyevsky, Ibsen). In his case study of Leonardo, the latter is portrayed as an artist rather than as a scientist or engineer. The application of psychoanalysis to twentieth-century scientific research practices gained more prominence in the work of followers such as Carl Gustav Jung, who analysed research practices (from alchemy up to quantum physics) as practices of the self (as exercises in self-formation or *individuation*). While studying the relationship between alchemy and modern science, he focussed on the role of archetypes and the collective unconscious in scientific discoveries. In his analysis of the discovery of the first law of thermodynamics by Julius Robert Mayer for instance, Jung (1916/1958) explains how Mayer was suddenly carried away by his εύρηκα-experience: the archetypal idea of an inexhaustible source of energy (fire) at work in nature: an overwhelming experience which destroyed his health and his career. Also famous is his analysis of the dreams of Nobel laureate Wolfgang Pauli, a quantum physicist, but also a prolific dreamer (Jung 1944/1968; Lindorff 1995; 2004). Pauli postulated the existence of the neutrino in 1930 and acted as Mephistopheles in the famous Copenhagen version of Goethe's *Faust*, written by Max Delbrück and performed in 1932 (Gamow 1966; Segre 2008). According to Jung, mandalas (archetypes of wholeness) played an important role in Pauli's dreamlife, perhaps to compensate for the disruptive impact of quantum physics on established worldviews.

Science also plays a prominent role in the oeuvre of Gaston Bachelard (1884-1962), according to whom scientific research not only requires the acquisition of knowledge and skills, but first and foremost of a scientific attitude. The formation of such an attitude requires a *reformation*, a conversion, an initiation into the scientific style of thinking, highly dependent on technicity (Bachelard 1947, p. 23). This reformation concurs with what Bachelard refers to as the *epistemological rupture*. Being in science requires an interminable process of self-analysis. Researchers must be willing to subject themselves to a permanent regime of "self-surveillance" (1949/1962, p. 7) and "auto-psychoanalysis" (1949/1962, p. 14) to rid themselves of epistemic obstacles, pre-scientific concepts and misleading ideas. The conversion can only be brought about in a practical manner, via sustained laboratory labour (1947, p. 50): research as therapy, as a practice of the self. Scientists commit themselves to a process of "permanent catharsis" (1947, p. 18).

At the same time, to play his role as a psychoanalyst of science (not of individual researchers, but of scientific discourse as such), Bachelard decided to analyse these pre-scientific conceptions from a psychoanalytic (notably Jungian) perspective. According to Bachelard, these preconceptions reflect archetypal ideas. They constitute basic components of speculative worldviews. Bachelard became so deeply involved in this type of research, however, that his analysis of archetypal images became a research program in its own right, compensating his

systematic analysis of the "iconoclastic" tendencies of contemporary technoscience. Archetypal conceptions (such as the Mother Earth archetype or the idea of fire as a primordial principle) continue to inform not only genres of the imagination (novels, poetry and the like), but also scientific discourse as such (albeit subliminally). In order to study the archetypes, Bachelard argues, psychoanalysts of science should not only focus on scientific research practices as such but should also pay attention to genres of the imagination as a different stage, notably the world of literature (poetry and novels). These are to science what dreams and day-dreaming (*reverie*) are to rational consciousness. They serve as windows providing access to the unconscious, the alchemical undercurrent of the technoscientific will to know.

Two forms of thinking

Bachelard discerns a tension between the *iconoclasm* of science (i.e. the tendency to replace images by texts, words, numbers, concepts, mathematical symbols and the like) and the fact that science is a prolific producer of archetypal images in its own right (the double helix, the Big Bang, etc.). This tension between iconoclasm and imagination reflects a basic distinction between two types of thinking, which goes back to Aristotle (1986), namely thinking as considering mental *images* (φαντάσματα) versus thinking as considering *characters* (γράμματα). If we see a beacon, Aristotle argues, we initially recognise it as fire: a phenomenon with a particular, recognisable form, until it begins to move, for then we realise that it actually is a symbol, signifying something (e.g. the approach of a vessel). Thus, Aristotle distinguishes fire as a gestalt (*image*) and as a *symbol*, i.e. an element in an alphabet of symbols, bearing a human signature.

This line of reasoning is taken up by Carl Gustav Jung (1911/1968), who distinguishes between imaginative and rational thinking. While imaginative thinking builds on mental images (Aristotle's φαντάσματα), rational thinking is directed by concepts, words and logic (Aristotle's γράμματα). And whereas imaginative thinking is non-directed, spontaneous and free-floating, rational thinking operates with the help of linguistic, logical and mathematical operators and is therefore more demanding and exhausting. Moreover, whereas imaginative thinking is the older form of thinking (reflecting the spontaneous functioning of the human mind), rational thinking is a more recent acquisition. Important intellectual developments, ranging from the invention of reading and writing via scholasticism up to modern science, have contributed to its current dominance, but logical thinking has never completely replaced or erased its imaginative rival, so that the tension between the imaginary and the symbolic continues to exist. This distinction recurs in the writings of Bachelard, who distinguishes archetypal images guiding the imagination from the iconoclastic tendencies of technoscience.

The distinction between two types of thinking resurges in the work of the French forensic psychiatrist and psychoanalyst Jacques Lacan (1901-1981) as the

distinction between the *imaginary* (focussed on images or φαντάσματα) and the *symbolic* (focussed on symbols or γράμματα). According to Lacan, technoscience initiates processes of symbolisation, taking us from the *imaginary* realm (of images, visual shapes, etc.) to the *symbolic* realm (the technoscientific world of measurements, numbers, nomenclature, chemical formulae, mathematical operations, methodological standards, ethical requirements, etc.). Technoscience amounts to a *symbolisation of the real*. Whenever technoscientific processes of symbolisation falter, however, there is a tendency to revert to imaginary explanations. An example of this would be, for instance, the tendency to attribute certain features of living organisms to a mysterious life force, a spark of life (i.e. vitalism) which, from a Jungian perspective, echoes the idea of the universal source of energy (fire, grace, mana, etc.) already mentioned above. Whereas Jung sees archetypes as the basic structural components of the collective unconscious, however, Lacan (1955/1966) emphasises the *symbolic* organisation of the unconscious, claiming that the unconscious is structured *like a language*, like a Rosetta stone. For Lacan, the unconscious is "the language of the Other", although similar phrases can be found in Jung (1959a, p. 131). Like most Freudians, Lacan tends to be critical of Jung, but from a Lacanian perspective, I will argue, the latter should be credited for having systematically explored the imaginary realm. Although Jung is more focussed on the imaginary and Lacan on the symbolic, both oeuvres start from a similar distinction between two "types of thinking" (Jung), two "registers of human experience" (Lacan).

Symbolisation and imagination

Technoscience can be defined as the *symbolisation of the real*, as an effort to capture the *noumenal* dimension of nature with the help of quantifications, formula, symbols, equations and mathematical operations. Psychoanalysis acknowledges an alternative strategy for coming to terms with the real, as we have seen however, namely the imaginary. *A priori* archetypal templates guide the imagination and provide scaffolds for developing a coherent worldview. These two axes (the axis of *iconoclastic science* versus the axis of *active imagination*) take us in juxtaposed directions (Bachelard 1943, p. 15), but psychoanalysis sees them as complementary dimensions (Bachelard 1938/1949, p. 10) and even consciously employs them in the context of triangulation. In the case of Bachelard, a twofold oeuvre unfolded in which two sub-oeuvres stand out as clearly distinguishable discursive pathways, devoted to the symbolic and the imaginary respectively. In the case of Jung and Lacan, however, one could argue that, whereas Jung's oeuvre is a systematic exploration of the imaginary, Lacan consistently focusses on the symbolic (on technoscience as a symbolisation of the real). Notwithstanding the divergence discernible between both oeuvres, they will

actually be regarded as complementary.[3] To develop a comprehensive, psychoanalytic assessment of technoscience, both dimensions must be addressed, and both oeuvres must be consulted.

We have now briefly introduced four sources of inspiration for a psychoanalysis of technoscience: Freud, Jung, Bachelard and Lacan, two German-speaking and two French-speaking authors. While Bachelard is closer to Jung, Lacan returns to Freud:

Freud	Bachelard
Jung	Lacan

And while this (introductory) chapter entailed a short discussion of Freud, subsequent chapters will focus on Jung (II), Bachelard (III) and Lacan (IV). Besides significant methodological differences, similarities will be pointed out as well. All four authors endorse the strategy of triangulation, for instance. In order to understand the discourse of neurotic patients, Freud already reverted to different scenes, comparing the stories of his patients with fin-de-siècle cultural anthropology, eventually even fabricating an anthropological myth of his own: the primordial killing of the father (Freud 1912/1940). But he also published analyses of literary documents by Shakespeare, Ibsen, Dostoyevsky and others, emphasising the congruence between real and literary case histories. According to Freud, a remarkable affinity can be discerned between poets (literary authors) and psychoanalysts (1908/1941). They use the same sources (dreams, day-dreams, symptoms, anxieties, etc.), produce similar insights and allow others (patients, characters) to take the floor to act and speak. Poets make similar discoveries and may even claim priority as "precursors" of psychoanalysis.[4]

Jung explored the guiding visions of prominent researchers such as quantum physicist Wolfgang Pauli by analysing dream materials. He asked his patients to *visualise* their dreams by drawing them. Besides free associations, dreams and drawings, psychoanalysis offers a methodological Ersatz, namely genres of the imagination, notably novels, as opportunities for triangulation. Not only the dreams of patients, also the daydreams and reveries of literary authors may function as windows into unconscious desires. For Jung's analysis of the transition from alchemy to modern science, Goethe's *Faust* was an indispensable source of insight: an *opus alchymicum* "from beginning to end" (1968, p. 36, p.

[3] As indicated, Lacan tends to be critical of Jung. Abusing Jung became a ritual among Freudians, as if, in order to enlist, distancing oneself from Jung was obligatory. The campaign against Jung, launched by Freud himself, is uncannily reminiscent of show trials used by communist organisations to publicly denounce former comrades as representatives of evil. This monograph evidently follows a different path, focussing on the valuable contributions made by Jung to a psychoanalytical understanding of technoscience, both before and after his breach with Freud.

[4] "Die psychoanalytische Beobachtung … muss den Dichtern die Priorität abtreten. Sie kann nur wiederholen, was diese längst gesagt haben" (1904/1941, p. 237).

67), a treasure cove of archetypal materials, a literary bridge between alchemy and modern science.

Bachelard likewise confronts the technoscientific (*symbolic*) understanding of water by modern chemistry (H_2O) with the *archetypal imagery* of water (encountered in the literary work of Edgar Allan Poe). The latter is casted by Bachelard as a "poetic chemist", an "explorer" and "genius" of the imagination (1942/1947, p. 63). Lacan's work also contains extensive analyses of literary texts: by Shakespeare (*Hamlet*), Edgar Allan Poe (*The purloined letter*), Lewis Carroll (the *Alice* stories) and many others.

In this monograph a similar route will be taken. Psychoanalysing technoscience involves detours via literary documents. Novels provide oblique sources of information, podiums where the meaning and future impact of technoscientific developments can be explored. Novels are laboratories in their own right, as Zola (1880/1923) convincingly argued, where literary experiments are being conducted, exposing characters to various challenges and conditions, manipulated by the "experimental author". How will they respond? Triangulation means that science novels provide a "different scene", so that case histories become *exercises in triangulation* between: (a) psychoanalysis (as a conceptual framework, a method of investigation), (b) technoscience (the object field) and (c) literature (the oblique perspective). Triangulation involves two types of laboratories: scientific and imaginative ones, mutually exposed to one another. Genres of the imagination provide an alternative scene where the epistemic and societal profile of research practices can be explored.

Post-Faustian science

From the Copernican revolution onwards, the profile of science has dramatically changed. From a psychoanalytical perspective, a Faustian impetus (bent on controlling nature) has always been at work in technoscience. In his classic *Decline of the West*, published in 1918 (a century ago), Oswald Spengler defined modern science as "Faustian" and in the psychoanalytic literature Faust embodies the modern scientific will to know, driven by a will to power. Goethe's hero was an alchemist who exchanged traditional scholarship (reading authoritative books) with a far more active and riskier type of enquiry, resulting in the creation of neo-life in the lab – the *homunculus* project. Reference was already made to the Copenhagen version of Faust, written by Max Delbrück and performed in 1932 (Gamow 1966; Segre 2008), featuring the neutrino as Gretchen: an enigmatic object of epistemic desire, electrically neutral and with a mass so small that it was long thought to be zero. In contemporary philosophical discourse the claim has emerged that we have entered a new, post-Faustian era of globalisation: the Anthropocene.

Scientific research entails a dialectical relationship between subject and object, but in the past research tended to be a small-scale activity, conducted by individual researchers or small teams (single researchers and their assistants).

Gregor Mendel (1822-1884) is a classic example of a lone experimentalist, conducting experiments in his monastery garden, his laboratory. Currently, however, we are witnessing a technoscientific revolution of global dimensions, a dramatic increase in pace and scale in research, exemplified by big science projects such as the Manhattan project (culminating in the atomic bomb), the Large Hadron Collider at CERN (culminating in the quest for the Higgs-boson) and Apple Park in Cupertino, California (culminating in next generation electronic gadgets). At the subject-pole of the knowledge relationship we notice a shift from N=1 to N=many. Solitary researchers are replaced by armies of anonymous science workers, while the cross-staffs and hand-sized telescopes of early modern astronomy have been replaced by machine parks. The object has become something enigmatic and uncanny, such as ^{235}U or the Higgs boson (H^0). The whole planet evolves into a global laboratory.

At the subject pole, we notice to emergence of vast networks of technicity, marginalising the individual researcher and opting for ubiquitous, pervasive computing, ambient intelligence and "everyware" (Greenfield 2006). We also notice transdisciplinary convergence. Disciplines which used to be compartmentalised are now converging into large-scale epistemic constellations (molecular life sciences, synthetic biology, astrophysics, nanomedicine). Oceans of knowledge are opened up by technoscience. Research becomes macro-research, conducted by large-scale, transdisciplinary consortia relying on high-tech contrivances. Examples are the *Human Genome Project*, the *Human Microbiome Project* and the *Human Brain Project*. This type of research results in decentralisation, anonymisation and collectivisation of the scientific subject. Research becomes increasingly automated: conducted by immensely complicated and highly intelligent machines.

Special attention must be given to two transformative moments. First of all, the year 1900, when Max Planck introduced the quantum concept, Gregor Mendel's work was rediscovered, Edmund Husserl announced the birth of phenomenology and Sigmund Freud initiated psychoanalysis. Another remarkable turning point was the year 2000, when Bill Clinton, Francis Collins and Craig Venter presented the draft version of the human genome sequence and five cloned piglets were born (one of whom was named Dotcom), announcing the advent of the epoch of xenotransplantation. In terms of a diagnostic of the present, a new style of thinking is emerging. Humans have evolved into a planetary species and the world evolves into a noosphere of global networks and circuits, a web of intelligence. Laboratories function as local nodes in globalised and computerised networks.

The technicity of science is closely related with the issue of scale. Since the early modern era, small-scale science (represented by Copernicus' cross-staff and Galileo's telescope) has evolved (exploded) into Big Science. Yet, impressive efforts to organise research on a large scale already emerged during the early modern period, also in literary sources, such as Francis Bacon's *New Atlantis*, parodied by Jonathan Swift's *Voyage to Laputa* (Nelis & Zwart 2013).

In this voyage, Swift depicts a scientific research institute situated on an unknown island: an ideal community of scientists — a scientific monastery or academic utopia. The research institute where the researchers are based, is described in detail. The scientists are called fellows, and the work is efficiently distributed. The researchers demonstrate their "contrivances" and assure visitors that they are about to make world-shocking discoveries — provided that ample financial resources continue to be supplied. While roaming the laboratory complex, Gulliver witnesses several experiments which he considers downright ridiculous. In one of the chambers, he meets someone who analyses the structure of spider web, while a fellow in another room aims to retrieve sunlight from vegetables. In hindsight, these research projects (focussing on biomaterials and bio-fuels respectively) are not as ridiculous as Gulliver thinks. They rank high on the agenda of contemporary researchers, who not only want to understand the structural features of cobweb but also to structurally "control" these biomaterials (Van Hest & Tirrell 2001).

A fascinating early modern example of the drive towards scientific upscaling is Tycho Brahe's astronomical observatory named Uraniborg (i.e. the city of Urania, the Muse of astronomy). Brahe's ambitious and extremely expensive project was completed in 1580, but already abandoned shortly after his death in 1601, and is generally considered a fiasco. Psychoanalytically speaking, this was due to a basic ambivalence still at work. On the one hand, early modern science was driven by the Faustian desire to control, materialising in impressive contrivances for scientific inquiry. Yet, as will be explained in more detail in *Chapter IV*, early modern astronomers (notably Copernicus) still insisted that the universe is a perfect spherical whole, and therefore admirable, for the sphere is the most perfect form, best suited to enclose and retain all things (1543/1978, p. 8). The concept of geometrical perfection was the basic philosopheme of astronomy, preserving the grand vision of a closed and spherical cosmos. Kepler, however, was already forced to discard this conviction (albeit reluctantly) as a fascinating but deceptive, archetypal idea. The idea of the perfect, spherical universe was ancient astronomy's primordial misconception. By overcoming spherical thinking (as an epistemic obstacle), Kepler was able to make his decisive discovery: planets follow elliptical orbits. It is no coincidence that the ellipse (a key component in Kepler's Baroque astronomy) also was a key component in Baroque architecture. The spherical cosmos functioned as a mechanism of defence, warding off the unsettling prospect of an infinite universe: incredibly cold, spacious and silent. Once this idea was dropped, the scientific revolution gained momentum.

In the course of the twentieth century, the upscaling of research increased exponentially, resulting in large-scale, collectivised and anonymised research networks, in the anonymisation and collectivisation of the scientific "subject". Habermas (1968/1973), Serres (1972) and others argued that research became large-scale and hyperactive. This has repercussion not only at the object-pole of the scientific endeavour (where "objects" are becoming increasingly artificial,

modifiable and technologically reproducible with the help of high-tech research equipment), but also at the subject-pole. Increasingly, research is transferred to big machines and, as Habermas argued (1968/1973), this not only applies to the monotonous handiwork of science, but also to brain work, to thinking as such. Humans become mere operators, highly dependent on their equipment, components within complicated networks of machines: "living accessories" in a machine park.[5] As a consequence, the importance of self-reflection becomes less evident and research even seems to immunise itself against "generalised" self-consciousness, i.e. philosophical reflection. In other words, for Habermas, the trend is toward instrumentalisation of the subject, whose activities become automated and regulated; an assessment which may even become more relevant in the current era of big data and robotics. At the same time, individuality continues to play a role. The demise of the scientific individual concurs with the rise of science celebrities (Craig Venter, Steve Jobs, Bill Gates), but also of celebrity frauds. This (the death of the scientific individual and its subsequent resurgence in the form of science celebrities and scientific perpetrators) is one of the enigmas which a diagnostic of the scientific present should address (Zwart 2017c).

At the object pole we witness the emergence of hyper-objects. Instead of analysing specific molecules, proteins or behavioural mechanisms, research consortia are studying the universe as such, the brain as such, the global environment as such. Timothy Morton (2013) introduced the term hyper-object for non-local targets of research, distributed in time and space, such as climate change. As Michel Serres (1972) has argued, philosophers should study technoscience (with its collectivised research consortia, its hyper-objects and giant machines) from a position of close proximity, entering the tissues and capillaries of emerging research arenas as embedded scholars, addressing philosophical issues raised by these developments in close interaction with the scientists involved. Philosophy becomes "conceptual epidemiology": analysing and assessing how techniques, vocabularies, concepts, metaphors and research practices spread through research fields worldwide, infecting and inflaming the tissues of the broader societal life-world as well.

Research laboratories can no longer be regarded as insulated in vitro environments, for research is conducted everywhere. In the terabyte age, all individuals are research subjects, collecting, sharing, producing, spreading and consuming data. The whole planet has become a world-spanning hyper-laboratory, a technoscientific noosphere, a global network of technoscience and its products (electronic infrastructures, computer networks, global research networks, etc.) and this emerging global knowledge sphere is pervading society at large. Research networks are assessing the impacts of technoscience on the global environment, from climate change via emerging viral threats (attributed to

[5] In the humanities, close reading gives way to "distant reading" (Hernnstein Smith 2016).

increased mobility, climate change and ecological disruption) up to neo-life (produced by synthetic biology and gene editing techniques). In short, welcome in the Anthropocene. In this monograph, the genealogy of this development will be reconstructed by focussing on three fin-the-siècle primal scenes: the quest for the missing link, the discovery of the conditioned reflex and the emergence of virology.

II. Archetypes of science: science and imagination

Obscurum per obscurius: Jung's psychology of science

Carl Gustav Jung (1875-1961) was a Swiss psychiatrist working at the famous Burghölzli mental hospital near Zürich (conducting reaction time experiments to explore unconscious "complexes"), when he became interested in Freudian psychoanalysis. For a number of years, he closely collaborated with Freud, who even elected him as his successor, until they broke up. Issues of contention included religion, sexuality and the occult. After the clash, Jung developed a keen interest in the history of spirituality and human inquiry, from pre-historic times up to the present, focussing on alchemy as a practice of the self. As a psychotherapist he preferably worked with highly educated patients suffering from a mid-life crisis, whom he encouraged to visualise their dreams via drawings and paintings, as exercises in active imagination and as techniques to foster "individuation" (i.e. the integration of various aspects of the self into a coherent whole). He also produced extensive analyses of literary works such as *Faust*, *Zarathustra* and *Ulysses*.

At Burghölzli hospital, psychiatric patients participated as research subjects in association experiments, designed to map unconscious "complexes" (Jung 1905/1979). Words were presented and subjects were asked to give their immediate associations in response, while Jung measured the response time with a stop watch. The focus was on words that evoked a longer-than-average response time ("complex indicators"). Quantification and technification were important ingredients of his research practice and Jung employed sophisticated devices such as a galvanometer and a *Fünftelsekundenuhr* (a one-fifth second time watch) to measure reaction times as accurately as possible (Jung 1905/1979). His experimental technique and up-to-date equipment is represented quite convincingly in the movie *A Dangerous Method*, released in 2011 and directed by David Cronenberg, casting Michael Fassbender as Jung.

The first theme Jung developed after his breach with Freud was his theory of personality types, notably the distinction between introverts and extraverts (Jung 1921/1971). While *introverts* are solitary, focussed, inhibited and withdrawn (primarily interested in their own self), extraverts are communicative, energetic, productive and outgoing (expecting gratification from external reality). Introverts are engrossed in their inner world of thoughts and feelings, extraverts are oriented towards the world of objects and people. Introverts are slow to act, distrustful, keeping their distance, as though objects were something dangerous, while extraverts have a more positive and inviting attitude towards external things. Unknown situations entice them. Jung (1972) elucidates the difference with the help of a story about two friends. When the extravert suggests to visit a castle, the introvert is reluctant to enter. Once inside, however, the extravert soon wants to leave, but the introvert discovers a library with rare manuscripts. His initial shyness vanishes completely, and he refuses to depart. He is fascinated,

overpowered even, by the object: absorbed by it. The distinction became a core concept of twentieth-century psychology and the starting point for the Myers-Briggs personality test. The distinction is also relevant for science, where, say, Isaac Newton counts as an introvert, James Watson as an extravert. Via these conceptions and techniques, Jung contributed to the symbolisation of mental existence, and they brought him international renown.

His core research interest, however, drew him into explorations of the imaginary. Already as a psychiatrist, he became interested in correspondences between experiences of hospitalised patients and ancient religious or mythological motifs, giving rise to his core theorem: the collective unconscious, the archaic psychic realm of collective complexes ("archetypes"). While Freud and his followers approach literary documents from a psychopathological perspective (regarding authors or characters as pathological cases, so that literary artworks become reports of a personal neurosis), Jung approaches literary and scientific sources from a different angle, focussing on the core archetypal idea at work in it. He opts for a "symbolical" reading, although this phrase may be confusing, as Jung uses it to refer to archetypal motifs. In the previous chapter we already briefly referred to the case of Mayer, an introvert physician who, in 1841, on his way to the Dutch East Indies, was suddenly overwhelmed by what later came to be known as the first law of thermodynamics: the idea that energy can be neither created nor destroyed. Although he himself was convinced of the significance of this breakthrough, his publications proved difficult to read and met with much resistance. He was even committed to a psychiatric institution because of his persistent claim that he had made a highly important discovery which experts refused to acknowledge. For Jung (1916/1958), Mayer's case exemplifies how time-old archetypal ideas may suddenly resurge. On his journey to Batavia, Mayer became obsessed with what, in essence, was an intuitive, archetypal vision, Jung argues, namely the idea of "fire" as an elementary principle, forever transforming and recurring, but without ever being extinguished: the principle of life and change. For Jung, Mayer's vicissitudes were symptomatic of the resistance and suspicion of modern science against the resurgence of pre-modern, archetypal concepts. Rather than seeing Mayer as a neurotic, Jung argued that he drifted into psychopathology precisely *because* he was overwhelmed by the impact of an archetype, whose medium he had become: an idea which had found *him*, which had spoken out to him, rather than the other way around. His mental deterioration was not cause, but *effect* of a decisive, creative experience. He became the victim of an idea, to which everything was sacrificed.

In academic circles, while Bachelard's work seems forgotten, Jung's work invokes widespread suspicion, so that this chapter may be regarded as a plea for rehabilitation. Jung's doubtful reputation is partly due to his interest in questionable topics such as telepathy and flying saucers, but first and foremost to the anti-Jung campaign launched by Freud himself (1914/1946) and continued up to this day, framing him as a persona non grata. A Secret Committee of inner

circle followers was founded by Freud to ward off the Jungian threat. This negative verdict of Jung's work has obfuscated his significant contributions to understanding contemporary technoscience. Even Lacan, who was not at all a Secret Committee member, tended to discard Jung's views as aberrations. Although unmistakably fascinated by Jung (whom he visited in 1954) he nonetheless joined the ranks of the international psychoanalytical movement by formally abusing him, not coincidentally in a paper written in commemoration of Freud's most trusted aid, Ernest Jones. Here, Lacan stages Jung as a "mountain gnostic" dwelling in a "Helvetian refuge" and propagating local "canton secrets" whose "local hereditary characteristics we would be wrong to neglect" (Lacan 1966, p. 700). Such anti-rural puns, meant to appeal to urban readers, miss the mark however, if only because Jung was a researcher of international prominence rather than an unworldly mountain hermit, whose oeuvre proves highly relevant for developing a psychoanalytic approach to technoscience. Lacan's basic concern is that Jung's ideas on symbolism, although congenial perhaps with the views Freud himself elaborated in *The Interpretation of Dreams*, opened the gate to mysticism, in the sense that archetypes such as the snake biting his own tale (i.e. Ouroboros, discussed below) allow the modern psyche to become reconnected with "ancient knowledge" and the concept of a "world-soul" (Lacan 1966, p. 702). But Ouroboros is basically a template, a structure if you will, resurging in nineteenth-century stereochemistry in a way comparable to how, more recently, the archetypal structure of the double helix resurged in modern molecular biology.

A telling example of the Jungian approach to technoscience is his book on Unidentified Flying Objects (Jung 1959b). His purpose was not to answer the question (central to most UFO publications) whether flying saucers really exist (although Jung was sceptical about the issue). Rather, he wanted to find out why flying saucers consistently assume a particular (spherical) shape. What caused the worldwide UFO rumour? How to explain that even highly trained professionals (airline pilots, police officers, the military, etc.) continued to report sightings, especially in the United States, "the land of science fiction" (Jung 1959b, p. 1). Also, he wanted to understand why these enigmatic objects moved like airborne insects, floating smoothly through the air and suddenly pausing, as if these visitors from outer space were insensitive to gravitation. And why did Orson Welles' broadcasting of *The War of the Worlds* in 1938 (about Martians invading New York) cause such a mass panic? Apparently, humankind *wanted* these cosmic intruders to exist, but why? When Jung himself (after an interview in a popular weekly) was misquoted as being a "saucer believer" (p. ix), this instance of fake news spread like wildfire while nobody wanted to hear his rectification: any news confirming the existence of UFOs was welcome, scepticism was undesirable.

In his analysis, Jung connects UFOs with scientific developments such as satellite technology, space travel and atomic warfare. Satellites were a novelty in the 1950s and public audiences were both fascinated and concerned by the

expansion of human technology into the stratosphere. According to saucer believers, the possibility of atomic warfare caused disquiet on distant planets, whose inhabitants were surveying human airports and industrial installations to monitor the irrational behaviour of earthlings (p. 4). Also, humanity was looking towards the sky to dispose itself of its surplus (resulting from overproduction and overpopulation): invading other planets as an alternative for the disasters of global warfare. If we are able to travel to the Moon, or even to other planets, the logical implication is that the same may happen to us: that we ourselves may be invaded as well. Furthermore, the world seemed on the verge of disaster, being split into two incompatible halves (capitalism and communism). Against this backdrop, humanity was hoping for signs from heaven: an intervention from above, a *Deus ex machina* (p. 9). All this concurs with the catastrophe archetype: the idea of an emerging cataclysm and the dawn of a new era. Jung considers UFO sightings as symptomatic for the global psychic distress invoked by the awareness that a "platonic month" (p. xi) is coming to an end, that we are entering a new epoch (the Age of Aquarius). Flying saucers reflect the conviction that, in times of global transition, only interventions from outer space can save us. Flying saucers unleash a "visionary rumour", Jung argues, because they function as projections of unconscious ideas on an aerial screen. Thus, UFO sightings provide an opportunity for studying how myths are formed de novo (p. 14).

Jung has written extensively on alchemy. One of the phrases he uses to distinguish alchemy (the *opus alchymicum*: 1968, p. 33, p. 37, p. 266) from modern science is: *obscurum per obscurius* ("the obscure by the more obscure"), an adage which summarises alchemy's basic method of explanation (1968, p. 35, p. 227, p. 244). Modern science and the spirit of Enlightenment aim to reduce the unknown to the known. What seems complex can be understood by reducing it to something simple and elementary. This is also the aim of quantification. Nothing seems as simple as an integer (1 + 1 + 1 + 1….). Via measurements and calculations, complex processes become predictable.

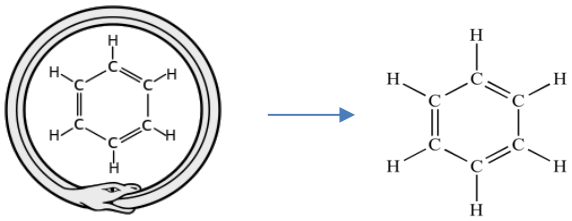
Alchemy, however, works the other way around. Obscure processes are explained by postulating enigmatic principles or causes that seem even more obscure. Newton's law of gravitation is of interest here as a mixture (a *coniunctio oppositorum*, alchemically speaking) of modern science and alchemy. Newton explains the movements of bodies (both in space and on Earth) with the help of a basic formula, consisting of four letters from the alphabet, a highlight for the modern scientific aspiration to symbolise the real ($F_{12} = G\, m_1 m_2 / r^2$). At the same time, he (a modern scientist, but also an alchemist) appeals to an obscure, unintelligible factor: the force of gravitation, which works from a distance (*actio in distans*). Whereas Newton's formula seems perfectly modern, his explanation of gravity with the help of an obscure, hypothetical force (the gravitational constant: *G*) aligns with the spirit of alchemy (*obscurum per obscurius*) rather than with the spirit of Enlightenment.

Psychoanalysis and alchemy

Jung extensively studied the transition between alchemy and modern science, elaborating the conviction that alchemy was actually a practice of the self, a form of transference. Individuals involved projected their concerns and desires onto the interactions between chemical substances. The obscure forces to which alchemists reverted, where actually unconscious complexes. For instance, the production of a chemical compound in vitro was referred to by alchemists as a "chemical wedding", indicating that erotic desire (love as a universal force of attraction) was guiding the behaviour of chemical substances. Much like the ancient Greek philosopher Empedocles, alchemists postulated the existence of a universal force (love, φιλία) to explain chemical results. A modern example of this association between chemistry and psychology is Goethe's novel *Wahlverwandtschaften* ("elective affinities"), whose title indicates that both human individuals and chemical substances have an intuitive preference to form bonds with certain individuals (or substances) rather than with others. While modern science explains biology on the basis of chemistry, alchemists explain chemical reactions on the basis of biology or even psychology (erotic drive). Thus, the obscure (a chemical reaction) was explained with the help of something which was even more obscure (φιλία as a universal force of nature).

Alchemy's method of explanation (*obsurum per obscurius*) was incompatible with Enlightenment (1968, p. 227), – although a certain level of obscurity is noticeable in every modern reach field, even in Newtonian physics, as we have seen –, so that in modern times alchemy split up in two branches, Jung argues, namely hermetic philosophy (the conceptual branch, represented by authors such as Böhme, Schelling and Hegel) and natural science (modern chemistry: the experimental branch). Notably during important breakthroughs (moments of transition), however, archetypal ideas may suddenly resurge, as happened in the case of Mayer, as we have seen. The birth of modern thermodynamics can be attributed to the resurgence of an ancient alchemistic notion. Similar moments of transition can be discerned in modern chemistry. Friedrich August Kekulé (1829-1896) discovered that carbon is tetravalent, so that four electrons are available in the outermost electron shell for bonding. In the case of methane (CH_4) for instance, the tetravalent carbon atom forms a chemical bonding with four hydrogen atoms, resulting in a cross-shaped structure. This insight provides the basic conceptual model to explain more complex (obscure) organic substances. As a modern scientist, Kekulé begins with a relatively simple structure and refrains from developing speculative theories about the forces at work within this elementary model (a task that was relegated to twentieth-century quantum science). The structure of benzene (C_6H_6), however, proved a major challenge. Kekulé discovered the ring shape of the benzene molecule when, during a reverie, he saw the vision of a snake seizing its

own tail, an alchemical symbol known as Ouroboros.[6] The bonding becomes a chemical wedding, mimicking a circular structure. As Jung phrases it, the alchemical idea finally reached its scientific goal (XVI, 1958, p. 179).



The archetypal vision played a maieutic role. An obscure symbol helped to solve a scientific problem, in other words: something obscure (the structure of benzene) was elucidated with the help of something even more obscure (Ouroboros as a symbol of nature as a whole, indicating how everything holds together). But the symbol was only a temporary scaffold. As soon as the discovery was made, modern science could emancipate again, could shed it off, resulting in a perfectly transparent structure (the version on the right).

Archetypes of science

Although Jung began his career as a scientist, he became increasingly infected, if you will, by the logic of alchemy, his key object of research, so that an alchemical signature is present in Jung's own method of explanation. The adage *obscurum per obscurius*, one could argue, applies to the Jungian approach as well. The fascination for flying saucers and other psychic pandemics is explained with the help of archetypes, such as the catastrophe archetype. According to Jung, archetypes can be discerned in the myths of ancient cultures, but also in the dreams, drawings and paintings produced by modern patients. They function like *a priori* templates: hard-wired components of our cognitive system, but also basic components of our cultural heritage, our socio-cultural environment. The collective unconscious (the aggregate of archetypes) is both a psychic and a cultural concept, both *nature* and *nurture*. Archetypes are congenital mental structures which are activated by experience and culture. Jung's archetypes concur with the basic drives postulated by Freud to explain neurotic symptoms: the pleasure principle and the death drive, associated with the two universal forces love/attraction (φιλία) and hate/repulsion (νεικος) posited by Empedocles (Freud 1937/1950). Some archetypes will now be discussed in more detail, starting with the Mother Earth archetype, the aeon (or catastrophe) archetype and the monster archetype.

[6] "I dozed off. Atoms danced before my eyes, contorting and turning like snakes. One of them took hold of its own tail and whirled derisively before my eyes. I awoke as though struck by lightning (and) spent the rest of the night working out the consequences"

The Mother Earth archetype conveys the idea of planet Earth as an immense living ("maternal") body in which matter is slowly moving and circulating: a superorganism desiring to bring forth and foster life, an idea which has fallen into disrepute. Modern science disenchants nature and promotes the view that Earth as such is abiotic and inorganic, albeit covered with a film of life: the biosphere. Yet, the Mother Earth idea occasionally resurges, in literature, but also in science. Jules Verne revivified the Mother Earth archetype in several of his novels, including *Voyage to the Centre of the Earth* (1864), in which the Earth's centre is a gigantic uterus inside an enormous female body in whose life-preserving liquids Jurassic life forms (that became extinct long ago on the surface of the Earth) are kept perpetually alive (as giant foetuses). Guided by clues provided by an alchemist, the protagonists reach this bizarre site through capillary veins in the crust of the Earth.

This same idea can be encountered in contemporary technoscience, however, where researchers discover extinct and bizarre life forms that managed to survive in dark and isolated places, in deep lakes covered by sheets of ice, or in inaccessible caves (Hazen 2005). A similar idea can be discerned in the work of biologist Lynn Margulis who describes how life on Earth is nourished by (and dependent upon) the presence of a life-sustaining "worldwide superorganism", a microbial *web of life* (Margulis & Sagan, 1986, p. 17). Margulis propounds the idea that Earth is basically a microbial planet while the microbial biosphere is a "communicating and cooperating worldwide superorganism" (p. 17). This same idea was elaborated and updated by Stephan Harding (2006), an ardent follower of James Lovelock (1979), depicting planet Earth as a sentient, living, suffering, nurturing and nourishing body with a personality of its own. Nature as a whole is presented as a super-being possessing organs and metabolism, a great body, a living being (p. 56). Lovelock conceived his seminal idea while working for NASA on a programme designed to detect life on Mars, realising that life on other planets can be more efficiently detected by considering these planets as a whole. He developed an *Electron Capture Detector* (ECD) for spotting Earth-like organisms, but instead of discovering life on Mars he provided the data on which Rachel Carson based her book *Silent Spring* (1962), showing how DDT pervades the biosphere as a chemical pandemic, poisoning Earth (the catastrophe archetype). Life has radically altered the Earth's atmosphere, turning it into a self-regulating system, maintaining an optimal oxygen level and enveloping the world in a protective ozone shell, thus creating and maintaining the conditions that allow life to flourish. Lovelock experienced his insight as a sudden revelation that abruptly and irrevocably changed his life. Another version is the idea that emerging viral infections indicate that Nature is striking back, suggesting that *we* are the invaders (cf. Chapter IX). Planet Earth is mounting an immune response against the human species (Wald 2008). Via viral parasites, its immune system is fighting us off, so that emerging infections are a response to our venturing into primordial places which should have been left undisturbed (the Anthropocene version of the oedipal complex: trespassing punished with a plague).

A final archetypal technoscientific scene is the artificial *in vitro* uterus designed to mimic (as a womb of glass) the primordial "soup" from which life emerged. In 1953, the year of the double helix, Stanley Miller and Harold Urey designed a glass enclosure containing a gas mixture to mimic the atmosphere of prebiotic Earth and exposing it to electric discharges. Soon, a significant part of the methane carbon had converted into amino acids and other biological constituents (De Duve 2002, Hazen 2005): the re-enactment of the primal scene of life in a laboratory setting. The Mother Earth archetype provides the imaginative scaffold. If the components are seen as matter, the archetype is the εἶδος, the form, the idea. What was explicitly addressed in alchemy became latent and dormant in modern science, but under certain circumstances time-old ideas can be reactivated. Besides historical (alchemical) and modern scientific sources, moreover, novels can be used as complementary scenes where archetypal ideas are fleshed out in a relatively uninhibited fashion. These literary amplifications help us to detect the subliminal archetypes at work in science.

The Mother Earth archetype not only conveys a basic image, but also a scenario: we are facing a worldwide ecological crisis, planet Earth has fallen ill: mass extinction as a scenario bridging Mother Earth with the catastrophe archetype, the idea that we are heading for disaster and that we ourselves are the primary causal factor responsible for this. Having pervasively and irreversibly changed the conditions for life on Earth, we have entered a new geological era, the Anthropocene (Crutzen & Stoermer 2000; Crutzen 2002). Similar cataclysm scenarios can be encountered in religious documents (from *Genesis* and the *Book of Revelation* up to millenarian cults). In the aftermath of the event, a dramatic and all-encompassing change of life-styles and basic attitudes will occur (Cf. Singer 2002), giving rise to a new era. Whereas the previous epoch (*Pisces*, symbolised by two fishes) was an era of conflict between two incompatible halves, the dawning era (*Aquarius*) will reflect restored unity (the unification of West and East, technology and nature, science and faith, iconoclastic science and imaginative art, etc.). Geology informs us that previous deluge-like events have been recorded in petrified archives. From a geological perspective, rocks are eloquent and stones can speak. Every layer is a memorial of lost worlds, every stone a Rosetta Stone. The world's crust is a library containing the annals of past catastrophes, of lost worlds inhabited by monsters.

The monster archetype appears in various shapes and formats, ranging from dinosaurs (macro-monsters of the Jurassic past) via human-like monsters (Frankenstein, Dracula) down to (viral or genetically modified) micro-monsters. Combining the monster archetype with the catastrophe archetype gives rise to the prospect of a man-made pandemic, an uncontrollable swarm of invisible entities, impossible to contain. Monsters are δείνος: terrible and threatening. In political science, the monster archetype emerges in the unsettling concept of *the masses*, envisioned by Le Bon (1919) and others (Freud 1921/1940). Monsters invoke *fascination* as well, and mass movements may be associated with the idea of a revolutionary cataclysm, cleansing the world, making a new political landscape

possible. The "revolt of the masses" incites a particular type of concern: mass phobia, the anxiety caused by the urban human mob, articulated by bourgeois authors such as Mill, Nietzsche, Kierkegaard and Santayana. In the democratic era of urbanised life, the intellectual elite will be outnumbered by a prejudiced, backward majority, acting as an amorphous, violent, irrational crowd, difficult to manage, threatening human culture like a dangerous flood, assuming a machine-like appearance: a fascinating prospect for some, an unsettling idea for others.

According to Jung, to prevent ourselves from succumbing to the power of the archetypes, we should become aware of them, making unconscious mechanisms visible. While modern science disenchants the world with the help of precision equipment, replacing fascinating images and worldviews with formulas, symbols and equations, it nonetheless continues to stir our basic archetypal schemata.

The mandala and the prophet

A *mandala*, Sanskrit for (sacred) circle, is a spherical-quadratic diagram, a pattern of geometric shapes contained within a circle or square (or "squared circle"), concentrically arranged and radiating from a centre. According to Jung, it is an archetypal symbol for restored unity or wholeness (1968, p. 27; 1959a, p. 356). It is a harmonious, symmetric image, gradually constructed, guided by active imagination (1968, p. 96; 1959, p. 356), allegedly containing everything and revealing how everything is related (1959a, p. 357). It may be the ground-plan for a building (garden, temple, monastery, city), such as the Pantheon in Rome: a spherical-quadratic building that contains everything (everything spiritual, for *pan-theon* means "all the gods").

Mandalas are often used as visual aids in contemplative and meditative exercises (Jung 1959a, p. 356), but may also function as roadmaps for processes of reconciliation and individuation. By realising wholeness, mandalas compensate for the contradictions, conflicts and disorderliness of actual reality (Jung 1968, p. 27; 1959a, p. 388). They enable the transition from disorientation and confusion to order, balance and homeostasis (Jung 1959a, p. 360). The centre has special symbolic relevance and may contain a symbol, a sacred text or a healing substance (φάρμακον). A mandala is a *coniunctio oppositorum* (a "union of opposites") as Jung calls it, for instance: light and darkness, circle and square, the rational and the spiritual, the symbolic and the imaginary. It is a symmetrical arrangement of seemingly disordered, contradictory and irreconcilable elements (1959a, p. 388). As the archetype of cosmic wholeness, it may reflect the shape of an eye or egg. A mandala represents integration as the map or program for a long and difficult journey towards wholeness or individuation, with each layer representing part of it. Although mandalas are prevalent in specific spiritual practices (e.g. Tibetan Buddhism) they can be encountered in all cultural traditions and historical periods.

As to the connection between mandalas and modern science, Jung first of all used mandalas to understand dreams, such as those of Wolfgang Pauli (*Chapter I*), but there are more mandalas showing up in modern science. One fascinating example is the famous *Photograph 51*, taken by Rosalind Franklin and her collaborator Raymond Gosling in 1952 and shown by Maurice Wilkins (without Franklin's knowledge) to James Watson (in a corridor at King's College, London) as a decisive piece of evidence for the helical structure of DNA, allowing Watson a glance through the keyhole of Franklin's laboratory as it were: the primal science of molecular biology research, a crucial step on the pathway that led to the discovery of DNA (Zwart 2015b; 2018). This photograph (a helical structure, seen from above) reflects the archetypal structure of a mandala, which is no coincidence, for it is a spectrographic rendering of the essence of life, symbolising the commencement (*Anfang*) of a long and complicated journey towards the molecular understanding of life. From a Jungian perspective, the emergence of mandalas in contemporary scientific discourse reflects a holistic turn in contemporary technoscience (Zwart 2018). Whereas in the past the focus was on analysis, on dismantling and breaking down living entities into basic molecular components, time has now come to put Humpty-Dumpty together again, to develop a systemic holistic perspective, focussing on the living entity as a whole to explore how all these partial objects fit and work together.

A final archetype is referred to by Jung as the archetype of the prophet (Master, wise man, medicine-man), descending from the mountain cave where, after extended spiritual and ascetic exercises, he experienced his moment of enlightenment. A telling case study is Nietzsche's *Thus Spoke Zarathustra*. Nietzsche's personality was overwhelmed by his super-ego, a process for which the hieratic language of his prose is symptomatic (Jung 1959a, p. 39). Succumbing to the archetype (instead of actively coming to terms with it), his project (after a fascinating and promising beginning) dramatically miscarries and derails. Authors should develop a dialectical dialogue with their archetypes, Jung (1998) and Bachelard (1960) argue, but Nietzsche reverts to the position of a medium, possessed by the voice of the Other, carried away by it, resulting in monotony. This is why Nietzsche envied Wagner, Jung argues, and (towards the end of his life) passed such an unfair judgement on him: Wagner succeeded where Nietzsche failed, for his music is an affirmative interaction with the archetypes, a process of working through (Jung 1972, p. 32). While Wagner reached unprecedented depths and became astonishingly productive, Nietzsche's neurotic heroism ended in a cramp (p. 33; Zwart 2012). I will now explain how Jung's theory of the archetypes was taken up by Bachelard and confronted with the iconoclastic technicity of technoscience.

III. Iconoclasm and imagination: Bachelard's philosophy of technoscience

Facta! Yes Facta Ficta! (Friedrich Nietzsche, *Daybreak* § 307)

Facta ficta

Nietzsche's exclamation plays on alliteration and highlights an intriguing etymological affiliation between *fact* and *fiction*, terms which are usually seen as opposites. The word *fact* is actually derived from the Latin verb *facere* (to fabricate), while the word *fiction* comes from the Latin verb *fingere* (literally: to bring forth with one's fingers). Etymology emphasises that facts (like fictions) are *made*, *produced*, rather than given, and this notably applies to scientific facts. They are products of science, of laboratory research; they are (literally speaking) *artefacts*: the outcomes of specific research practices; fabricated with the help of special research contrivances.

Nietzsche's alliteration reminds us that scientific facts are "fingered", coloured (tainted, if you will) by the scientific method, the knowledge production processes that brought them forth, the researchers whose fingerprints they bear. In order for scientific facts to be credible and convincing, the recipient must trust the scientific way of producing knowledge. We already discussed how Galileo tried to persuade the establishment to study the Moon with the help of a precision instrument instead of with the naked eye. Can technical artefacts be trusted? Yes and no. A telescope provides a more precise and detailed view of the Moon's bleak surface (pummelled by meteorites), but we inevitably lose sight of the firmament as a whole. These contrivances announce the death of holism. From now on, reflections on nature *as such* are transferred to the philosophers. There is something artificial about scientific facts, although they are brought forward in a very methodical and replicable way. A similar etymology can be discerned in the word *laboratory*, which builds on the Latin verb *laborare* and literally means 'workshop': a locality where certain entities are manipulated (literally: *handled*) and certain products (namely facts) are fashioned or moulded (in a hands-on, fingering way).

The relationship between facts and fiction is a key issue in the work of French philosopher and psychoanalyst of science Gaston Bachelard (1884-1962). For Bachelard, science is not about *knowing the facts*, but about *knowing how* they are produced. Nietzsche's aphorism applies to all human knowledge, Bachelard argues, and yet modern science is different. Before the dawn of modern science, thinking was highly imaginative, resulting in fascinating, seductive worldviews, based on imagination, on projection, on "intuitive metaphysics" (Bachelard 1943/1973). According to Bachelard, however, an epistemological rupture divides scientific research (conducted in artificial settings known as laboratories) from mundane life-world experiences. A laboratory object, Bachelard argues, is a laboratory artefact (a model organism, a particular

molecule, a purified sample of a chemical substance, etc.), produced and maintained with the help of laboratory equipment (*in vitro*), often unable to exist or survive in the outside world. Paradoxically, laboratories (although designed to study nature) are secluded places where real (outdoors) nature is kept at bay as much as possible, so that only small samples of reality (controllable and manipulated by scientific dexterity and laboratory equipment) are allowed to enter. Rather than studying phenomena as they present themselves to us, scientists build contrivances that allow them to measure and manipulate these phenomena as effectively as possible (knowledge = power and vice versa). In other words, what scientists are studying (under controlled conditions) are laboratory artefacts. While pre-scientific worldviews rely to a large extent on imagination and projection, science relies on manipulation and quantification. In other words, science is *iconoclastic*, rather than imaginative (Bachelard 1947, p. 38, p. 77). And whereas phenomenology as a research field analyses the phenomena emerging in the every-day life-world, laboratory life is a "phénoménotechnique" (1943/1973, p. 17; 1947 p. 61; 1949/1962, p. 3). Science is a technological experimental practice and scientific phenomena are technical phenomena, brought about by instruments: drastic simplifications of physical nature (1943/1973), materialisations of the scientific style of thinking, allowing scientists to produce, control and replicate these facts.[7] Instead of adequately reflecting the world, the world as it is brought about by science (i.e. objectivity) reflects the principles of scientific rationality itself. Every-day reality is replaced by a technical neo-world (1940/1949, p. 33). The "sur-rationalism" of quantum physics (with its sub-atomic "sub-objects", p. 139) is the scientific counterpart of surrealism in the imaginative realm (p. 39, p. 138).

For Bachelard, science focusses not on the phenomenal, but on the noumenal dimension of nature. Rather than studying water as we know it from every-day experience (water as a concrete phenomenon with a particular colour and taste for instance), scientists study H_2O. The chemical formula reveals the noumenal dimension (1932/1970, p. 19; 1940/1949, p. 60; 1951, p. 15): that what water truly and essentially is. For Bachelard, epistemology of science is "micro-epistemology", focussing on the molecular, noumenal level, inaccessible for the natural senses, brought to the fore by scientific technology, by technoscience. And this also applies to history, where facts are nowadays produced with the help of technologies such as radiocarbon dating or DNA sequencing of organic remains. Current archaeology would be unthinkable without bio-chemistry, genome sequencing and computers (Jones 2001).

All objects are bi-objects, composed of a phenomenal and a noumenal dimension, and scientific progress consists in progressively revealing the latter. According to Bachelard, this dual nature of things must be reflected in philosophy

[7] "Il faut que le phénomène soit trié, filtré, épuré, coulé dans le moule des instruments... Les instruments ne sont que des théories matérialisées. Il en sort des phénomènes qui portent de toutes parts la marque théorique" (1943/1973, p. 16).

as well, where a *phenomenology* of the every-day lifeworld must be complemented by a philosophy of science as *noumenology* (1951, p. 80). The visible, tangible phenomenon disappears from view, is obliterated by the noumenon (the molecular composition and arrangement of things). The objective of philosophy, as Bachelard sees it, is not to produce *a priori* knowledge about nature (via contemplation), but to critically reflect on forms of knowledge produced by other research fields (Chimisso (2001, p. 65). The problem is, however, that philosophers often fail to keep pace with the sciences, so that a process of catching up is indicated, to become more aware of the vicissitudes of "subject" and "object", not as metaphysical conceptions, but as real-life entities existing in laboratories.

While the *objects* of science are laboratory artefacts (rather than natural entities), the *subjects* of science, i.e. the researchers themselves, are reformed and remoulded as well, via systematic scientific training, a formative process which amounts to a spiritual "reformation" (Bachelard 1947, p. 23). The subject-object relationship is a dialectical dialogue which transforms both poles. Scientific objectivity is a transformed reality which bears a human mark (Chimisso 2011, p. 92). Researchers must subject themselves to a permanent and auto-polemical process of "self-surveillance" (1949/1962, p. 7) or even "auto-psychoanalysis" (1949/1962, p. 14). Psychoanalysis is necessary because even in modern culture, the power of the imaginary is "pervasive" (Chimisso 2001, p. 2). This process of self-surveillance (by an epistemological super-ego: i.e. the scientific method) amounts to an "epistemological rupture" (Bachelard 1938/1970) , a "conversion" (Bachelard 1940/1949, p. 8), brought about by sustained laboratory labour (1947, p. 50), allowing (or forcing) researchers to break away from the sway of pre-scientific ideas and to enter the world of reliable and replaceable scientific agents, devoted to a "spiritual" form of existence: a life of patience, dedication and self-sacrifice (Bachelard 1947). In other words, the scientists themselves are subjected to processes of "permanent catharsis" (1947, p. 18) and the scientific style of thinking entails an epistemological "mutation" compared to pre-scientific modes of thought (Bachelard 1947).[8] Science requires a "reformation" of the subject, an iconoclastic "destruction" of pre-scientific ways of thinking (1940/1949, p. 8), a radical "transformation" of the human psyche and its time-old cerebral mechanism (p. 129), a self-imposed "mutation" of human nature (p. 144).

At the same time Bachelard emphasises that this conversion is an interminable process, and in many cases pre-scientific convictions will only be temporarily repressed (by the censorship of the scientific method) rather than drastically eradicated. The systematic elimination of pre-scientific conceptions will never be fully completed. As Chimisso (2001) formulates it, rather than permanently eliminating the irrational from the domain of scientific activity, obstacles continue to trouble science, and science needs these obstacles to

[8] "Par les révolutions spirituelles, l'homme devient une espèce mutante" (Bachelard 1947, p. 16).

progress by overcoming them (p. 2). Modern science failed to completely destroy the imaginative core of pre-scientific approaches to nature, resulting in a *Spaltung*, a "division of the subject" (Chimisso 2001, p. 81). Scientific activity splits the subject into two parts: the one supervising and criticising the other. This division of the subject is an effect produced by science.

Science is *iconoclastic*, as we have seen (Bachelard 1947, p. 38, p. 77; 1953, p. 122). Rather than in the visual image or gestalt of things, science is interested in molecules and processes that can be captured in terms of formulas, symbols, equations and the like. Science advances by saying No to its pre-scientific past (Bachelard 1940/1949). And yet, scientific discourse continues to be susceptible to imagination, so that the distinction between *facts* (produced by science) and *fictions* (holding sway in the outside world, as products of a more popular, imaginative world-view) is relative, rather than absolute. Repressed ideas continue to resurge from the unconscious. This is why, increasingly, scientific research will opt for automation, replacing human researchers by robotics. The disdain for the robot is a pre-modern misconception. The electronic robot will be the perfect embodiment of scientific rationality, the rational and quantifying style of thinking (Bachelard 1949/1962, p. 25).

This praise of the scientific method also results in a critical attitude towards philosophy proper. As a philosopher of science, Bachelard criticises Sartre who, in *L'Être et le Néant*, referred to the continuous wave-aspect of electrons as their "feminine" and the discontinuous particle-aspect of electrons as their "masculine" dimension (Bachelard 1951, p. 192). Philosophy of science should put a stop to such projections, to the sexualisation of quantum physics. When it comes to science, philosophers tend to act as belated alchemists, thereby retaining a pre-scientific way of thinking. The task of psychoanalysis, as Bachelard sees it, is to surgically remove such misguiding preconceptions (1953, p. 18) in order to contribute to the reformation of the intellect. At the same time, Bachelard admires Sartre for the way he, as a psychoanalyst, in his novel *La Nausée*, describes the case history of a person who fails to establish a relationship with things in his life-world, who fails to achieve solidity, because all things invoke in him an experience of ambivalence. And he also praises Sartre for the way he discusses the secret (noumenal) darkness of things (the night of the world), for instance: the secret darkness of milk (Bachelard 1948, p. 25): an intuitive apprehension of a dialectical tension between essence and appearance, which, for Bachelard, is connected, not only with dialectics (the darkness of matter), but also with the poetic theories of alchemists concerning a mysterious blackness that is blacker than black, *nigrum nigrius nigro* (p. 27). Thus, on the one hand, Sartre is criticised for projecting archetypal images (of femininity and masculinity) on scientific concepts which he, apparently, fails to understand. For Bachelard, such images are screens produced by the human psyche to avoid the confrontation with the threatening real (Pire 1967, p. 22). On the other hand, he is praised as a gifted psychoanalyst and phenomenologist when it comes to analysing lifeworld experiences in a literary manner.

This basic ambivalence is a key feature of Bachelard's oeuvre. On the one hand, he firmly supports the symbolisation of the real by technoscience, even in a polemical manner. On the other hand, he appreciates the imaginative styles of thinking exemplified by genres of the imagination (e.g. Sartre's novels). Bachelard's psychoanalysis of science is split in two complementary branches: on the one hand a psychoanalysis of technoscience, focussing on how science (as symbolisation) reveals the noumenal dimension of things, on the other hand a psychoanalysis of imagination (of the imaginative phenomenology of literary phantasies). This splitting (*Spaltung*) forces Bachelard to produce a divided oeuvre and to write two completely different types of books, written in a completely different style. In parallel with his philosophy of science, a poetics emerges. In one and the same year (1940) he published both his polemical *The Philosophy of No* and a psychoanalytical study of animal images in the poetry of Lautréamont, a precursor of surrealism. The contrast between the two, in terms of content and style, is quite remarkable, and yet there seems to be a hidden unity (Lecourt 1974, p. 32, p. 139) which joints these opposites together.

Scientific discourse and its imaginary double: two oeuvres

Bachelard's ergography

	Manifest phenomena	*Noumenal structures*
Psychoanalysis of technoscience	Technoscience as phénoménotechnique	Science as symbolisation of the noumenal dimension of the real
Phenomenology of elementary imagination (earth, water, air, fire)	Phenomenology of literary reveries	The archetypes as *a priori* structures or templates of the imagination

The table above provides an overview of Bachelard's oeuvre. In the table below, the left column lists books that focus on the epistemological profile of the scientific style of thinking, while the right column lists books in which Bachelard is fascinated by the basic archetypal images reflected (realised) in literary documents. In both cases, Bachelard is interested in the noumenal dimension. Technoscience, as we have seen, is dedicated to revealing the noumenal essence of natural things and processes, captured with the help of symbols and equations (the symbolic). In literary imagination, the noumenal aspect is represented by the archetypes. An archetype is an *a priori* form (εἶδος) which realises itself in a certain context (e.g. the monster archetype resurging in Michael Crichton's *Jurassic Park*, a novel about palaeontology, or the Mother Earth archetype resurging in Jules Verne's *Journey to the Centre of the* Earth, a novel about geography). As a psychoanalyst of technoscience, Bachelard is bent on revealing the unconscious obstacles (the archetypal projections) that are barring scientific

progress. As a reader of novels, Bachelard's psychoanalysis is a depth psychology of archetypes.

Bachelard's ergography in book titles

	Technoscientific symbolisation	*Literary imagination*
1932	Noumène et microphysique	
1932	L'Intuition de l'instant	
1934	Le nouvel esprit scientifique	
1936		La dialectique de la durée
1938	La formation de l'esprit scientifique : contribution à une psychanalyse de la connaissance objective	La psychanalyse du feu
1940	La philosophie du non : essai d'une nouvel esprit scientifique	Lautréamont
1942		L'eau et les rêves
1943		L'air et les songes
1946		La terre et les rêveries du repos
1948		La terre et les rêveries de la volonté
1949	Le Rationalisme appliqué	
1951	L'activité rationaliste de la physique contemporaine	
1953	Le matérialisme rationnel	
1958		La poétique de l'espace
1960		La poétique de la rêverie

Literary imagination constitutes a different scene. To bring the unconscious archetypes of technoscience to the fore, Bachelard employs a detour via literary documents, where these archetypes are more visibly and tangibly present, due to artistic amplification. What is subliminally present in scientific discourse (but often remains unsaid and unseen), can be detected more easily with the help of literary counterparts.

Thus, Bachelard is involved in two branches of applied psychoanalysis. On the one hand, his philosophy of science aims to contribute to the formation (*Bildung*, training) of future researchers, by explaining what technoscience is, what technicity of research means and what the scientific method really is about. On the other hand, as a method of investigation, psychoanalysis allows him to explore the archetypes. In Bachelard's readings, the focus is neither on the molecules or processes as such, nor on the plots or narratives, but on the archetypal structures. More specifically, he focusses on the elementary archetypes, associated with the four ancient elements (earth, water, air and fire): the elements of the alchemists. It is here that the scientific unconscious (the

archetypes of alchemy) can be encountered. By confronting scientists with literary amplifications of archetypal images in poetry and novels, they will become more aware of them, so that they may recognise them and come to terms with them and deal with them. In the course of his work, however, Bachelard becomes increasingly fascinated and infected by these archetypal images. Indeed, he even stresses the extent to which the iconoclastic scientific style of thinking may *deform* our perceptivity (1942, p. 80). Therefore, a "noumenology" of science must be complemented by a meta-poetics, a consistent analysis of the role of the imagination, in literary documents, but also in technoscience as such.

His oeuvre reflects a return of the repressed insofar as it combines an analysis of technoscience with a meta-poetics of elementary imagination. In contemporary academic discourse, Bachelard is much better known for his poetics than for his philosophy of science, but these two branches or sub-oeuvres belong together. Initially, this duality posed a challenge for Bachelard himself as well. He saw rational concepts and archetypal images as opposites and wanted to "exorcise" archetypal images from technoscientific discourse (1960, p. 45). A synthesis between concepts and images, between the rational and the imaginative seemed out of the question. Eventually, however, he came to realise that both poles (the rational and the imaginative) belong together as complementary dimensions and must be alternately addressed (p. 47). Contrary to classical (Freudian) psychoanalysis, the aim is not to psychoanalyse the author. The attention shifts to the text, not of one particular author, but of a large number of authors, both major and minor ones (1960, p. 3): a psychoanalysis of literary discourse as such.

This is the difference between him and Marie Bonaparte (1958) for example when analysing Edgar Allan Poe. While she focusses on the (psychopathologies of the) author, Bachelard focusses on the archetypal images as such. He works with written documents only (p. 81; 1942/1947, p. 14) and explicitly forbids himself to move from an analysis of an oeuvre to an analysis of the author (p. 81). His key source of inspiration, moreover, is Jung, rather than Freud, (1960, p. 17, p. 50; cf. Pire 1967), notably because of the former's work on alchemy as a research practice which put archetypal phantasies to the test in an experimental manner, by transferring and projecting them onto matter, in order to realise a synthesis (a *coniunctio oppositorum*) of rationality and imagination (p. 60). An important lesson from psychoanalysis as a meta-psychological anthropology is that human beings are divided subjects who can only be understood from a dual perspective: a technoscientific and an imaginative one.

In Lacanian terms one could argue that, as a philosopher of science, Bachelard studies the *symbolic* dimension of technoscience: how technical contrivances produce a type of discourse consisting of numbers, technical terms, mathematical and chemical symbols, equations, and so forth. As a philosopher of the imagination, however, Bachelard analyses the imaginary dimension and its basic archetypal structures. Therefore, Bachelard's writings basically amount to a "comparative epistemology" (Zwart 2008): a systematic comparison of

scientific knowledge forms with their literary (imaginative) counterparts, seeing novels as literary laboratories (as theatres of the imagination) which allow us to study typical images which, due to the epistemological rupture, are less visible, but nonetheless effective, in scientific discourse. Special attention is given to *material* imagination: basic images associated with the four elements (earth, water, air and fire), while a special connection may arise between elements and authors, for instance: Edgar Allan Poe as a poet of water, Heraclitus and Mayer as thinkers of fire, Nietzsche as a philosopher of air. Heidegger (not mentioned by Bachelard) could be added as a philosopher of earth.

Gaston Bachelard occupies a unique position. As a philosopher of science, he developed a profound interest in genres of the imagination (notably poetry and novels). While emphatically acknowledging the strength, precision and reliability of scientific knowledge (compared to every-day experience), he saw literary phantasies as important additional sources of insight. And although he significantly influenced authors such as Jacques Lacan, Louis Althusser and Michel Foucault, while concepts such as "epistemological rupture", "epistemological obstacle" and "technoscience" are still widely used, his oeuvre tends to be overlooked in mainstream science studies discourse.

The imaginary

For Bachelard, as far as imagination is concerned, the fundamental signifier ("*vocable*") is not *image*, but *the imaginary* ("*l'imaginaire*"*:* Bachelard 1943, p. 7). There is something seductive and fascinating about the imaginary. It entails an invitation to embark on an imaginary voyage through an imaginary landscape. And whereas classical psychoanalysis (i.e. Freudianism) is iconoclastic (bent on cleansing human consciousness from imaginary remnants), Bachelard proposes to complement this tendency by developing a "counter-psychoanalysis" (1943, p. 204) bent on purifying the imagination, stripping off everything accidental, until we reach the archetypal core of the imaginary realm. This counter-psychoanalysis is elaborated in his books devoted to elementary archetypes, associated with the four elements of traditional (imaginative) metaphysics.

In *Psychoanalysis of Fire*, Bachelard (1938/1949) argues that scientists must break away from fire as an immediate object of experience, as a familiar phenomenon (with all its seductive associations) and as something which can be intuitively grasped (Bachelard 1938/1949, p. 9). In modern chemistry, the signifier "fire" has disappeared from scientific manuals, and rightly so. It is something only poets still write about. Fire no longer counts as an object of scientific inquiry, it is *repressed* from scientific discourse, but this repression is fully *justified* (1938/1949, p. 164) from the point of view of modern science. And yet, fire (and its complexes of associations) is never *completely* erased from scientific practice and scientific discourse. Underneath the engineer, the mindset of the alchemist still lurks (Bachelard 1938/1949, p. 14). And the same goes for mental operations such as association and projection, which belong to a

primordial, pre-scientific mode of thinking (p. 44). Therefore, in order to fully understand the technoscientific engineer, philosophers of science should not only study the manifest logic of science, but should also explore the persistent complexes of alchemy, in a psychoanalytic manner, as *the unconscious* of modern science. To achieve this, Bachelard explicitly builds on the work of Jung (1938/1949, p. 44).

The element air is associated with verticality, with ascension and height (Bachelard 1943), with a particular form of upward mobility: the Icarus-complex, the desire to reach unprecedented altitudes, but also the accompanying fear of falling or crashing down into the abyss of emptiness beneath. Ascending and crashing are typical dream motifs, but also standard ingredients of stories and novels about flying, aircrafts or space travel. Plato's story about the soldier Er who, while travelling through the geocentric universe, heard the imaginary music of the spheres (the celestial symphony) also falls within this category (Plato 1935/2000, 614-621). The element air is connected with the upward gaze of ancient and medieval cosmology, with phantasies concerning the spherical cosmos and its concentric heavenly spheres, but also with the zodiac whose constellations have always served as a "collective Rorschach test" for humanity (1943, p. 202), a heavenly screen onto which psychological ideas have been projected since time immemorial (p. 210). Imagination is a primordial way of thinking, Bachelard argues (p. 119), relying on associations and projections. And alchemy is a dreamlike way of thinking, unblocking the imaginary in the realm of human inquiry. This clearly builds on Jung, who argues, for instance, that the truth of astrology is that we are able to read something about ourselves in the stars precisely *because* we use these constellations as screens onto which unconscious complexes are projected. That is why the stars predict our future: they reflect the unconscious dynamics of our inner psyche and mirror the psychic contents we transfer to them.

In his book on water (fluidity), Bachelard (1942/1947) again distinguishes mere phantasies (the surface, the accidental content) from the imaginary as such: the basic structures at work, discernible in daydreams, reveries and literary phantasies (for those who have an eye for them). Although Bachelard opts for a "vague" title (*Water and its Reveries*, p. 9) instead of a more programmatic title (*Psychoanalysis of Water*), the methodological procedure is the same. The target is not the author (the poet), but the literary text itself (p. 14). Philosophers and psychoanalysts, Bachelard argues, always read twice: the first time to follow the author (a superficial reading), the second time to reveal the archetypal complexes guiding the author's phantasies (p. 26), resulting in a depth poetics. For modern science water is basically H_2O. Whether water is polluted or pure can be determined with the help of tests, resulting in scientific indicators (symbols), such as the sign ("écriteau", p. 184) placed beneath a tap to indicate whether the water is drinkable.

Literary texts adopt a pre-modern stance towards water, and Bachelard discusses a number of basic associations connected to water: water as a mirror,

water and suicide (the Ophelia complex), the nymph taking a bath (the Diana complex) and so on. Edgar Allan Poe's water texts, Bachelard argues, are guided by an archetypal idea (notwithstanding the various pseudo-scientific and pseudo-mathematical ingredients, the technical details, the scientific references, the information concerning latitudes, longitudes, temperature, etc.). Poe's water, according to Bachelard, is heavy, silent, dead and opaque, while giving rise to interminable and monotonous adventures. For both Jung and Bachelard, monotony as such is already an indication that a particular archetype is at work, in this case: the deceased mother. Water is the dark, antediluvian aspect of our planet, that part of planet Earth which is still flooded, representing otherness and the unconscious. In roman languages, Bachelard argues, the letter *a* stands for water (*aqua*), but also for otherness (*autre*, etc.). Another association with fluidity is the idea of an alchemical mixture of substances, the idea of a potion, a love potion, a panacea or φάρμᾰκον. Alcohol is a mixture of water and fire (spirit-water). Again, we find these associations in Jung as well. According to Jung, water (dreams about dark lakes at night, the ocean at night, etc.) represents the unconscious as such (1959a, p. 18). But water is also associated with rebirth (the Mother archetype), cf. the gospel story about the pool of Bethesda, functioning as a panacea (1959a, p. 19).

Most explicitly, Bachelard builds on Jung in the two volumes that are dedicated to the element earth (Bachelard 1948a; 1948b). Although on the surface level literary texts may be regarded as reproductions of reality, they are basically sublimations / elaborations of archetypes (p. 4). Historically speaking, the imaginary is the primordial mode of human self-expression (p. 5). Whereas narratives constitute the conscious part, archetypal motifs constitute the unconscious part of literary stories (p. 6) and the focus of a philosophical-psychoanalytical reading should be on the fundamental structures. Therefore, all stories must be read twice (p. 262).

Whilst Bachelard's first earth book explores the *extravert* aspects of images related to earth (activity, labour, etc.), the *introvert* aspects (rest, leisure, reflection) are addressed in the second volume. Earth as primordial matter (*prima materia*) is associated with the Mother Earth archetype. As indicated above, while modern science explains biology on the basis of chemistry, the pre-scientific mind explains chemistry on the basis of biology (planet Earth as a living super-organism). Earth is that which offers resistance, but at the same time entails a provocation (Explore me!). Humankind no longer fears or admires terrestrial nature and is tirelessly transforming the environment. Because classical psychoanalysis (i.e. Freudianism) was a bourgeois endeavour (addressing elite circles and city-dwellers), the world of manual labour remained virtually unexplored. Attention must shift from the inhibited bourgeois neurotic to the active workers, defined by their equipment and their products. Tools are materialised aggression, reifications of the will to power, but recalcitrant matter continues to offer resistance. Whereas from a Freudian perspective all activities are social activities (seeing modern labour as an assault which is unconsciously

directed against father figures), Bachelard rather focusses on the immediate target of the activity: on material earth as such.

Labour, Bachelard argues, is an activity guided by imagination, an effort to impress geometrical order on nature. From the standpoint of manual labour, nature is not harmonious at all. Rather, geometric order is enforced by human workers, guided by an internal image (εἶδος). Egyptian pyramids are archetypal ideas concerning the geometrical, crystalline structure of elementary minerals, captured in stone and projected onto a very large scale. The modern era not only transforms natural materials into artificial useful things, but even produces new materials (e.g. plastics): a dramatic reduction of nature's recalcitrance. Whereas traditional philosophical contemplations only touched the surface of things, labour really acquires solid knowledge concerning nature. The primeval destructive club of pre-historic times has now evolved into a plethora of sophisticated instruments. In Nietzsche, however, Bachelard still discerns a regression to infantilism: the hammer as an iconoclastic club that merely destroys (p. 136). The tools of modern labour are becoming quite sophisticated, and this notably applies to a specific form of manual labour known as laboratory research, where precision instruments are used to produce robust knowledge.

Labour always retains an element of self-analysis and self-therapy, resulting in individuation, and this notably applies to technology-based research. It is essentially a practice of the self, resulting in *selbst-Bildung* or self-edification. In the laboratories of alchemy, labour was still under the sway of the imaginary: of archetypal structures projected on matter, even on a cosmic scale, so that the purpose of alchemical experiments was to validate imaginary projections. The most decisive outcome, however, was self-knowledge and self-therapy. In Richard Wagner's *Siegfried*, the smithy still serves as a therapeutic setting where the protagonist is able to heal himself and to become what he is. What is put together again is not only the sword, but also the hero's fragmented identity. In Wagner's opera, the stage becomes an alchemistic soundscape facilitating individuation. From the point of view of alchemy, the whole world is an immense alembic. Planet Earth is alive, so that research is basically "pan-biology" (p. 240). The animal realm follows a daily rhythm, the lunar realm a monthly rhythm, the vegetal realm an annual rhythm and the mineral realm a millennial rhythm. While traditional philosophers merely contemplated nature from a safe distance (as city-dwellers), scientists (i.e. active laboratory workers) develop what Bachelard refers to as "depth chemistry": real knowledge concerning the noumenal (molecules, atoms, protons and so on). Ignoring Kant's bourgeois caveat that we supposedly cannot know things in themselves, laboratory work relentlessly opens up the noumenal dimension of terrestrial nature, giving rise to "noumenal chemistry" (1948b, p. 11).

Notwithstanding the discontinuities between modern scientific and pre-modern forms of inquiry, the imaginary is still at work as the unconscious of contemporary technoscience. Geological research, for instance, is like climbing a mountain top (accepting nature's provocation to do so). Upon reaching the

summit, the climber is exposed to a breath-taking, panoramic view of the immense terrestrial body, while human beings are reduced to insects or microbes inhabiting the skin. This desire, to perceive Earth as a whole, and to miniaturise human beings (or the other way around: to perceive the human body as a giant ecosystem inhabited by tiny microbial creatures) fuels contemporary research areas. To deepen our understanding of this desire, we may consult genres of the imagination (such as Swift's story about Lilliput) where this drive towards miniaturisation is enacted and elaborated in detail, via active imagination. The fact that Jonathan Swift (1667-1745), the author of *Gulliver's Travels*, and Robert Hooke (1635-1703), the author of *Micrographia*, were contemporaries is no coincidence.[9] Both the microscope and active imagination are techniques for modifying the scale of things. Modern science enables voyages of exploration into our own bodies and allows us to either dwarf or enlarge ourselves in rather dramatic ways.

Sublating the epistemological rupture

Bachelard's leading concept is the epistemological break or rupture, separating scientific knowledge (fabricated in laboratories) from life-world experience, explored by phenomenology (Vydra 2014). This rupture is first of all a historical event, separating modern (Faustian) science from pre-modern knowledge practices, notably alchemy. The epistemological rupture marks the gap between the pre-scientific period of a discipline (under the sway of imagination) and the scientific one. Modern researchers consistently have to endorse and re-enact this rupture, biographically as it were, in order to transform themselves into genuine scientists. Moreover, this transformation affects both the subject-pole and the object-pole of the knowledge relationship. Chemists study chemical processes under controlled conditions and the main objective of Bachelard's *Psychoanalysis of Fire* is to explain why fire (as a life-world phenomenon of every-day experience) no longer constitutes a valid object of scientific research. Fire (for instance: a hearth-fire) may invoke stories, narratives and childhood reminiscences, but modern science focusses on the noumenal dimension of combustion, representable in the form of structural formula and chemical equations. Experimental researchers study model organisms and other bio-objects that are fully adapted to laboratory circumstances, dramatically different than wildtype relatives. Something similar applies to the artificial human (the *homunculus*) produced in the laboratory (*in vitro*) by Faust and his pupil Wagner, a lab creature who spends his life in a crystal vial, a sterile bubble, unable to survive exposure to a natural environment (Goethe 1808/1910, 6884). The researchers themselves (as laboratory subjects) also become affected by laboratory life, however. The most important product of laboratory life, one could

[9] "La beauté lilliputienne des livres scientifiques qui ont relaté les toutes premières découvertes microscopiques" (1948b, p. 19).

argue, is a particular type of subject: reliable, trustworthy and replaceable, an emptied subject, a subject without qualities or idiosyncrasies, a subject "without depth" (Lacan 1966): a "kenotic" subject (Zwart 2016c).[10] In this subject, established worldviews and life-world convictions have been replaced by the "philosophemes" of modern science (1949/1962, p. 7). The cathartic process of systematic elimination of pre-scientific misconceptions (via auto-psychoanalysis) results in the psycho-*synthesis* of a scientific consciousness. According to Bachelard, it is the vocation of a philosopher of science to clarify the basic philosophemes of science, the conceptual building blocks of the scientific world-view.

This cathartic process, however, is an interminable endeavour, bound to remain unfinished, so that the scientific subject is actually a divided subject, unable to consistently live up to the stern ideal, hampered by the return of the repressed: the resurgence of prescientific (alchemical) ideas. Therefore, scientific discourse is in need of therapy and Bachelard aims to provide precisely this. He sees his oeuvre as a depth psychology of science, bent on probing and exploring the collective unconscious of science, resurging in symptoms such as failures, mistakes, logical inconsistencies, paralysis, depressions or mid-life crises. To achieve this, rather than studying science directly, psychoanalysis of science requires a different stage, as we have seen, a different *Schauplatz*: the world of literature (belles-lettres). Poetry and novels are to science what dreams and day-dreaming (in French: *reverie*) are to individual consciousness. They serve as windows providing access to the unconscious. What remains subliminal in science becomes manifest in literature (cf. Freud's famous dictum: if we cannot understand consciousness directly, try a detour via the lower, deeper realms of psychic life: *acheronta movebo*). Ancient ideas, expelled from scientific discourse, may be very much alive in poetry and novels. These genres provide an epistemological reserve where repressed ideas continue to flourish.

While modern science adopted the periodic table, literary imagination continues to think in terms of the four elements of premodern thinking (earth, water, air and fire) and the various archetypal complexes connected with them, such as Mother Earth (connected with earth) or the dream-flight motif or Icarus complex (connected with air). The time-old association between fire and eroticism (between electricity and eroticism, between friction and arousal, etc.), rejected by modern science, is still very much alive in belles-lettres, where love is experienced as electrifying. Unconsciously, such complexes and associations, although formally dismissed, remain active in science as well. For that reason, Bachelard produced his parallel series of books which purport to psychoanalyse science from two angles: from the perspective of scientific technicity (the symbolic) and from the perspective of elementary imagination (the imaginary).

Building on Kant, Bachelard claims than an adequate understanding of imagination requires a Copernican revolution (1938/1947). According to the

[10] κένωσις is self-emptying, self-renunciation. Cf. Paul's *Letter to the Philippians* (2:7).

traditional view, observation comes first, while imagination uses observations as raw material to fabricate stories, art-works and the like. According to Bachelard, however, it works the other way around. Imagination comes first, providing the *a priori* structures that allow us to organise and make sense of the overwhelming flow of observations. Imagination *precedes* observation and archetypal ideas allow us to contain the chaotic avalanche of empirical phenomena to which we are exposed, guiding our intentionality and allowing us to embed experiences in a world-view.

Scientific research works differently, as we have seen. In the case of science, focus and intentionality are provided by technical contrivances (such as telescopes or microscopes). They narrow the field of vision in a radical way and allow research to concentrate on a specific microbe or a specific constellation. Yet, even in science, archetypal templates are never completely erased (repressed) once and for all. They are bound to resurge in the folds and margins of mainstream discourse, notably in times of crisis, when normal science is challenged by anomalies and frustrations. By determining the basic structure of these archetypal complexes, they can be more easily detected and dealt with. Yet, in the course of his program, Bachelard increasingly falls under their spell as we have seen. They become complementary sources of insight, rather than mere obstacles. Dialectically speaking, it is the negation of the negation: the negative attitude towards archetypal images (entailed in modern science) is sublated and overcome, so that science and imagination become reconciled again (*coniunctio oppositorum*). As complementary sources of insight they converge into a more comprehensive understanding. In other words, Bachelard's oeuvre reflects a Jungian process of individuation.

The resurgence of the Mother Earth archetype

The archetype associated with the element earth (the Mother Earth archetype) invites us to see the planet as a living, caring, maternal body, a super-organism. From this perspective, sheets of crystallised minerals become veins, apertures (volcanoes or rivers) become mouths, caves become wombs: sheltered environments, the dwelling place of primordial human beings, where the process of anthropogenesis unfolded. The archetype resurfaces every now and then, even in scientific discourse, as exemplified by the Gaia-hypothesis (Lovelock 1979; Harding 2006). What Lovelock (1979) announces as a "new" look at life is actually the revivification of a fairly ancient idea. Seeing Planet Earth as a super-organism was one of the basic philosophemes of alchemy. From an iconoclastic technoscience perspective, the affinity of the Gaia-hypothesis with the Mother Earth archetype evokes suspicion. To come to terms with nature, pre-modern archetypal views must be exorcised and replaced by quantified input. As a philosopher of technoscience, Bachelard endorses the iconoclastic tendencies of critical Enlightenment. Archetypes belong to a different, more imaginative, but eventually deceptive mode of thinking, at odds with the rigorous logic of

experimental and quantitative research. At the same time, as a psychoanalyst of the imagination, Bachelard is well aware of the extent to which archetypal ideas continue to play a role. A more comprehensive view on science should encompass both the rational and the imaginary, both the conscious and the unconscious components.

A paradigmatic example of the Mother Earth archetype is Plato's simile of the cave, describing a group of human beings dwelling in a subterranean cavern, whose legs and necks are fettered from childhood, so that they can only stare at the wall in front of them. A fire is burning higher up, at a distance behind them, and between the fire and the prisoners a low wall has been built, and behind that wall images of humans and animals are carried about, as in puppet-shows, whose shadows are cast onto the wall (Plato 1935/2000, 514-515). At a certain point, some prisoners are freed from their chains. Their initial resistance is overruled as they are dragged away towards the outdoors world, towards the light. Psychoanalytically speaking, the shadows on the wall reflect archetypal shapes. The epistemological rupture takes us from deceptive images to genuine knowledge, freeing us from our imprisonment, leading us upward, literally *educating* us. At the same time, Plato's story adheres to the Mother Earth archetype itself: picturing the original human condition as a protective cavity reminiscent of a womb, with prisoners as foetuses, chained to their petrified uterus by umbilical cords (fetters). They seem perfectly happy in an environment which in readers may invoke claustrophobic anxiety. At a certain point, they depart from their abode, which apparently satisfies all their needs, and progress towards enlightenment, via scientific education. Liberation is a traumatic experience, however: the trauma of birth, of intellectual awakening. Plato's scene suggests a Palaeolithic hatching facility for domesticated humans, hypnotized by images projected on a screen: a Flintstone-like cinema based on pyro-technology, but perhaps we may also see them as passengers on a transatlantic flight. In short, Plato's simile plays upon the very archetype it aims to disrupt and replace by true knowledge (e.g. logic, astronomy, geometry).

The Mother Earth archetype not only surfaces in Plato, however, but can be discerned in modern research practices as well, such as palaeoanthropology. Typically, paleoanthropologists look for fossilised early human remains in caves. It was in Sumatran caves that Eugène Dubois hoped to discover his "missing link" (cf. *Chapter V*). From 1887 to 1890, while stationed on the island of Sumatra as a military doctor, he systematically explored every single cavern he came across (Theunissen 1989). It was only when he tried his luck on the banks of the Solo River near Trinil on Java that he found his *Pithecanthropus erectus* (*Homo erectus*) skull. The archetypal image of early humans dwelling in tropical caves inspired him to travel to the Dutch East Indies (now Indonesia) in the first place, but this image became an epistemological obstacle. According to Bachelard (1948), the archetype of the cave is part of the Mother Earth complex: i.e. the view of planet Earth as a living super-organism, fostering and nurturing life. The prehistoric cave is a Pleistocene uterus, a primordial dwelling of early human

beings, exemplified by the association between caves and cranes (1948, p. 171), not only in terms of alliteration (two instances of C-minor as Bachelard phrases it: the cave as a sombre, primordial human soundscape), but also in terms of their visual shape or *Gestalt*, for the primordial cave is shaped like a crane, inhabited by early human beings (homunculi as it were), while the cave's openings function as eyes or windows into the outside world. According to the logic of imaginative thinking, cave floors are likely places for unearthing early human skulls. In the case of Neanderthal or Homo Naledi (Berger & Hawks 2017) research, this association proved helpful and valid, but Eugène Dubois had to discard it, had to emancipate himself from this captivating image, before he could achieve his goal, replacing it with a substitute vision of early human beings thriving along pastoral river banks.

Bachelard's psychoanalysis is not a psycho-pathography of science. Rather than staging Eugène Dubois as a neurotic, he sees his work as a force field where technoscience and imagination reinforce or collide with one another. The rational logic of science and the archetypal logic of imagination are depicted by Bachelard as complementary or even compensational.[11] And although Edgar Allan Poe's novel *The narrative of Arthur Gordon Pym of Nantucket* is quite implausible from a scientific point of view, Bachelard discerns a different kind of truth in it, by casting Poe as an "explorer", a "genius" of the imagination (p. 63), who develops a "poetical chemistry", a literary analysis of the element water and its various archetypal associations, such as the image of the maelstrom, connected with the frightening yet intriguing depths looming beneath the surface (p. 64), a source of inspiration not only for novelists, but also for oceanographers, ichthyologists, marine archaeologists and deep sea zoologists. The sensitivity and articulacy of authors such as Poe allows us to discern, flesh out and even revivify the archetypal dimension of human experience in a convincing and systematic way. His prose explains what outsiders find so fascinating about oceanography and related research areas, investigating the enigmatic depths of aquatic nature and its weird inhabitants. Literary authors are experts of the imaginary. Whereas technoscience entails a rigorous symbolisation of the world (reframing human knowledge with the help of scientific nomenclature, mathematical symbols, numbers and equations), novelists probe and assess the imaginary.

Thus, Bachelard discloses the psychodynamics of imagination in scientific discourse. Formally, the seductive world of images, myths and phantasies must give way to a more rational form of scientific agency, exploring the world in scientific terms, in accordance with Freud's famous formula *"Where Id* was, there *ego* shall be" (1932/1940, p. 86). Where seductive archetypal images once reigned, the scientific, rational ego must take the floor. At the same time, Bachelard realises that this cathartic operation should not restrict itself to the manifest level of discourse but requires a depth psychology as well.

[11] "Les axes de la poésie et de la science sont d'abord inverses. Tout ce que peut espérer la philosophie, c'est de les rendre complémentaires" (1938/1949, p. 10).

Archetypes (primordial images, *a priori* templates) are the basic constituents of the collective unconscious. While the rational, scientific mode of thinking relies on technology, precision measurements and quantification, imaginative thinking relies on the logic of correspondences and associations. Bachelard's understanding of archetypes is logocentric rather than neuro-centric, moreover. Rather than seeing them as hard-wired into our brains, he sees them as *discursive complexes*, structuring discourse, giving rise to various *discursive* symptoms. The craft of philosophers is discourse analysis: systematic reading (1948, p. 6) and comparative epistemology: the mutual exposure of scientific and literary sources (triangulation).

Whereas Bachelard initially considers science as fundamentally superior compared to pre-modern (imaginative, archetypal) modes of thinking, he eventually frames imagination as *different* rather than deficient. Genres of the imagination provide a different scene where the logic of the archetypes can be systematically explored. After *Psychoanalysis of Fire* (1938/1949), the term "psychoanalysis" disappears from his titles. For whereas *Psychoanalysis of Fire* addresses both technoscience and elementary imagination, seeing the latter as deficient, subsequent volumes reflect a trans-valuation of values. Both dimensions are now seen as equally important (as complementary endeavours). In books on elementary imagination, the positive epistemic value of literary daydreams is underscored. This results in dreamlike titles: "Earth and reveries of Will" (1948a); "Earth and reveries of repose" (1948b), "Water and its dreams" (1942/1964). Daydreams compensate the impoverishment and disenchantment brought about by technoscience.

The sciences and their archetypes

According to Bachelard, all research fields have their archetypes. The core archetype of chemistry is the explosion (1938/1949), an association which he already noticed as a teacher. Adolescent students are bored by formulas, but the chemistry practicum appeals to them, precisely because of the possibility that, sooner or later, tinkering with chemical compounds may result in explosions, smoke, a nasty smell or a bang. Bachelard noticed that, in biographies of prominent chemists, such as Justus von Liebig or Humphry Davy,[12] explosions (both thrilling and uncanny, both fascinating and unsettling) played a similar role. Building on the infantile urge to play with fire, which is forbidden not only

[12] The same goes for the poet Percy Bysshe Shelley on whom Mary Wollstonecraft modelled Victor Frankenstein: "Shelley's attitude to science was never scientific in the empirical sense, but speculative and imaginative. Chemistry, electricity, astronomy fused easily with alchemy, fire-worship, explosives and psychological investigations... [He was] the chemist in his laboratory, the alchemist in his study, the wizard in his cave" (Holmes, 1974, p. 16.). Holmes summarises his adolescence as: "horror books, alchemy, ghost-raising, chemical and electrical experiments, and the delights of outrageous speculation" (Holmes 1974, p. 13).

because it is dangerous, but first and foremost because it is a privilege of the father (Bachelard 1938/1949; Freud 1932/1950). The idea of an explosion was the oedipal motive that drew them into chemistry in the first place. The appropriation and domestication of pyro-technology enacts a promethean emancipation. One may also think of the late medieval monk Berthold Schwarz, an adept of the gothic *scientia experimentalis,* credited with the discovery gunpowder, but paying for it with his life. Pollution is an explosion of chemicals at a slow pace on a large scale, resulting in proliferation of pesticides, a biological catastrophe, a "silent spring" (Carson 1962).

The archetype of biology is the monster: the concrete materialisation of nature as frightening and overwhelming: as δεινός. Biology is fascinating to outsiders as soon as the monstrous is brought to the fore. The classic exemplification of the biological monster is the dinosaur (the terrible reptile), a signifier coined by Richard Owen in 1840. Precisely this makes palaeontology a fascinating field: excavating the remains of enormous animals, reconstructing their image, their *Gestalt*, preferably in full colour and large as life – as extinct icons of a lost Jurassic world.[13] For Bachelard, the literary paragon of the monster archetype is Mary Wollstonecraft's novel *Frankenstein*. Initially, Victor Frankenstein immerses himself in the writings of the alchemists ("necromancers", as Mary prefers to call them). Their grand, fantastic theories appeal to him. At the University of Ingolstadt, however, he is exposed to the iconoclastic logic of modern science: apparently an unassuming and tedious research practice. Initially, he is deeply disappointed by what modern science has to offer,[14] but he soon discovers that scientific research is actually driven by unconscious desire: to create artificial life in the laboratory. Thus, he willingly exposes himself to the scientific mode of thinking and after "incredible labour and fatigue" he finally achieves his goal. Terrified by the spectacular success of his experiment, however, he flees from his laboratory and suffers a nervous breakdown, so that he is unable to continue his scientific work.[15] In the aftermath of trauma, Victor tries to resume a more poetic mode of existence, but science has irreversibly infected him and the result is an epistemological neurosis paralysing him, intellectually, erotically and socially (Zwart 2008; 2010). Mary Shelley's novel provides a case history for a psychoanalysis of technoscience, a different scene where tensions and dilemmas of modern technoscience are *worked through* and *acted out*. But the same archetype can also be discerned in the micro-monsters of molecular biology: the genetically modified microbes

[13] According to Gould (1996), dinosaurs are interesting because they are "big, fierce, and extinct – in other words, alluringly scary, but sufficiently safe" (p. 223).

[14] "The ambition of the [modern] enquirer seemed to limit itself to the annihilation of those visions on which my interest in science was chiefly founded. I was required to exchange chimeras of boundless grandeur for realities of little worth" (p. 306)

[15] "I had conceived a violent antipathy even to the name of natural philosophy… The sight of a chemical instrument would renew all the agony of my nervous symptoms… I had acquired a dislike for the room which had previously been my laboratory" (p. 328).

which may escape from the laboratory, creating havoc in the outside world, unleashing an anthropogenic cataclysm, when containment proves impossible (Rifkin 1998/1999).

In his final publication, a retrospect, Bachelard (1960, p. 64) positions the two dimensions of his oeuvre with the help of a Jungian scheme, based on the distinction between *animus* (the principle of activity, upper level) and anima (the principle of passivity, lower level) and between research (left side) and imagination (right side). On the basis of this scheme, Bachelard reviews his life's work as follows:

Modern technoscience *(animus)*	Active poetic imagination (*animus*)
Archetypes of alchemy (*anima*)	*a priori* archetypal templates (*anima*)

What this quaternity indicates is that the *massa confusa* of primordial nature (the Lacanian "real") can be approached from two directions. Via technoscience (the *animus* principle, rational activity), resulting in a process of symbolisation, or via active literary imagination. Both poles have an internal *animus*-*anima* duality however. The *anima* side of modern technoscience are resurging archetypal ideas (the collective unconscious of scientific discourse). While alchemists transferred and projected *a priori* ideas onto natural processes, in modern science these complexes and associations are repressed by scientific discipline (the *animus* principle) so that they function in an unconscious manner, although the basic dynamics is still discernible (for those who have an eye for it). In poetic and novelistic reveries, however, these images are applied in an uninhibited, exuberant manner (the imaginative version of the *animus* principle), but on closer inspection, *a priori* templates or structures actually guide the process (so that active imagination builds on passivity and receptivity, the *anima* principle). Imagination is the other (reverse) side of technoscience, but both dimensions have an inner duality, so that we are actual dealing with a "quadrupole situation", involving four positions (1960, p. 70).

Bachelard elucidates this scheme with the help of Nietzsche's oeuvre. For Bachelard (again fully agreeing with Jung), Nietzsche is first and foremost the author of *Thus Spoke Zarathustra*. By announcing the twilight of the idols, he seemingly advocates iconoclasm and radical Enlightenment (the intellectual version of the *animus* principle, upper-left position). We must emancipate ourselves from religious and metaphysical idols of Christianity once and for all. What he apparently fails to realise, Bachelard argues, is that this attitude of uncompromising hyper-masculinity (the *animus*-principle) is actually a ferocious compensation for the lost pastoral "paradise" (1960, p. 50) of his youth, the atmosphere of Christian piety (the *anima*-dimension: lower-left position). Writing *Zarathustra* is an effort to free himself from these shackles so to speak, but once again Nietzsche (although proclaiming himself to be a psychologist) fails to realise that his opus magnum (his exercise in active imagination, upper-right position) is actually written under the sway of an archetype, the archetype

of the prophet, descending from the mountain cave where he experienced his moment of enlightenment:

Radical iconoclastic Enlightenment (*animus*)	Active imagination: Zarathustra as a literary figure (*animus*)
Pastoral paradise (*anima*)	The prophet archetype (*anima*)

Whereas in the case of night dreams our cogito is suspended, in literary reveries the author can and should maintain a certain level of conscious presence and self-control (p. 129). The poet (upper-right position) represents an intermediary position between the scientist (upper-left position) and the medium (lower-right position). Whereas technoscience aims to separate concepts from images (1960, p. 182), to cleanse concepts from their imaginary ballast (upper-left position), mediums succumb to the archetypal image (lower-right position). True poets and novelists (Poe, Baudelaire, Sartre, etc.) synthesise the two. In terms of the quadrupole scheme:

Science: cleansing rational concepts from imaginary remains *(animus)*	Novels: elaborating archetypal images in an active manner (*animus*)
Alchemists: understanding nature through projection of archetypal images (*anima* principle)	Mediums: *a priori* archetypes take possession of the author (succumbing to the *anima* principle)

Because scientists such as Kepler and Pauli, notwithstanding their susceptibility to the sway of the archetype, developed an active dialogue between scientific rationality and grounding images (via processes of working-through), they became creative scientists (upper-left position) instead of reverting to the position of the alchemist (lower-left), falling victim to the poetic power of archetypal forms.

IV. Lacan and science

The matheme of desire

Although Lacan is not commonly regarded as a philosopher of science, both in his *Écrits* and in his *Seminars* he developed a sophisticated psychoanalytical approach to technoscience. First and foremost, Lacan urges us to rethink the basic dynamics of the knowledge relationship (the subject-object relationship), both at the subject-pole, where traditional epistemology posits the rational subject (e.g. the *cogito*, the thinking ego of Descartes) and at the object-pole, where Kantian epistemology posits the split object: split between the *phenomenon* (as is appears to us) and the *noumenon*, the *thing in itself* (inaccessible to us).

Lacanian psychoanalysis entails a radical subversion of the knowledge relationship as it emerged during the era of the scientific revolution. At the subject pole, the rational (autonomous, self-conscious) ego gives way to the divided, speaking *subject of desire* (*$*), dwelling in a world of language (the symbolic order). At the object pole, the intentionality of the divided subject is directed towards an enigmatic (absent, lost, impossible) object: the *object of desire* (the "object *a*"). While scientists focus their attention on particular objects of research, these objects may actually function as ersatz objects or replacements. The inexorable object *a* is what they are really after. Ultimately, researchers (as subjects of desire) are obsessed by an impossible, toxic object, Lacan argues, something which is often actually missing, or not yet there, or appears as a waste product, an enigmatic black spot. Thus, Lacan replaces the traditional knowledge relationship with what he refers to as the *matheme of desire*, where the lozenge (◊) indicates that the subject is both obsessed by and pulled towards the object *a*, zooming in and out as it were: *$ ◊ a*.

The matheme of desire was initially designed to reflect the basic dynamics of erotic desire (where "*a*" may refer to the enigmatic gaze or pupil of the beloved object of desire for instance), but Lacan extrapolates this schema to the knowledge relationship as well. The subject of science is driven and consumed by a *cupido sciendi*, a desire to know and to control the object. From a Lacanian perspective, the subject is not the *homunculus* of classical knowledge theory, the "little man" located somewhere in the system, receiving information about the world via his sense organs and reacting to this by initiating movements and interventions (via his cognitive dashboard as it were). Rather, as Heidegger already argued, human subjectivity entails *Dasein*, being-in the-world, more precisely: being-in-language. Language (the symbolic order) ignites in us a longing for things which are not visibly or tangibly present, things which may have existed in the past or may exist in the future, things which can only be represented in a symbolic manner, can only be encountered via substitutes or displacements (via "something else").

Thus, at the subject position, we find the tormented, desiring subject, in need of guidance, of a compass. Initially, during pre-scientific stages of the

knowledge relationship, this guidance was provided by the authoritative voice of the Master: the primary subject (S_1). Rather than approaching objects directly, the world is explored via the word of the Other: via *Genesis* or the works of Aristotle, for instance. During the dawn of philosophy (in ancient Greece, twenty-five centuries ago) the Master of a philosophical school initiated his disciples into a certain mode of thinking, thus allowing divided subjects (*$*) to constitute themselves as recipients or custodians of a message (S_2). For the divided subject (*$*), nature initially emerges as chaos, as chance events, but the Master stabilises both the subject pole and the object pole by providing reliable knowledge. The subject assumes a new role, being converted into a disciple (so that *$* gives way to S_2). The discourse of the Master relies on canonisation, turning the Master (S_1) into a privileged knowledge source. The Master is staged as someone who allegedly knows the truth. As indicated, Lacan refers to the Master as S_1 (the Master signifier). This authoritative source (the starting point of a knowledge practice) may be a sacred ancient text, based on revelation (e.g. *Genesis*), but it may also consist of a body of writings attributed to the Master (carrying his signature, the Name-of-the-Master), whose authorship functions as guarantee of truth. This applies to documents such as the *Physics* of Aristotle, or the *Analects* of Confucius. The Master's legacy (S_1) allows divided subjects (*$*) to constitute themselves as trained and tested scholars (S_2). Via a rigorous program of education and initiation (consisting mainly of close and systematic reading of the authoritative corpus, up to the point of incorporating it and learning it by head), the subject becomes a qualified expert, a custodian of an intellectual legacy, addressed by the Master, who thereby stabilises the subject pole: S_1 (authoritative source) $\rightarrow$ S_2 (qualified recipient). This structure (the discourse of the Master) is a global model, which can be encountered in various cultures, consistently involving Masters (Confucius, Laozi, Buddha, Pythagoras, etc.) and their disciples.

The scientific revolution and the emancipation of the subject

During the early modern period, however, Western science deviated from this model, when practitioners such as Descartes, Galileo and Newton initiated the modern scientific revolution, i.e. the emancipation of the expert (S_2). Modern scientists are driven by the resolve not to rely on the authority of others. Their aim is to be independent on a Master, to examine everything for themselves, to follow and explore their own convictions, to produce their own knowledge, and to accept only their own products and outcomes as valid and convincing (cf. Hegel 1807/1977, p. 50). Rather than on a Master, the scientist now relies on the *scientific method* and on the *technicity* of technoscience to produce reliable knowledge. S_2 replaces (dethrones) the Master (S_1) as the initiator of the knowledge process (S_2/S_1). S_2 no longer functions as recipient, but from now on plays a more active role, addressing and taming the object (*a*) via contrivances and precision instruments.

In order to study light, for instance, Isaac Newton, rather than reading *Genesis* or Aristotle, withdrew into a shed, a dark room, a *camera obscura*. Here, he made a little hole in the wall, an artificial orifice, a pupil so to speak, to allow a minimum of light (a small beam of sunlight) to enter the darkness, small enough to be manageable: easily modifiable with the help of a prism. "How do you hold a moonbeam in your hand?", as *The Sound of Music* phrases it, but Newton already solved this problem. He created an artificial eye, with a pupil (the hole), a lens (the prism) and a retina (for the prism forced the beam to diffract into a spectrum, projected against a screen). The prism allowed him to study the anatomy of seeing and the diffractive properties of light. He himself acted as the "little man", the *homunculus* inside his self-made model of an eye: to see and study how seeing works, *how* we see *what* we see, in an experimental fashion. Via his little hole, Newton seemed able to control something which seemed extremely elusive, namely light: he suddenly seemed able to control and study the "object *a*" of early modern optics. Real "wild" light is an overwhelming experience (Being as such), but the hole in the wall allowed Newton to process small samples of light. The autonomy of the subject relied on technology (the camera obscura, the prism, etc.), in other words: on *active* observation, on experimentation. Perception was preceded by a series of *acts*, by menial interventions.

Galileo employed a similar device: his telescope, as discussed in *Chapter I*, likewise consisting of a *camera obscura*, a hole (pupil), a lens, etc. in order to bring the Moon's surface closer into view. An artificial contrivance replaces and amplifies the naked eye as organ of knowledge. Rather than contemplating the cosmos as a whole, moreover, a hole is created to capture the elusive object *a*, the beam of light that is broken, deflected and projected onto a screen. Via a contrivance (via technicity), science stabilises (domesticates) the elusive object *a*. Thus, the matheme of desire gives way to an apparently much more stable situation: the interaction between experts (S_2) and their domesticated objects. But this is only part of the story, and a Lacanian philosophy of technoscience aims to reveal that on closer inspection things are much more complicated. First of all, the autonomous subject is far from disinterested. The subject of science is still guided by a worldview (S_1), a basic conviction, albeit unconsciously. In the lower-left position, below the bar, at the reverse side of the Moebius-ring, this worldview continues to hold sway:

S_2	*a*
S_1	

Newton produces modern scientific insights about light and gravitation, captured with the help of mathematical formula, but at the reverse side of scientific discourse, ideas about alchemy and Bible exegesis continue to unfold. This is why science eventually aims to marginalise or even eliminate the subject, because

subjects (S_2) will always retain (consciously or unconsciously) a connection with a guiding truth (S_1).

At the object side, the object is far from tamed. Before long, anomalies will accumulate, as the recalcitrant object refuses to live up to the researcher's expectations. As a result, the researcher becomes a tormented subject, perhaps even a victim of science, a potential fraud (*$* as by-product). Thus emerge the "four discourses", entailing four positions:

Agent	Other
(disavowed) Truth	(unintended) By-product

In the case of the Master's discourse described above, this scheme results in the following constellation. The Master, the primary subject (S_1), acts as agent, initiating the discursive process. Doubts and frustration on the part of the Master are disavowed (*$* pushed into the lower-left position). By becoming a recipient (disciple), subjects constitute themselves as scholars: experts of the Master's legacy or oeuvre (S_2). Knowledge concerning enigmatic objects is produced via strenuous reading and rereading of the Master's body of writing (as by-product of a library mode of knowledge production):

S_1	S_2
$	*a*

The scientific revolution entails an anti-clockwise quarter-turn to the left: the emancipation of the former servant or disciple. This results in *university discourse* (the normal discourse of modern science), a discursive formation which can be represented as follows:

S_2	*a*
S_1	*$*

The experimental expert (S_2) is now the agent, taking the initiative, initiating the process, relying on technical dexterity, designing and conducting an experiment directed at addressing, questioning and capturing the object *a* (in the position of *Other*). The authority of the Master is rejected (pushed beneath the bar), but the disavowed truth of this type of discourse is the new worldview (of rationality and Enlightenment) that functions as a source of inspiration, replacing the traditional teachings of the Master and providing guidance (S_1), by framing knowledge in a certain manner. And the *by-product* is the frustrated, divided, tormented subject, who falls victim to and becomes trapped in his obsession. The experiment falters, anomalies accumulate, the paradigm refuses to function and a crisis (for instance: a replication crisis) emerges (*$*).

Subjects ("heroes") inevitably play an important role during the primal scene of a paradigm when, in the context of discovery, inhibitions are suddenly lifted and a breakthrough is experienced: a dawn of day. Eventually, however, as science evolves into normal science, the subjectivity and individuality of the scientific subject may easily become a burden, a source of error. Via training and education, the subject becomes increasingly reliable, predictable and replaceable, anonymous even, but the subjectivity of the subject is never eliminated completely. Receptivity is outsourced to precision devices, which function like "organs without a subject", and something similar applies to mathematical equations, which function as a discourse without a subject: symbolism without a body. Natural senses are replaced by contrivances, brains by computers, menial skills and *Fingerspitzengefühl* by robotics. The human subject (allegedly disinterested) is driven by a desire for control, but also hampered by inhibitions (intimidated for instance by the sublime perfection of the object), and therefore always a source of risk. Psychoanalysis aims to bring these hidden drives and obstacles to the fore.

The domestication of the object

Besides the subject pole, a Lacanian psychoanalysis of technoscience also gives due attention to the object pole of the knowledge relationship: the enigmatic "object *a*" (the object-cause of desire).

The object position may be elucidated with the help of an example, one of the most familiar items of contemporary technoscience, something which can be encountered in every laboratory around the globe: the test tube, seemingly self-evident, but on closer inspection this apparently unquestionable item (produced by mass production) proves a rather remarkable thing, the technoscientific version of a Heideggerian "thing". In an essay entitled *The Thing* (1951/1954), Heidegger likewise questions an allegedly simple object, namely a jug or jar (p. 164). The test tube is the technoscientific version of such a jar or vessel, something which is designed to hold something else within it, albeit consisting of glass instead of earth. It contains emptiness, and this void is indeed what it contains. Empty space (nothing) is what the tube essentially is. It is a kind of hollow, a transparent glass structure, a perfect geometrical shape, an artificial hole, a glass surface, enveloping and creating empty space, containing void. For although scientifically speaking it contains air, it symbolises (in a negative manner: as absence) the entity which the scientist desires to see, but which is not yet there, the object *a*: something which may suddenly fill the tube, like a "gift", something toxic probably. Sooner or later, this something may be poured over into another vessel, shared with others, mixed with something else. This (the advent of the object *a*) may require years of taxing laboratory work, if it is ever brought about at all. Perhaps the scientist already has a technical name for it, so that it exists symbolically, as a chemical formula, or as something which is provisionally referred to as "factor X", the missing, unknown cause, – something

which exists only as a signifier. Many years may be spent (or wasted) on producing this inexorable item, it may frustrate a whole career.

The thing which finally comes to fill the tube is likely to be something contentious, a thing which calls for a "Thing", in the original sense of the term: a gathering, a deliberation, a dispute, a critical assessment, a review: will this thing, this something (this novelty) pass the test? The test tube is "in waiting", standing out towards (and designed to become the recipient of) this enigmatic and highly valuable something, which is not there yet (*nondum*, not yet) and whose ontological status seems highly uncertain, something on the boundary between living and non-living, between natural and artificial. The tube refers to something which one day may come to occupy (and thereby *negate*) this emptiness, as the enigmatic object of desire (*the negation of the negation*). To this enigmatic something, everything else (other career options, but also things like leisure, health, worldly pleasures etc.) is sacrificed. As Nietzsche already argued (*Genealogy of Morals* III, §23, §25), science is an *ascetic* practice, sacrificing more immediate opportunities for satisfying needs to the uncertain prospect of a future gratification (a mechanism which in psychoanalysis is known as *sublimation*).

Interestingly, from a Lacanian perspective, congruence can be discerned between the gaze of science (the desire to know, the *cupido sciendi*) and perversity: the gaze of the voyeur, peering through the keyhole. The gaze of the fetishist is obsessed by a specific item (high heels, leather boots: substitutes for the object of desire, the female phallus as the object *a*). This may explain the predilection of so many scientific researchers for certain types of objects (*la prééminence de certaines formes comme objets de sa recherche*, Lacan 1964/1973, p. 204), such as saliva (Pavlov), urine, faeces (microbiome research) and so on. We already discussed Galileo's aim to bring the Moon's naked surface closer into view, with the help of a phallic instrument (a telescope, something which can be elongated). Something similar applies to Van Leeuwenhoek, who used his microscope first of all to observe his spermatozoa: the object *a* of the microscopic gaze.

The technicity of modern science extends and amplifies the sensitivity of natural sense organs in order to retrieve the object *a*. Recently, with the help of microscopes, for instance, scientists have discovered female insects equipped with a penis-like organ, a *gynosome*, besides organs for grasping and holding reluctant males, coercively gripping their sternum, so as to procure gametes from their sperm storage organ (Zwart 2017b). There is a hinge of eroticism involved in bringing together spermatozoa and egg cells in a petri dish, or even in disclosing someone's skeleton via an X-ray picture. Sadism can be discerned in many animal experiments: from producing cancerous growths in naked mice up to Schrödinger's cat (whose existence can be annihilated any moment). The pervert's phantasies have experimental quality and often involve a kind of test.

Reforming the subject

At the subject pole, psychoanalysis replaces the disinterested ego of traditional epistemology by a speaking, divided subject, obsessed by an allusive object of desire, as reflected by the formula *$* ◊ *a*, the psychoanalytic version of the correspondence (*adequatio*), or rather: the lack of it, between thinking and being. The object *a* is an effect of symbolisation (of thinking) and refers to something which should be there (according to the cognitive grid), but for some inexplicable reason cannot be found: absence in vitro.

Modern science moves away from S_1 (the argument from authority), but also from *$* (the divided, malcontent subject), replacing these modes of subjectivity with S_2: the subject of science, supported by the methodology and technicity of technoscience. The shift towards S_2 (the *reformation* of the subject) is realised through training and discipline, through the acquisition of technical and methodical skills, resulting in a replaceable subject whose experiences are predictable and replicable. The purpose of an experiment is to make seemingly unique events repeatable. The laboratory setting enables a *passage à l'acte*, allowing reformed subjects (S_2) to effectively intervene in nature and to install themselves as subjects in experimental practices. Instead of addressing Being as a whole, science focusses on partial objects, preferably something like a hole or a black spot, providing a window into the enigmatic thing as such. Researchers may focus on the spine of a decapitated frog, allowing them to disclose its body as a circuit of reflexes. The messy complexity of the frog's real inner body is obfuscated, and the organism is reduced to something which can be represented symbolically, like a graph or cybernetic scheme. Initially, confronted with the object of research, there is a sense of incompetence (-φ), but the technicity of science develops the instrument or organon (φ) which provides access to the object *a*, by creating a window into otherness ("Le *Réel* n'apparaît donc que par un artifice", Lacan 1977-1978, p. 18). While Newton studied a beam of light, in twentieth-century physics the holes became so extremely small that they allow single particles (one photon or electron at a time) to pass. Newton was the homunculus who entered the eye to analyse the anatomy of the enigmatic gaze, as we have seen. Aristotle had written about perception, and his views constituted an authoritative source for many centuries (S_1), but what is absent in his treatises is the key contrivance of modern optics: fingering with the *camera obscura*.

In *Chapter VII* we will discuss the work of Ivan Pavlov who created a fistula (a hole or window) into the gorge and stomach of a dog to collect bodily secretions (saliva and gastric juice) to study the organism's physiology. A small sample of bodily fluid is analysed symptomatically, looking for key indicators of functionality and dysfunctionality. The hole in the wall (Newton), the fistula (Pavlov), the lens of the telescope (Galileo), all these openings function as keyholes allowing researchers to peer into something which is otherwise inaccessible. In Pavlov's case, the object of research mimics the *oral* object *a* (a particular liquid or substance), accessible via an artificial orifice, created with the

help of a cut or slit: an additional erogenous outlet besides the natural ones (mouth, nipple, penis, anus: Lacan 1966, p. 817).

Other branches of research may focus on the *anal* object *a* (e.g. scientists studying faeces, using high precision instruments to analyse its composition to detect telling symptoms concerning the body's inner metabolism), or the *acoustic* object *a* (such as a bell, i.e. a hole with a clapper, also used in Pavlov's experiments). Science entails a drastic simplification of the real thing, using the isolated spine of a frog to study a particular reflex arc. What is disavowed / repressed, however, namely the organism as a whole, "returns in the real", as Lacan phrases it, namely when the laboratory finding (the discovery made *in vitro*) is extrapolated into the real, is tried in a real, living organism or ecosystem (*in vivo*), where the causal connection probably fails to function because of the recalcitrance and complexities of *real* bodies and *real* nature, resulting in experimental malcontent (*$*). Science is an interminable stream of letters, symbols, numbers and graphs, but what is disavowed (the messy complexity and entanglement of things) returns in the Real, for instance in the form of pollution.

The dialectics of experimental research

As explained, the knowledge relationship involves a *subject* pole (the experimental expert, guided by a conceptual framework and relying on a method of investigation, connected with a terminological grid) and an *object* pole (the enigmatic laboratory object, contained in a test tube or petri dish, on which the intentionality of the researcher is focussed). The knowledge production process is a dialectical interaction between subject pole and object pole. The conceptions and technologies of the scientific subject determine how the object is allowed to appear, what types of questions can be asked and what type of answers can be experimentally procured.

Mainstream philosophy of science endorses the normative ideal of a disinterested, anonymous, objective researcher, quietly manipulating and investigating (with the help of laboratory equipment) an allegedly neutralised object (a model organism for instance), fully adapted to laboratory circumstances, completely under the researcher's control. The vocation of the disinterested scientific subject is to produce objective, reproducible knowledge concerning this object. Ideally, the scientific subject is anonymous (a subject *ohne Eigenschaften*) and fully replaceable, and the same applies to the object pole of the relationship. The model organism (a naked laboratory mouse for instance) should be completely standardised and fully replaceable. One of the characteristic developments of twentieth-century science is the production of standardised objects, such as the naked mouse or the Wistar rat, organisms whose characteristics are extensively documented and who function as living test tubes as it were, as laboratory tools.

The aim of a psychoanalytical perspective is to reveal that this definition of the research situation is obfuscating. First of all, if the object would really be

as predictable as suggested, why would researchers spend so much time and effort on trying to understand and control it? The object may not live up to the researcher's expectations at all, may become a source of frustration, something impossible to deal with, something toxic and elusive. The allegedly neutral object may become the inexorable "object *a*": the impossible, recalcitrant and enigmatic object of desire, challenging the scientific will to know (the *cupido sciendi*), so that the subject-object relationship of traditional epistemology becomes trapped in the matheme of desire, involving a subject driven by desire (*$*), obsessed by a recalcitrant object (*a*), while the lozenge (◊) refers to the technoscientific contrivance, the research gadget, allowing researchers to zoom in and out: *$ ◊ a*.

An important and paradoxical characteristic of the object *a* (the object of scientific desire) is that, strictly speaking, it tends to be absent, or highly artificial. On the basis of certain theoretical expectations, it should be there, as a dark spot on the screen, or as a significant difference, but in actual practice it may prove difficult to discern or replicate. Science desires to move beyond what is actually visible, but in the course of the symbolisation process, a gap or parallax may emerge between scientific objectivity (the object as it appears on a computer screen, for instance) and the real thing out there. Quite often, the latter can only be encountered indirectly, via a surrogate, an ersatz object. In other words, the research object, visible in vitro as the focus of the researcher's intentionality, may actually be a replacement: something which is related to, but not fully identical with the scientific object of desire. Researchers may try to close in on the forbidding object, and to approach it as closely as possible, and yet, because of the connection with the missing object, there is something uncanny even about this (apparently familiar, normalised and domesticated) substitute as well.

Gaston Bachelard likewise drew attention to the dialectics of the knowledge production process, as we have seen. The object under study is actually a laboratory artefact, something that is produced or *fabricated* (in the non-pejorative sense of the term) by scientific technicity, under laboratory conditions, where epistemic obstacles are effectively counteracted with the help of methodological interventions. The scientific subject (armed with precision equipment) has a hand in the objectivity thus produced. The nature that is studied in laboratories is a technologically simplified or amplified version of the Real. As soon as knowledge is extrapolated into the outside world (from *in vitro* to *in vivo*), researchers are bound to experience the Real's recalcitrance: the impenetrable, that which resists the progress of verification and replication. Something else seems to be at work there, an unknown factor X, which refuses to light up and cannot be brought to the fore. How to translate or extrapolate the knowledge acquired under laboratory circumstances (*in vitro*) into the complex messy environment of the outside world?

Something similar is at work at the subject pole. The subject-object relationship of classical epistemology suggests that research is conducted in a socio-cultural vacuum. The socio-cultural, normative and ideological ambiance of research (the "context of discovery") easily becomes obfuscated in mainstream

philosophy of science. Although this ambiance may not be immediately visible (to the extent that we tend to focus on the researchers as experts, labouring with their equipment and their objects), it is nonetheless decidedly there. For instance, in the form on an implicit worldview that is either challenged or reinforced by research, or in the form of an implicit normative credo (producing scientific knowledge is a necessary and socially relevant thing to do). There may be preliminary convictions at work which are not explicitly addressed or put to the test, but which are nonetheless there, guiding the research. A brain researcher, for instance, may desire to prove that we *are* our brain; a genomics researcher may desire to prove that we *are* our genome; a microbiome researcher may desire to prove that we *are* our gut microbiota. Other decisive factors (such as environmental ones) may become (temporarily at least) eclipsed, fading into the background. Social scientists may desire to prove that we *are* our socio-cultural environment (rather than our genomes or brains). In other words, to every experimental practice, to every knowledge-production setting, there is something which is guiding the research. Established mainstream discourse often seems unwilling or unable to explicitly acknowledge and address this. Implicitly or explicitly, a number of preconceptions are guiding the experiments, perhaps even up to the point of hampering, frustrating and poisoning the experimental work. Indeed, a preconception may easily become an epistemic bias: the πρῶτον ψεῦδος of the research line, that which made the research program possible (by providing focus), but eventually becomes a cause of frustration and derailment, giving rise to anomalies, confirmation biases, replication crises, fraudulent interventions (data massage) and other traumatic experiences.

The vicissitudes of university discourse

Lacan (1969-1970/1991) developed a schema that purports to capture this dialectic in a concise manner: his theorem of the four discourses already outlined above. Basic convictions (epistemic imperatives, ideological truths) are guiding the research (S_1). Without being aware of it, researchers, instead of conducting research in an "objective" and "disinterested" manner, may actually be carrying out an ideological research program. In psychology, for instance, behaviorism is more than a research methodology. It entails a philosophical anthropology as well, as is confirmed by B.F. Skinner's novel *Walden Two*, written by an experimental psychologist of the behaviorist school and discussed in *Chapter VIII*. Researchers may aspire to verify or undermine a (religious or anti-religious) worldview. For critics and apostates, the paradigm's basic truth may constitute its πρῶτον ψεῦδος, functioning as a source of error. A phenomenologist, for instance, may use Skinner's novel to demonstrate why behaviorism is fundamentally wrong. The fact that Skinner decided to write a novel to elaborate his views is telling in itself. He created a *different scene* where the broader future implications of behaviorism could be systematically explored: the utopian dimension of laboratory labour, the laboratory as a window into the promised

land of behaviorism. In normal science, the basic imperative (the ideological truth) tends to be obfuscated, placed beneath the bar, but the knowledge producing subject, the experimental expert (S_2) is spurred into action by a voice from below: S_2 / S_1.

This is the core structure of the subject pole of the knowledge relationship. The scheme must be complemented by the object dimension, however. Rather than being a neutral object, completely under the researcher's control, the object may become a source of frustration, an obsession, something toxic, draining the researchers' energy and ruining their lives, something which systematically fails to live up to expectations. Such frustrating experiences may give rise to doubt and despair. The researcher becomes a "divided", desperate subject once again (*$*), situated in the force field between S_1 (the imperative to produce more knowledge) and the elusive, recalcitrant object *a*. This results in the following scheme, representing the vicissitudes of university discourse:

S_2 (scientific *knowledge*)	*a* (the recalcitrant *object*)
S_1 (hidden imperatives, the obfuscated *truth*)	*$* (epistemic despair as *by-product*)

Notwithstanding the patience and endurance of the dedicated researcher (S_2 in the upper-left position), the insatiable quest for knowledge may never be rewarded at all.

Still, more optimistic scenarios are possible as well. It may happen, for instance, that researchers, while struggling with their object of research, unexpectedly stumble across something they were *not* looking for. This happened in the case of Ivan Pavlov, for instance, when quite accidentally, in the context of a tenacious research program concerning metabolism in dogs, he made his most famous discovery: the conditioned reflex, the commencement, the elementary building-block, one could argue, of twentieth-century psychology, the decisive stepping-stone towards behaviorism. Or, to take a literary example, something similar happened in the case of Martin Arrowsmith who, in the context of microbiology research, accidentally discovered the bacteriophage (Zwart 2017c). As Paul-Laurent Assoun (1997/2007) convincingly argues, eureka ("I have found it") can often be reversed: "it" (the object) has finally found me, its discoverer.[16] Research means *re*-search, "look again", notably at that which was initially discarded: the refuse. A dog's saliva produced in response to the sound of a bell may provide an unexpected technoscientific window into psychic existence.

Rather than leading towards utopia, science tends to disturb and disrupt the world as we know it. The beautiful cosmos of yesteryears was gradually replaced by a disenchanted universe of quarks and molecules, while the human world became a technical ambiance populated by and under the sway of

[16] "Eurêka: l'objet m'a trouvé !" (Assoun 1997/2007)

contrivances, gadget and machines. The subject may feel alienated from such a world, resulting in the technoscientific version of discontent in civilisation (*$* as by-product). Or the subject may decide to become involved in this process, joining the ranks of technoscience, resulting in a reformation (*$* → S_2), contributing to science as a joint effort, a communal endeavour, a rectification, not only of the object, but of the subject as well.[17]

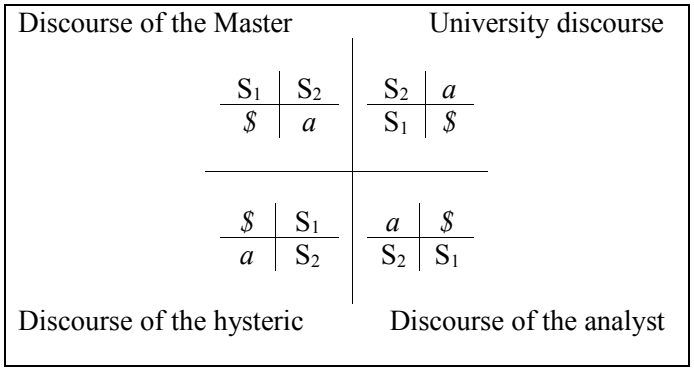
Symbolisation of the real: the four discourses

Before the eruption of the scientific revolution, human inquiry relied on authoritative texts such as *Genesis* to explore and come to terms with nature. An intriguing example of a text-based practice of empirical inquiry was alchemy. Alchemistic research practices were guided by the discourse of the Other, by texts bequeathed by Masters, such as Aristotle, or even the priests of ancient Egypt, the *Sacerdotes Aygyptiorum* (Jung 1968, p. 276). The voice of the Other may also be an inner voice, like Socrates' δαιμόνιον. Lacan refers to the authoritative source as S_1 (the Master signifier). The Master (S_1) is the agent who initiates the knowledge process by calling (addressing, assembling) adepts or disciples as recipients of the message (S_2). The type of discourse resulting from this situation is the discourse of the Master, the structure of which can be specified with the help of the quadruped scheme in which four variables can be inserted (S_1, S_2, *$* and *a*: Lacan 1969-1970/1991):

Agent	Other (recipient)
(suppressed) Truth	By-product

This results in four types of discourse (four discursive formations): the discourse of the Master, the university, the hysteric and the analyst:

[17] A paradoxical form of discontent concerns the subject who seems lost in technological civilisation (Lacan 1966, p. 281), the contemporary version of Hegel's *schöne Seele*, unable to recognise the extent to which we are actually involved in the state of affairs we deplore so much. A way out may offer itself through conscious engagement with the workings of technoscience, for instance by reading techno-thrillers, participating in conferences or group therapy (p. 282).



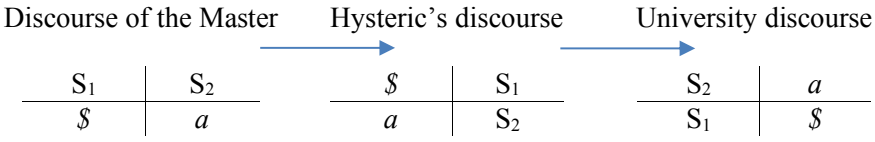
The Master's discourse entails the following constellation, already briefly discussed above:

S_1	S_2
$\$$	a

A trusted source (S_1 in the upper-left position) forms the point of departure. Doubt and uncertainty ($\$$) are disavowed (pushed into the lower-left position, beneath the bar). As real persons, Masters must have experienced doubts and existential crises, but these all-too-human aspects are repressed in hagiographic texts produced by epigones and adepts (S_2). Numerous paradoxes and obscurities may nonetheless be discerned in the Master's oeuvre, and these become the focus of devotional attention by adepts who voluntarily commit themselves to a life of toil and labour, an interminable exercise of interpretation and justification, although intellectual jouissance will be involved in this type of intellectual labour as well (a as by-product), for instance when an obscure section is suddenly elucidated by an unexpected finding.

Young Martin Luther was a tormented soul, a genuine hysteric ($\$$), who entered a monastery to become a Bible expert (S_2). He was intimidated by the Master signifier, however, notably the phrase *iustitia Dei*, which seemed to suggest divine punishment as a terrible and inescapable threat (Zwart 1996; 1999). He was terrified to such an extent that he was unable to constitute himself as a recipient and custodian of knowledge (S_2), until he experienced his truth event in the form of the so-called Tower Experience. Dwelling in the monastery's latrine, there was a sudden experience of release and relief, so that the discourse of the Master (which had left no room for doubt) suddenly collapsed, and the object a (embodied by the expulsion of his excrements) was produced as a moment of jouissance (a). His inhibitions were suddenly lifted, resulting in anal or urinal release (a) as by-product. While struggling with the terrifying words *Justitia Dei*, it suddenly dawned on him that a drastic reinterpretation was possible: an insight which transformed a neurotic, inhibited monk into a prolific and highly effective author overnight (Zwart 1996; 1999), proclaiming a new truth, initiating a new type of university discourse.

The object *a* of the discourse of the Master is connected with text production (the "anal" object *a*) and the terrifying phrase *Iustitia Dei* was blocking the system and seemed impossible to digest, until Luther suddenly understood that he would be *rectified* rather than punished. His moment of revelation caused a clock-wise quarter-turn to the right, into a different type of discourse: the *discourse of the hysteric*, Luther's coming out as a voice of protest, confronting the authorities and producing a lot of turmoil, but also initiating a new practice of Bible reading as by-product (S_2), which eventually established itself as a new form of expertise, a new regime of teaching and university discourse (exemplified by scholars such as Melanchthon). Thus, in Luther's case, we see thee discourses successively at work: (a) the Master's discourse (the tormented Catholic monk, working hard to become a qualified custodian of the truth); (b) his hysterical episode (the voice of protest challenging the establishment); (c) Luther as the initiator of a "reformed" paradigm of university discourse: theology as reformed expertise:

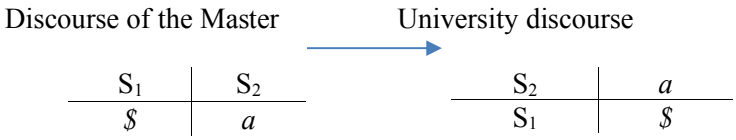


David Hume opted for a different strategy to distance himself from the discourse of the Master. He concludes his *Enquiry Concerning Human Understanding* (1748/2012) with the following quote: "If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, does it contain any abstract reasoning concerning quantity or number? No. Does it contain any experimental reasoning concerning matter of fact and existence? No. Commit it then to the flames: for it can contain nothing but sophistry and illusion." A whole library is critically assessed, volume by volume: does it contain empirical research or mathematics? If the answer is no, consider it as so much waste, ready to be eliminated. The whole library of metaphysics is suddenly considered a waste product, and Enlightenment is basically a cleansing operation. The burning library is an archetypal scene (the archetype of the humanities), a cataclysm, but also a liberation. It is precisely here, in this mass of waste, this heap of letters or discursive litter, that the Master signifier can be found. Setting libraries to fire is a desperate, violent effort to emancipate.

In modern science, this emancipation (this shift from the discourse of the Master to university discourse) is thematised as the scientific revolution. Its spirit is captured by two paintings by Joseph Wright of Derby, the first of which is entitled *The Alchemist Discovering Phosphorus* (1771). That the alchemist is an old man is quite significant. After a life of intense reading and numerous abortive experiments, it suddenly works: a flash of intellectual jouissance, and the alchemist is even willing to accept that the exposure blinds him (all other worldly satisfactions are reduced to insignificance by this truth event). The authoritative

discourse of the Other (S_1) is finally realised in vitro. Compare this to the second painting entitled *Experiment on a Bird in the Air Pump* (1768). Here, the authoritative source has disappeared and an autonomous scientist has taken the floor (S_2), apparently fully in control of the situation, equipped with an effective contrivance, which allows him to manipulate the air inside the pump. If the oxygen is replaced by (suffocating) nitrogen, or if a vacuum is created, the research animal (a bird) will die. The target of research, however, its "object *a*", is not the visible bird as such. The object (*a*) is an enigmatic, invisible, volatile substance called oxygen, only noticeable indirectly, in a negative manner, by its suffocating absence.

For Lacan, the scientific revolution (the advent of modern science) entails an anti-clockwise turn to the left of the quadruped scheme:



The authoritative Master (the discourse of the Other) is dethroned (pushed beneath the bar), so that the enigmatic, elusive and toxic object (phosphor or oxygen, for instance) can be addressed and questioned with the help of the technological repertoire, accumulated during centuries of servile research, driven by the quest for truth. The experimenter now seems fully in control and completely insensitive to the fate of the bird, while the authoritative voice of the Master no longer interferes. Science has finally emancipated, so it seems.

This interpretation of the situation is a deceptive simplification, however. From below the bar, guiding views and imperatives (S_1) continue to address (autonomous and enlightened) scientists who continue to be inspired (or pestered) by worldviews, albeit in a more subliminal manner. According to Bachelard, psychoanalysis encourages researchers to immunise themselves against the deceptive worldviews of the past, while strengthening the researcher's control over the object (via technification), but the challenge remains in place (self-reformation as an interminable process). Moreover, as discussed earlier, the object may turn out to be a recalcitrant, elusive target, so that research gives rise to frustrations, or even epistemic despair (*$* as unintended by-product). As Lacan points out, however, discontent (*$*) may also emerge among students, enrolled into the university system not only as consumers of knowledge, but as an auxiliary labour force, conducting experiments in the context of internships: the slaves of the system, while the surplus value (the object *a*, the significant experimental outcome, i.e. publishable and citable results, boosting citation indexes and other performance indicators) is appropriated by the expert (Lacan 1969-1970/1991):

S_2 (modern science)	*a* (the recalcitrant object)
S_1 (the repressed but alluring worldviews of the dethroned Master)	*$* (epistemic despair and systemic discontent)

Kekulé represents modern scientific knowledge (S_2 as agent), but the structure of benzene (*a*, upper-right position) continues to elude him. The scientific approach, building on the tetravalent carbon model, fails to work, the object refuses to live up to expectations. During a moment of reverie, censorship is temporarily suspended, the bar between S_2 and S_1 becomes more fluid and we witness a sudden resurgence or influx of a time-old idea, to which Kekulé suddenly proves susceptible: a basic structure conveying how everything hangs together (S_1). There is a relapse into Master's discourse, as Kekulé suddenly finds himself in the position of the recipient, while the unexpected by-product is a brief moment of jouissance (*a*) as he discerns the ring-shaped structure:

S_1	S_2
$	*a*

The discourse of the Master conveys a metaphysical worldview (S_1), projecting an archetypal idea on a cosmic scale (e.g. conceiving the world as a chemical marriage between *anima* and *animus*). Modern science emancipates itself, not only from the authority of the Master, but also from the susceptibility to the imaginary. This is achieved via technicity and practice, via measurements and quantification, so that images and metaphysic concepts give way to the symbolisation of the Real with the help of mathematical symbols and chemical formula. Thus, before long, after this epistemic intermezzo, university discourse re-establishes itself, and the Ouroboros archetype is reduced to (and incorporated as) a stereochemical structure which allows him to domesticate the object *a*, similar to how in Wright of Derby's painting, equations allow the researcher to predict whether the research animal will suffocate or survive. While the alchemist is under the sway of the imaginary, the experimental researcher of modern science contributes to the symbolisation or quantification of the Real. Oxygen becomes a scientific symbol (O_2), a substance whose presence or absence can be determined in an experimental fashion. In Wright of Derby's second painting, everything seems under control, the contrivance is functioning properly, everything goes as planned. Yet, as Lacan's quadruped indicates, imaginary components (retained beneath the bar, at the reverse side) can still be activated. Underneath the engineer, the alchemist still lurks.

Wright of Derby's second painting concurs with the *exposition* stage, the first part of the narrative curve, when protagonists and equipment are introduced. At a certain point, however, something goes wrong or runs astray. In *2001: A Space Odyssey*, the spacecraft's computer (HAL) suddenly starts to misbehave. The contrivance becomes dysfunctional, a crisis emerges. The problem may also be caused by qualified experts themselves (S_2) who are operating their machines,

misusing them for their own benefits, or when the experiment refuses to produce the expected results. Instead of acting as reliable experts (S_2), scientists relapse into the position of the divided subject (*$*, lower-right position), tormented by incompatible expectations and demands.

Responses to technoscientific crises may involve multiple scenarios, including the "discourse of the hysteric", where the tormented subject emphatically takes the floor as agent (*$*, upper-left position), raising a voice of protest against the system and those in command (S_1, upper-right position). What provokes the hysteric is an imaginary component: the gestalt of the Master, the powerful Other, serving as a screen onto which suspicions are projected (cf. political cartoons). According to Lacan, however, hysterics do not really know what they want or what is driving them. They challenge the ersatz Master, but what they really want is a genuine Master to guide them, enabling a relapse into the Master's discourse. In the late 1960s, discontent in university discourse converted students into Maoists, followers of Mao Zedong (as an imaginary Master), but what exactly was spurring them on (what was their objective, their object *a*)? As an unintended by-product, the former hysterics would later adopt the role of managerial experts to optimise the system, so that former protesters became technocrats: S_2 as by-product of the hysteric's discourse (lower-right position), replacing the ancient regime of Masters with a more efficient, but also more taxing technocratic power game:

$	S_1
a	S_2

Regardless of whether S_1, S_2 or *$* takes the floor, however, something seems to be missed in these types of discourse, whether it is the disavowed uncertainty of the Master (*$*), the implicit metaphysics of the scientist (S_1) or the hysteric's unknown object of desire (*a*). In science novels, these discourses are mutually exposed to one another, resulting in a multi-vocal, heteroglossic ambiance. Rather than identifying themselves with one of the positions portrayed, novelists give to floor to multiple voices, to Masters (S_1), hysterics (*$*), laboratory researchers and technocrats (S_2) and the question is what is driving them, what do they really want? What are their anxieties and desires? In other words, the focus of attention shifts to the agency of the object *a*, spurring desiring subjects into action. Ideally, novelists develop a type of discourse which aligns with the discourse of the analyst:

a	*$*
S_2	S_1

The object of desire (*a*), in the position of the agent, assumes a semblance of agency, challenging tormented subjects. In order to understand the dialectical liaison between *a* and *$*, scientific expertise must be suspended (pushed into the

lower-left position). A novel is not a psychopathological report, although psychiatric or clinical expertise (S_2) may be part of the mixture of voices and perspectives, in novels involving such experts, whose integrity is under pressure and whose credibility is threatened. After the climax, during catharsis (or denouement), a normative insight is gained (the morale of the story) as by-product (S_1). Amplification of this message would turn the novel into mere propaganda, in service of a worldview, so that the art-work miscarries. The novel ideally brings the full dialectical spectrum into view. Various positions and options are played out against each other, which explains why case histories read like novels and vice versa, focussing attention on the object *a*.

In the discourse of the Master, as we have seen, the object *a* is connected with text production: with textual sediments and textual waste, with letters as so much litter: the *anal* object *a*. In university discourse, the object *a* is an *optical* object. We notice this in Galileo's sunspots, for instance: the object *a* as an enigmatic stain. Such spots and stains continue to show up in modern physics. Building on Newton's spectrographic work, for instance, the German physicist Joseph von Fraunhofer (1787–1826) discovered dark lines (absorption lines) in colour spectra emitted by stars. With the help of these dark lines (representing absence: gaps) the chemical composition of stars could be determined. But we may also think of cancer as a disturbing dark spot on an MRI scan. The word *discovery* already emphasises the visual component: something is spotted, uncovered, and the discoverer is the first person who spots this novum, never seen before. Journals are a product of the scientific revolution, emerging in the seventeenth century as academic outlets for experimental research, but their primary function was to put an end to issues of priority. Via a journal publication, the discovery, the significant result could be unequivocally attributed to a particular author, rendering it acknowledgeable and citable. To publish means to make publicly available, but authors are compensated for their benevolence: the citation score as the ultimate object *a*, making their contributions traceable. In the end, *h*-scores (on display on computer screens) become more important than use-value.

The discourse of the hysteric revolves around the *oral* object *a*: a particular liquid or substance as object of desire, which allegedly satisfies our desires, but actually may prove a poisoned, toxic gift or a placebo.

Finally, the discourse of the analyst revolves around the *vocal* object *a*: a particular word, association or Fehlleistung, exposing the subject's disavowed desire.[18] Psychoanalysis focusses on the vicissitudes (the birth, obliteration and resurgence) of symptomatic signifiers (Parker 2005; Calum 2013)

These four types of discourse have their typical forms of output. The discourse of the Master results in a thesis devoted to an oeuvre, a material product

[18] I once had a conversation with a philosopher from Paris, travelling to Nijmegen via Breda. Passing through Breda, he vaguely remembered a connection with Husserl. Had Husserl been there? No, but the Husserl archive had been set up by Father van Breda.

(*a*) bound to become superfluous waste. University discourse produces citable signifiers in peer-reviewed academic journals (the citation index as the ultimate object *a*). In the hysteric's discourse, a pamphlet or manifesto (written by a "beautiful soul") emphatically confronts the establishment, but the anger is misdirected (for hysterics typically do not really know what they want). Finally, the discourse of the analyst results in a case history, revolving around the object of desire (*a*), given away in a moment of confession.

Although Lacan introduced the four discourses in Seminar XVII (1969-1970/1991), important components were already present in the final essay of *Écrits* entitled *Science and Truth*, tracing the vicissitudes of the "subject of science", starting with the advent of the Cartesian cogito as the paragon of emancipated knowledge (S_2). Modern science, Lacan argues, constitutes an epistemic "mutation", resulting in a change of style, a dramatic increase of pace: a chain reaction in the knowledge production system,[19] resulting from a decisive "modification" in the position of the subject, whose emancipation inevitably entails a split (or separation) between knowledge (S_2) and truth (S_1). This separation (represented by the bar) is a necessary condition, constitutive of modern science. The refusal to act as a custodian of the discourse of the Master implies a dramatic *rejection* ("rejet") of and *loss* of knowledge (1966, p. 856), but modern science offers something in return: an anchoring ("amarrage") in Being, via the techniques and methodologies of scientific research. What science produces is knowledge (S_2), rather than truth (S_1). At the object position, university discourse is focussed on taming the object *a*, something which refuses to leave the subject in peace (p. 864). The logic of science (the "architecture" of signifiers in chemistry or molecular biology for instance) is an attempt to "suture" the challenged subject (p. 861), but crises do occur, and the *drama of science* takes its toll in the form of *victims of science* (p. 870):

S_2 – The subject of science, sutured by the logic of science	The object which refuses to leave us in peace (*a*)
S_1 – The rejection or loss of knowledge	The drama of science, taking its toll (*$*)

Although psychoanalysis builds on modern science, psychoanalysis itself is *not* a science, but a unique mode of discourse, a *Verfahren sui generis*. If it were a science, it would have been a *human* science, operating in accordance with the logic of university discourse and propagating technocratic expertise (S_2).

To clarify the relationship between psychoanalysis and science, Lacan compares science with two rival modes of gaining insight in nature, namely

[19] "…un changement de style radical dans le *tempo* de son progrès, de la forme galopante de son immixtion dans notre monde, des réactions en chaîne qui caractérisent … les expansions de son énergétique" (1966, p. 856)

magic and religion (p. 870). In the case of magic, the shaman uses certain signifiers (words, sounds, gestures, etc.) to conjure up certain responses (rain, storm, lightening, etc.). While performing these rituals, the shaman does not really *know* how it functions. It is a game of correspondences, and the actual causal relationship remains veiled. Nature cannot be *forced* to respond. The shaman operates like a medium, he/she is intuitively embedded in nature.

Religion, on the other hand, is about truth. Theology is a research field (S_2, upper-right position) based on the works and councils of the Church Fathers and decidedly rational, but ultimately inspired by an intuited truth (S_1), e.g. the dogma of trinity (God being both three and one): a truth which defies rational comprehension (p. 873) but is considered beyond doubt (*$* in the lower-left position). In Jungian style almost, Lacan claims that this dogma entails the structural apprehension (*Anschauung*) of a basic image (in Jungian terms: an archetype), and Lacan even advices his readers to go and visit a famous sixteenth-century tapestry to explore this further. These four modes of discourse (introduced in 1966) anticipate the four discourses (introduced in 1969):

Modern science	University discourse
Religion	Discourse of the Master
Magic	Discourse of the hysteric
Psychoanalysis	Discourse of the analyst

While modern science adheres to the structure of university discourse (inaugurating S_2 as agent), religion concurs with the Master's discourse, building on authoritative sources, allowing scholars (S_2) to produce knowledge in return. As to magic, hysterics often operate as medium: they intuitively "know things". Famous hysterics (Fredericke Hauffe, Hélène Smith, Helene Preiswerk) were often seers (clairvoyants).

This comparison allows us to determine the specificity of psychoanalytic discourse, by emphasising what psychoanalysis is *not*. Although psychoanalysis descends from science,[20] it is not a human science itself, and Lacan criticizes certain deviations, such as *ego psychology*, developed by Heinz Hartmann and others, for seeing psychoanalysis as a subbranch of psychology. Neither is psychoanalysis a religion, and Lacan deplores that the *International Psychoanalytical Organisation* operates like a church, on its guard to detect and denounce heresies and deviations, ever since Freud established the Secret Committee, in response to Jung's apostacy. Psychoanalysis should distance itself from magic as well. Freud already criticized Jung for his interest in telepathy and the occult, an attitude which he considered unscientific, i.e. incompatible with the constitution of the subject of science through the rejection of apprehension (*Anschauung*) and intuition as imaginary forms of insight. Phenomena such as

[20] "Die Analytiker können ihre Abkunft von der exakten Wissenschaftlichkeit und ihre Zugehörigkeit zu deren Vertretern nicht verleugnen" (Freud 1921/1941, p. 29)

hearing voices or fortune-telling should be considered as pathological symptoms or as transference (Freud 1921/1941). Psychoanalysis (the discourse of the analyst) presupposes the constitution of the modern subject of science (the cogito) but entails an anti-clockwise turn of the quadruped to the left. Religion and magic, on the other hand, entail clock-wise turns of the quadruped to the right: as relapses into pre-scientific ("illusory") knowledge practices.

Copernicus as a case history

To further elucidate the theorem of the four discourses, I will use a historical case history, the Copernican revolution, i.e. the discovery of the heliocentric universe. Above the bar, Nicolaus Copernicus (1473-1543) emerges as a conscientious researcher (S_2), carefully studying the movements of astronomical objects known as planets, wandering across the sky (hence their name, for πλανήτης means "wanderer"). While in the Ptolemaic (geocentric) universe the movements of planets could only be predicted with the help of artificial constructions known as epicycles, a more straightforward method can be developed when the Sun is placed in the centre of the solar system instead of the Earth (when earth itself is considered a wandering planet). This idea produces an enormous astronomical challenge, however, known as the parallax problem. If planet Earth circles around the Sun, changes should be visible in the relative position of the stars, reflecting Earth's movement along its orbit. Stars nearer to the solar system should seem to move compared to distant ones. Yet, the position of "fixed" stars seems absolutely stable (hence their name). The parallax problem, i.e. the *absence* of a parallax (of a displacement or difference in the apparent position of stars) refutes heliocentrism. The focus of attention inevitably shifts from the planets as such (the original objects) to the parallax, or rather its *absence*: the absence of a displacement that *should* be there but cannot be detected. The problem can be solved if we accept that the universe is incredibly large, so that the distance between Earth and Sun is negligible compared to the enormous distance between the fixed stars and the solar system. The sudden awareness of the intimidating immensity of the universe is what this revolution really is about. It was not Catholic doctrine, but the *parallax* problem that made heliocentrism difficult to swallow.

This epistemic situation can be visualised with the help of Lacan's quadruped scheme:

S_2	*a*
S_1	*$*

Above the bar (upper-left position) Copernicus is the reliable astronomer (S_2) who develops a model to reconstruct the movements of the planets, resulting in a manuscript entitled *De revolutionibus orbium coelestium* (*On the Revolutions of the Heavenly Spheres*). Allegedly, this manuscript unleashed the Copernican

revolution, allowing modern science (S_2) to emancipate from the Christian worldview (S_1 pushed into the lower-left position and replaced by a new, emerging truth: the worldview of Enlightenment).

On closer inspection, however, things are not that simple. First of all, Copernicus' treatise is not as revolutionary as the phrase *revolutionibus* suggests. Copernicus was still thinking along the lines of the established worldview (S_1), as indicated by the second half of the title, the phrase "heavenly spheres". Copernicus believed the universe to be perfect, and therefore spherical. He dropped Ptolemaic epicycles because they compromised the system, suggesting a lack of perfection. It should be as straightforward and transparent as possible. He was very much attached to the belief (S_1) that the perfect universe is spherical. This is how he himself phrases it:

> The universe is spherical… Of all forms, the sphere is the most perfect, needing no joint and being a complete whole… it is the most capacious of figures, best suited to enclose and retain all things… The Sun, Moon, planets and stars are seen to be of this shape… Hence no one will question the attribution of this form to the divine bodies (1543/1978, p. 8).

This intuition is neither a modern scientific idea, nor suggested or confirmed by empirical observation. Copernicus (a devout Catholic scholar) articulates a basic conviction entailed in the Christian worldview (S_1). His work as an astronomer, as a scientific subject, is still under the sway of a spherical mindset: his source of inspiration, inspiring him to see the universe not as disenchanted, but as something admirable.[21] As Lacan phrases it, Copernicus-the-revolutionary is a historical phantasy (1960-1961/2001, p. 113), because in reality he was under the sway of the imaginary, captured by the fascinating gestalt or *image* of the sphere (p. 114; cf. Lacan 1966, p 797).[22] In other words, Copernican heliocentrism is the outcome of a complicated dialectics between the imaginary and the symbolic, between modern astronomy and the spherical worldview, between observation and mathematization.

One could even argue that, to a considerable extent, Copernicus was still encapsulated in the discourse of the Master. In this scheme, science has not yet managed to emancipate itself from the dominant worldview (S_1): the revolutionary anti-clockwise turn to the left has not yet occurred. The astronomer is still a pious servant, remaining faithful to a basic truth, the spherical world, and working hard to *make it* true (verification):

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[21] Cf. the famous quote attributed to Ptolemy: "When I trace at my pleasure the windings to and fro of the heavenly bodies, I no longer touch the earth with my feet: I stand in the presence of Zeus himself and take my fill of ambrosia, food of the gods" (Boyer 1968, p. 158).

[22] "La révolution copernicienne n'est nullement une révolution" (1972-1973/1975, p. 55).

S_1 (spherical worldview)	S_2 (the astronomer as a servant, verifying the dominant worldview)
$ (doubts repressed)	*a* (the aim to drop the epicycles as waste products)

Doubts concerning the validity of this worldview are repressed (pushed in the lower-left position): the universe *must be* spherical, as we have seen (the key philosopheme of Ptolemaic astronomy). While clinging to this view, the astronomer-servant enjoys the experience of studying the spherical sky at night, cleansing it of compromising epicycles.

In a famous painting, *Astronomer Copernicus, or Conversations with God* by Jan Matejko (1873), the Copernican event is portrayed as a flash of insight, emerging during a dialogue with God. In other words: for Copernicus (the pious researcher, the Catholic cleric, observing celibacy), research is a spiritual exercise. Copernicus (S_2) is using a wooden cross-staff (at the right side of the painting) to verify the spherical model (on the left side of the painting). His gesture of sudden withdrawal suggests hesitance or doubt (*$*), eventually resulting in paralysis, more precisely: in his decision *not to publish* (so that the book resulting from this truth event was published posthumously). The subject of science (S_2) desires to confirm the philosopheme of the sphere (S_1), but discovers the parallax instead (*a*), resulting in paralysis (*$*):

S_2 (the conscientious astronomer)	*a* (questionable absence)
S_1 (the spherical guiding idea)	*$* (epistemic doubt as by-product)

The art work captures a moment of transition. Knowledge (S_2) is emancipating from the traditional worldview (S_1). Instead of on authoritative books by Aristotle and Ptolemy,[23] Copernicus relies on a contrivance (the cross-staff) to analyse the firmament. The anti-clockwise quarter-turn to the left suggests this moment of emancipation. Yet, the spherical intuition remains his guiding philosopheme (S_1 in the lower-left position), the truth he clings to. His will to know is focussed on the object (the wandering dot of light), but the experience of jouissance gives way to angst, invoked by the budding awareness of the infinity of the universe (*$*).

At the object pole, planets move in allegedly perfect circular orbits across the surface of heavenly spheres. Unexpectedly, while working hard to verify the spherical idea, he runs into an unexpected finding: heliocentrism offers a more straightforward solution. The focus of attention shifts from the planets themselves

[23] Ptolemy worked according to the logic of the Master's discourse: he relied on reading and consulting authoritative documents rather than on personal observation. For that reason, he is nowadays accused of plagiarism: "Claudius Ptolemy did most of his work not at night on the coast of Egypt but during the day, in the great library at Alexandria, where he appropriated the work of a Greek astronomer" (Broad & Wade 1982, p. 22). This accusation builds on the current conviction that research should rely on empirical research. For Ptolemy, consultation of textual sources was a core activity.

(as visible objects) to something which cannot be seen but should be there: the parallax. In fact, it was not until 1838 that the first measurements of stellar parallax were made (Zeilik & Gregory 1998). The parallax is the "object *a*" of Copernican astronomy, the anomaly which puts the system into question because of the implication that the universe must be incredibly large. Copernican astronomy is a research endeavour which sets out to optimise our understanding of the universe and discovers something completely unexpected, namely the infinity of the universe. Although we got used to the idea, Pascal articulated a metaphysical experience when he confessed that the eternal silence of these infinite spaces terrified him. The dialectics of the parallax gave rise to an ontological crisis (*$* in the lower-right position). In terms of Lacan's quadruped scheme:

S_2 (knowledge: birth of modern astronomy)	*a* (the undetectable parallax)
S_1 (the persisting philosopheme of the sphere)	*$* (by-product: ontological crisis)

For Slavoj Žižek (2006/2009) the parallax is an experience of non-coincidence. We constantly shift perspective between two points of departure which cannot be sublated into a single, comprehensive view: a paradoxical situation in which technoscientific existence is inevitably caught.

Having thus introduced four key sources of inspiration for a psychoanalysis of technoscience (Freud, Jung, Bachelard, Lacan), in the next chapter the first case history will be addressed: the case of Eugene Dubois, discoverer of the missing link. Subsequently, two other case histories (conditioning and virology) will be discussed. Each case history will contain a short resume of key concepts, providing a bridge with the conceptual chapters (I, I, III and IV), so that, in principle, each of the three case histories can be read as a semi-independent segment.

V. Resurrecting the missing link: the case history of Eugène Dubois

Introduction

The signifier "missing link" (no longer in circulation in scholarly discourse) referred to the idea of a hypothetical intermediary life form that allegedly bridged the evolutionary gap between higher primates and contemporary humans. As Stephen J. Gould (2007) phrased it, in the wake of Darwin's theory of evolution, the missing link became "the greatest desideratum" (p. 126) of fin-the-siècle research, although Darwin himself never literally used the term (the concept was introduced by his mentor Charles Lyell in 1851). Eventually the term was expelled from the professional vocabulary because of its association with the *scala naturae*: the idea that a hierarchical chain of being could be discerned in nature, ranging from inferior to superior forms, from minerals via plants and animals up to humans, with the missing link serving as the penultimate rung, just before the human optimum was reached.

The missing link represented an ontological gap which fin-de-siècle palaeoanthropology tried to close with the help of fossils finds, especially partial objects such as skulls and femurs. The idea that primordial, pre-human ancestors once existed (probably somewhere in the tropics) not only intrigued specialists but affected human self-understanding on a more general level as well, raising questions such as to what extent modern humans had distanced themselves from their ancestors. Could it be that certain characteristics and experiences still lived on (atavistically) in contemporary individuals? The concept incited self-positioning (in terms of continuity or discontinuity) against the backdrop of a largely unknown, primordial, animalistic past.

During the fin-the-siècle era, the missing link concept (or more generally: anthropogenesis) became a source of inspiration, not only for scientists, but for novelists as well. In two chapters, an exercise in triangulation ("comparative epistemology": Zwart 2008) will be conducted, by mutually exposing a scientific case history with two missing link novels (written by Jules Verne and Jack London). In this Chapter, I will reread the case history of Eugène Dubois (1858-1940), the Dutch anatomist who travelled to Indonesia in 1887 to search for the missing link and discovered a *Homo erectus* skullcap in 1891, one of the most fascinating and controversial episodes in the history of palaeoanthropology. Up to this day, his achievements trigger contrasting responses. Dubois has often been caricatured as an accidental discoverer and paranoid eccentric (Shipman and Storm 2002, p. 108). Stephen J. Gould (1993/2007) for instance, compliments him for his perseverance and perspicacity, but scolds him for being a "dogmatist" and a "numerologist" (p. 136). Caspari and Wolpoff (2012) even name a problematic research practice after him: the "Dubois Syndrome", i.e. the tendency to reconsider interpretations of paleoanthropological findings in response to changing theoretical expectations. This paper assesses the Dubois file

as a fascinating window into fin-de-siècle palaeoanthropology: at that time a hazardous research practice emerging in the force field between imagination and symbolisation. From a psychoanalytical perspective I will argue that the case of Eugène Dubois reflects a dialectical, creative tension between the imaginary and the symbolic.

Subsequently, I will focus attention on two missing link novels, written by literary contemporaries of Dubois, namely *Village in the Treetops* by Jules Verne (1901) and *Before Adam* by Jack London (2007), although *The Star Rover* (2015), another Jack London novel addressing a similar topic, will be consulted as well. A number of intriguing affinities between these documents can be discerned, so that these novels may help us to elucidate some crucial aspects of the Dubois case and vice versa. Obviously, novels are different, notably because of their tendency towards "dramatization" and "exaggeration" (amplification). Yet, precisely because of this tendency to amplify certain aspects which, although present in scientific discourse as well, may easily be overlooked, they function as a magnifying glass, providing a window into a pre-historical lost world. They serve as complementary vehicles for resurrecting missing links and for understanding paleoanthropological research.

Psychoanalysis and missing links

The quest for the missing link will be assessed from a psychanalytical perspective, via the work of authors whose oeuvres were introduced in the previous chapters, notably Gaston Bachelard (1884-1962) and Jacques Lacan (1901-1981). Palaeoanthropology and psychoanalysis have much in common. Both are interested in the distant past and in the relationship between phylogeny and ontogeny. Freud himself already displayed a keen interest in anthropogenesis because of its potential to elucidate the current human condition. In *Totem and Taboo* (1913/1940) he argued that contemporary neurotic symptoms should be interpreted against the backdrop of a hypothetical event which allegedly had occurred in the distance past: the killing of the primordial father, as a precondition for the development of conscience, allegedly resulting in a post-horde, human society, based on fraternity and collective guilt. According to Freud, research into the distant past may further our understanding of the present. Discontent in contemporary civilisation may be symptomatic of the extent to which our unconscious psyche has remained Palaeolithic. In other words, the human psyche suffers from what may be referred to as the simultaneity of the non-simultaneous (*die Gleichzeitigkeit des Ungleichzeitigen*). In the human psyche, the primordial and the contemporary co-exist, albeit not always in a peaceful manner.

Psychoanalytically speaking, the missing link idea functioned on three levels. First of all, it was a symbolic *concept*, a signifier connected with a network of related signifiers (such as "evolution", "origin", "descent", "common ancestor", "hybrid", "scale of being", etc.). Secondly, it was an archetypal *image*: the threatening/fascinating gestalt of a hybrid, intermediary type (often

envisioned as a hairy, ferocious brute, combining ape-like features with human ones), inspiring (or even haunting) fin-de-siècle research. Finally, the idea of a missing link fuelled processes of symbolisation, giving rise to empirical explorations and precision measurements: to accumulations of quantitative information provided by research practices such as craniometry. In other words, we may discern a conceptual, an imaginative and a quantitative dimension in fin-de-siècle palaeoanthropology. For the very outset, the imaginative dimension was emphatically present, both as a source of inspiration and as a methodological risk. While hunting for fossil sites, preferably in colonised, tropical areas, and analysing early human skulls with the help of craniometric measurements, researchers would also try to *envision* what primordial human existence looked like very long ago. They gathered factual information but were also guided by active imagination. As a rule, paleoanthropological data were fragmentary and partial, and by definition controversial (Corbey & Theunissen 1995), so that imagination was called in to fill the gaps and to enliven the past. And it is precisely here that the proximity between scientific research and novel writing is most obvious. Missing link novels are exercises in "active imagination" (Jung 1968, p. 96; 1959a, p. 356): literary forms of time travelling if you like. They provide complementary strategies for entering a lost paleoanthropological world. Both strategies (research and novel writing) constitute journeys backwards in time. And while narrative elements are discernible in scientific publications, missing link novels may contain careful descriptions of quantitative research practices. Therefore, both reflect the tension between the imaginary and the symbolic (between imagination and computation), which constitutes the force field of Dubois' research practice.

According to Gaston Bachelard (1947), an epistemological rupture divides scientific research from mundane life-world experiences, such as amateur fossil hunting, as we have seen. Whereas technoscientific research relies on quantification (with the help of precision instruments), pre-scientific activities remain under the sway of the imaginary: they are guided by fascinating worldviews and archetypal images (of missing links for instance). The objective of academic training is to convert future researchers from imaginative amateurs into impassive, objective, reliable producers of quantified information, sufficiently immunised against seductive phantasies that continue to haunt the public realm. For although such phantasies may initially have a positive effect (functioning as source of inspiration), they may eventually become an epistemological obstacle, hindering the development of genuine, valid knowledge. On closer inspection, however, things prove to be more complicated, notably because the dialectics of imagination continues to hold sway even in modern, quantitative research. Precisely because he saw himself as a psychoanalyst of science, supporting scientists on their difficult itinerary from archetypal images to measurements, formulas and equations, Bachelard deemed it necessary to meticulously analyse the imaginary realm as well, where he discovered the role of archetypes that can both inspire and hamper scientific

research. As a result, his oeuvre came to consist of two complementary strands of writings, as we have seen, so that his analysis of technicity, quantification and symbolisation (i.e. the tendency of science to describe the world in terms of numbers, mathematical or chemical symbols and equations) was complemented by an analysis of archetypal images as basic ingredients of a pre-scientific, imaginary worldview. Although they continue to be active in the scientific realm as well, they are most easily accessible via poetry and novels (which may therefore function as a magnifying glass).

One of the archetypes of "ancestral life" (1948a, p. 395) studied by Bachelard was the archetype of the cave, which is part the Mother Earth complex: i.e. the view of planet Earth as a living super-organism, fostering and nurturing life. The prehistoric cave is a Pleistocene uterus, a primordial dwelling of early human beings. Bachelard points to the association between caves and cranes (1948b, p. 171), not only in terms of alliteration (two instances of C-minor: the cave as a sombre, primordial soundscape), but also in terms of visual shape or *Gestalt*, for the primordial cave is shaped like a crane, inhabited by pre-human homunculi, while the cave's openings are like eyes or windows into the outside world. And cave floors are likely places for unearthing early human skulls (an association which in the case of Neanderthals proved valid).

Lacan's views on science resonate with Bachelard's. Like Bachelard, he sees science as a symbolisation process (1972-1973/1975, p. 104). Via precision instruments, lifeworld experiences are replaced by a symbolic universe composed of quantitative data, technical terms, chemical symbols and mathematical equations. Rather than studying tangible, visible objects in the every-day world, technoscience focusses on entities which can be represented and manipulated with the help of symbols (molecules, microbes, genes, electrons, quarks, etc.). To understand a tree, for instance, science prompts us to consider it as something which is basically composed of *cellulose* ($C_6H_{10}O_5$). A similar dynamic is at work in palaeoanthropology, which, during the past decades, became an increasingly technical endeavour, as fossil hunting rapidly evolved into a biomolecular and computational specialism, based on carbon-dating and DNA-sequencing. Indeed, present-day palaeoanthropology increasingly relies on computation and automation, on bio-information produced by high-throughput sequencing machines (Jones 2001; Pääbo 2015). The same tendency towards symbolisation applied to fin-de-siècle palaeoanthropology as well, however, in the sense that archetypal images (representations of early humans as hairy brutes armed with clubs) gradually gave way to craniometry as a process of symbolisation. Thus, Lacan's understanding of the chronic tension between the imaginary and the symbolic concurs with Bachelard's emphasis on the "iconoclasm" of science (1947, p. 77; 1953, p. 122), i.e. the tendency to replace iconic, archetypal images with measurements and formula: the technoscientific mode of thinking.

Besides the imaginary and the symbolic, however, Lacan distinguishes a third dimension of experience, *the real*: that which cannot be seamlessly captured, neither by imaginative worldviews nor by scientific equations: that

which recalcitrantly resists "assimilation" (Lacan 1964/1973, p. 65), revealing itself in the form of gaps, crevices or ruptures, or as something totally unexpected or unacknowledged (Lacan 1960-1961/2001, p. 58).

I will now briefly recapitulate the case history of Eugène Dubois as a palaeontological journey through time (bent on unearthing fossilised remainders of a forgotten past), but also as a geographical journey, from the Netherlands (Eijsden and Amsterdam) to the Dutch Indies (Sumatra and Java). My key source of information will be a biography written by taphonomy expert and science author Pat Shipman (2001), which actually reads like a novel. As a reviewer phrases it: Shipman tells Dubois' story "almost exclusively in the present tense, sacrificing authorial distance for immediacy… The book often reads, therefore, as if it were Dubois' own memoir" (Riper 2003, p. 191). Thus, in terms of genre, it represents an intermediary form between scientific and literary genres. Apparently, there are so many gaps in Dubois' biographical record that biographers such as Shipman revert to literary techniques to produce a plausible account. Dubois' scientific journey will be complemented by a fictional geographical journey (Verne's novel) and by an introspective journey, exploring the inner mental cave (London's novel).

Rereading the case history of Eugène Dubois

Eugène Dubois was born in 1858 (between the discovery of the first Neanderthal skull in 1856 and the publication of Darwin's *The Origin of Species* in 1859) in the Dutch village of Eijsden near Maastricht (in South-Limburg, a region clamped between Germany and Belgium, between German-speaking and French-speaking Europe) as the son of an apothecary who also acted as mayor. As a youth he had hunted fossils in the chalk deposits near Maastricht (where in 1780 the remains of a mosasaur were found) and his life-long interest in human evolution was sparked by public lectures on evolution given by German biologist Carl Vogt in 1868 and discussed in Dutch newspapers (Theunissen 1989). He studied medicine at the University of Amsterdam where he specialised in comparative anatomy, teaching human anatomy to art students at the Rijksmuseum while conducting comparative anatomical research on the larynx of vertebrates, notably whales. Instead of pursuing a promising academic career, however, he yielded to his obsession for palaeoanthropology, more precisely: his vocation of finding the "missing link": the greatest "scientific desideratum" of his day (Gould 1993, p. 126). In 1886 and 1887 (during his vacations) he already launched a human fossil expedition at the Henkeput near Rijckholt, where a prehistoric flint mine had been discovered in 1881, but Dubois was convinced (prompted by the work of Ernst Haeckel and Alfred Russell Wallace) that humankind originated in the Asian tropics (De Vos 2009). Both Haeckel (1868) and Wallace (1869) had suggested

the East Indies as likely birthplace of humankind.[24] Therefore, in 1887, Dubois gave up his university position to enlist as a military physician (medical officer) in the Royal Dutch East Indies Army, sailing to the Dutch East Indies (now Indonesia, at that time a disease-ridden climate notoriously unhealthy for Europeans) with his wife and newborn daughter to "mount a search for early human ancestors" (Theunissen 1989, p. 2), a project which seemed as promising as finding the proverbial needle in a haystack.[25]

Initially, believing that archaic humans had lived in caves, he began his quest for early human skulls on Sumatra, where caves are abundant and where he was stationed from 1887 to 1890, systematically exploring every single cavern he came across. Yet, although this episode undermined his health (living out in the tropical forest for weeks on end and contracting malaria), not a single early human fossil was found. After his Sumatran fiasco, he tried his luck on the banks of the Solo River near Trinil, central Java, where Javanese painter Raden Saleh had already been successful in collecting fossils (Theunissen 1989). And here, in August 1891, something which seemed highly improbable actually happened. His team of convict excavators (forced labourers provided by colonial rule and supervised by two army sergeants),[26] unearthed the upper part of the cranium of a species (more than 700,000 years old) with protruding, ape-like brow ridges: the first archaic human remains found outside Europe. Nine months later (in August 1892) a femur was added, looking strikingly human and excavated at some fifteen meters distance. Two molars where also found during these excavations, apparently belonging to the same species. Initially, the skullcap (*calvaria*) had looked like the carapace of a turtle, but the closer Dubois studied it, the more human-like it became. After some wavering, he named it *Pithecanthropus erectus* (the upright ape-man), but the species would be relabelled as *Homo erectus* (the upright human) by Ernst Mayr in 1950.

To embark on an ocean voyage to the Dutch Indies in 1887 to search for the missing link, as Eugène Dubois did, was an endeavour which seemed "nearly impossible" (Shipman 2010, p. 1). As Papagianni & Morse phrased it, his almost clue-less digging campaign was quite a "quixotic bid" (2015, p. 29). Dubois stubbornly ignored all scepticism, however, and after years of hardship and hard

[24] "With what interest must every naturalist look forward to the time when the caves and tertiary deposits of the tropics may he thoroughly examined, and the past history and earliest appearance of the great manlike apes be at length made known" (Wallace 1869, p. 47). Haeckel thought that the Asian gibbon was the closest living relative to humans (Kramer 2002)

[25] "Although Dubois's chances amounted to what was in all likelihood a million-to-one shot, he defied the odds and, amazingly enough, actually discovered what he had set out to find" (Kramer 2002, p. 140).

[26] The colonial authorities supplied him with forced labourers: natives from the Dutch East Indies who worked a month or two every year instead of paying taxes. Although these diggers would sometimes sell fossils to Chinese merchants, who used them in medicinal mixtures, they excavated more than 12,000 animal fossils over the years.

labour his perseverance was rewarded with the discovery of his now famous skullcap (currently at the science museum Naturalis in Leiden, the Netherlands), which remained a reference point for palaeoanthropology ever since. And although his name will always be linked no doubt with the discovery of Homo erectus, he subsequently embarked on several other ground-breaking scientific pursuits. Via systematic cranial measurement, for instance, he tried to establish a mathematical relationship between body size and brain size, and later in life he tried to create a Pliocene Park at his country estate in Limburg.

Initially, Dubois' fossils provoked scepticism rather than applause, but during the 1920s and 1930s the scientific debate began to turn in his favour (Theunissen 1989). Although Dubois was gradually gaining support (Gould 1993, p. 129) and a growing number of scientists recognised his fossils as a transitional form linking humans with ape-like ancestors (De Vos 2009, p. 371), the scepticism which had dominated the initial academic responses to his findings, perhaps in combination with intrinsic psychic factors (Theunissen 1989), turned him into a difficult, suspicious and embittered misanthrope.

Persuasive images and epistemological ruptures

Eugène Dubois' case history exemplifies Bachelard's psychoanalytic view of science outlined in Chapter III and summarised above. Initially, Dubois was driven by a vision, a fascinating *Gestalt*: his guiding image of hominids living inside tropical caves, a view which, although partly based on scientific sources, echoed an archetypal idea: the primordial stone-age womb, an image of sufficient persuasive power to seduce Dubois to ignore his father's disapproval (Shipman 2001, p. 109) and undertake his allegedly impossible expedition, inspecting every single Pleistocene uterus-cavern he could find (even though some of them proved a tiger's den). On the island of Sumatra, he stubbornly held on to his vision for years. He was an imaginative explorer, a "seer in the land of the blind", as Shipman phrases it, completely devoted to his idea and endowed with an uncanny ability "to reach beyond the readily observable" (Shipman 2001, p. 139), but the archetypal cave-image inevitably became an epistemological obstacle. By tenaciously clinging to this guiding image, Dubois not only lost years of research, but also undermined his health. The archetypal mental picture of primordial cavemen proved misleading and the "emptiness" of the Sumatran caves (the Sumatran "Real") was an unsettling experience for young Dubois (Shipman 2001, p. 107).

At a certain point, Dubois decides to replace this image, consistently at odds with recalcitrant reality, with a substitute vision, of early human beings thriving along the pastoral banks of a tropical river. And now, Dubois was able to link his image with reality. Because of this gestalt-shift, a completely new type of find-spot opened-up for him: in the open air, away from the dusty, dark and dangerous caves. As Shipman phrases it: "with a flash of insight, Dubois realised that he had been hampered by a European notion of where fossils would be found,

a notion that did not apply here because the topology was different" (2001, p. 129). Rivers are perfect excavators, moreover, and the Solo River had been cutting its way through Javanese soil for millennia, thus providing a natural window into the Pliocene-Pleistocene past.

From the perspective of science as understood by Bachelard, however, Dubois' finds could only be the beginning. The truly scientific work still lay ahead of him, the tedious process of symbolisation and quantification: of craniometrics (skull measurement). Because of his precision measurements, Dubois realised that the cranial capacity of his missing link was considerably larger than he initially estimated, so that he was apparently dealing with a life form much closer to contemporary humans than he initially expected (Theunissen 1989, p. 60). Therefore, he changed the original label for his find (*Anthropopithecus*, i.e. man-ape) into *Pithecanthropus erectus*, the upright ape-man: a human-like species, a transitional form, *eine Menschenähnliche Übergangsform*, as he phrases it in his publication (published in 1894 in Batavia and written in German, the academic lingua franca at that time). In fact, *Pithecanthropus* (more precisely: *Pithecanthropus alalus*, the speechless ape-man) had been Ernst Haeckel's name for the hypothetical missing link (Theunissen 1989, p. 6; Shipman 2001, p. 170).

Psychoanalytically speaking, various oedipal motifs were involved in Dubois' decision to shift from comparative anatomy (as a laboratory practice) to the more adventurous research field of palaeoanthropology, where he wanted to make a name for himself and stand on his own legs (Dubois erectus as it were). Biographers describe young Dubois as an "unusually restless person" (Theunissen 1989) and as an "outdoor type" (Shipman 2001), and although fossil hunting had made him opt for an academic career, restlessness is not easily compatible with the patience required for anatomical research. Perhaps Dubois became a paleoanthropologist *because* it seemed obvious to his seniors (his father, his professor) that his chances of success were small. His difficult relationship with his supervisor, Professor Max Fürbringer (his father substitute), also played a role. The latter had tried to claim Dubois' larynx discoveries as partly his own, and Dubois was rather sensitive in this matter (Theunissen 1989). But the main motive for setting sail to Indonesia must have been his archetypal guiding vision of the cave-dwelling missing link. Yet, precisely this imaginary vision increasingly became an obstacle for his paleoanthropological excavations: an imaginary legacy predating the epistemological rupture.

Upon his return to Europe, Dubois was disappointed and eventually even outraged by the critical reception of his work. After a series of desperate fights, he became increasingly depressive and isolated. But instead of opting for retreat (as is sometimes suggested), he intended to convince his opponents by producing additional evidence. The Trinil finds became the first step in a long-term research program that was both imaginative (guided by visions) and quantitative (based on precision measurements), revolving around the evolution of brain size and the genesis of human consciousness. Craniometry is a type of research which, as

Hegel once phrased it, builds on the premise that our uniqueness and identity as human beings is reflected in our cranial bones, notably the inside of our skulls.[27] In a series of publications, Dubois set out to show that the mammalian brain evolved towards human intelligence in a leap-like fashion, by doubling in size, to underscore his conviction that Pithecanthropus indeed represented an intermediary stage between humans and chimpanzees, also where brain size is concerned.

In passing, however, he developed another (again quite unconventional and imaginative) idea. For the *Exposition Universelle* in Paris in 1900 he produced a sculpture of Pithecanthropus erectus, to be exhibited in the *Pavillon des Indes Néerlandaises* (Dubois 1902). In order to imagine what his early hominid looked like in the flesh, he designed a life-sized statue, a 3-D image of a male Pithecanthropus. Dubois, an excellent artist on paper (making exquisite drawings of the femur, molars and skull with pen and pencil), managed to produce a credible sculpture (Shipman 2001, p. 320; Albers & De Vos 2010, p. 31), a clay figure supported by a metal frame, cast in plaster and painted in lifelike colours, with brown skin and orang-utan red hair, and equipped with a deer antler to suggest tool use: the first example of what would later evolve into a thriving scientific-artistic genre: reconstructing early humans. Again, Dubois proved to be a visionary, a pioneer, a "theoretician" in the sense of the Greek verb θεωρέω, i.e. contemplating (discerning) mental pictures. As underscored by Bachelard, however, there is always the danger of falling victim to the seductive sway of the imaginary, so that such sculptures may reflect prejudices and desires rather than reality. Indeed, later in life, Dubois would discard his 1900 reconstruction as "erroneous"; – but we will come to this.

During the final decades of his life, Dubois embarked on yet another imaginative project. On his estate *De Bedelaar* in Limburg, not far from Tegelen (a famous late-Pliocene mammal fossil site), he established a nature park to restore the vanished Pliocene habitat (Shipman 2001, p. 335), a kind of prehistoric lost world, a *Pliocene Park*. His project underlined that humans are beings-in-a-world and that brain-centred understandings of consciousness should be complemented by an ecological dimension: a real-life ambiance for his skull-based image. Although critics challenged the adequacy of his reconstruction, it stands out as another pioneer project: anticipating similar endeavours developed more recently, such as Pleistocene Park in Chersky, Siberia (Zimov 2005; Gammon 2017). In order for natural history to become a science, imagination has to give way to symbolisation, but imaginative thinking can play an inspirational role during the exploratory stage. His expedition to the Dutch Indies, but also his Pithecanthropus statue and finally his Pliocene park, constituted imaginative experiments: constructive efforts to work through imaginative scenarios and, eventually, to allow imagination and symbolisation to converge into a

[27] "Die Wirklichkeit und Dasein des Menschen ist sein Schädelknochen*"* (1807/1987, p. 250).

comprehensive, integrated vision. But it also gave rise to tensions or even contradictions between these two registers of experience (between the imaginary and the symbolic), posing a challenge to an imaginative researcher like Dubois.

What's in a name: craniometry and the symbolisation of the real

A Lacanian reading of the Dubois case basically concurs with the Bachelardian one developed in the previous section. The "Real", in the case of Dubois, was first of all the tropical real: sweltering heat, exhaustion, malaria: the reverse side of paradise. But the Real also manifests itself as unexpected findings which flout our expectations, as something which seems utterly "impossible" (Lacan 1971-1972/2011, p. 141). In the case history of Eugène Dubois, science is enacted as a symbolisation process, frustrated by the recalcitrant Real and spurred on, but also deceived, by the Imaginary.

In Dubois' case, symbolisation progresses via craniometrics: measuring the Pithecanthropus *calvaria*. Although the left thigh bone was a tremendously important find in its own right (suggesting upright gait), the identification of the species as an intermediary between non-human primates and modern humans notably depended on the shape and volume of the cranial cavity. This object did not present itself ready-at-hand, however, but had to be actively brought to the surface, cleaned and emptied, stripped of its real debris. Face-to-face with this skull, Dubois the paleoanthropologist became a comparative anatomist again, exchanging excavations for comparative craniometry, which represented the more scientific stage of the process: classification based on accurate measurements, rather than on visual impressions.

The skullcap initially emerges as something *real*, condensed into a singular, inexorable find: difficult to embed into the existing body of knowledge (at first glance it had looked like a turtle carapace). How to measure, symbolise and categorise such a thing? Initially, Dubois describes the impressive skull as belonging to a species which he labels *Anthropopithecus erectus*, the upright-walking man-ape, closer to non-human primates (such as chimpanzees or gibbons) than to present-day humans. At a certain point a gestalt-switch occurs. Dubois realises that he miscalculated the size of the brain and decides to correct his mistake. The skull is larger, decidedly more human, than he initially acknowledged. Therefore, the signifier *Pithecanthropus* (ape-man) seems more appropriate, involving a shift (on the symbolic level) from *pre-human* to *approaching human*. As recorded by Theunissen (1989), while writing one of his formal quarterly reports, Dubois stated, in an accompanying letter: "I have the honour of offering the first instalment of the description of some of the fossils I have collected. This instalment deals with only one species, ~~A~~Pithecanthropus erectus" (Theunissen 1989, p. 60). This slip of the pen (*Fehlleistung*) is a symptom, psychoanalytically speaking. The abrupt replacement of the initial *A* by a *P* suggests, Theunissen argues, that the name had been changed only shortly

before. Dubois quite suddenly came to see his fossil as much more closely linked to humans.

Shipman describes the scene in a novel-like manner. The fossil (the *object a*) is sitting on Dubois' desk, she writes, literally facing him, almost speaking to him and greeting him (2001, p. 169). He has found it, the missing link: "this is *it*" (p. 164). An idea "dancing at the edge of a clearing" is transformed into something tangible and visible (p. 165). Working late into the night, finalising and polishing his report, he suddenly experiences his epiphany. As he pens the letter A for *Anthropopithecus*, he suddenly realises his mistake: "the truth of the matter overwhelms him… These fossils are something entirely new. They are the transitional form, the missing link that joins ape to man. He cannot call the fossils *Anthropopithecus* any longer. There is only one name that can be given to this creature. He superimposes a *P* over the *A* and replaces *Anthropopithecus* by *Pithecanthropus*, Ernst Haeckel's name for the hypothetical missing link" (Shipman 2001, p. 170). Dubois realises that the skullcap has a cranial capacity of nearly 1,000 cc., more than twice the size of a chimpanzee's brain and approaching the size of contemporary human brains (roughly two-thirds the modern size). This species (combining upright posture with an almost-human brain), matches the profile of the proverbial missing link. This is acknowledged by the shift in nomenclature, the sudden reversal of the order of the two signifiers (*Anthropus* and *Pithecus*) on the symbolic level.

The *A*, replaced by a *P*, was a *Fehlleistung* symptomatic of Dubois' initial underestimation of the skull volume of his find. As if he had wanted to maintain the distance: the gap between object and subject, between Anthropopithecus and himself. The sudden reversal on the level of the signifier, swapping one composite term into another (*Anthropopithecus* → *Pithecanthropus*; Ap → Pa), indicates a change of mind, but also a drastic repositioning of the object. With this reversal he also re-classifies himself; turning himself into "the man who found the missing link". The missing link, the lost "object *a*", is missing no longer; Dubois has achieved his seemingly impossible goal. A whole world of meaning is contained in this inversion. The skull facing him no longer represents otherness. It is a human skull, as if looking into a mirror and discerning something essentially human. A quantitative change (a craniometrics correction) results in a leap-like, qualitative transition, from difference (man-ape) to almost-identity (ape-man). A time-lapse of millennia is suddenly abolished, and a contemporary researcher steps into a lost but almost-human world (through this skull-shaped looking-glass). Dubois more or less ignores the rest of his impressive treasure store of vertebrate fossils and decides to write a monograph solely devoted to *Pithecanthropus erectus*, the resurrected missing link.

The signifier *Pithecanthropus* had been coined by Ernst Haeckel in his influential book *Natürliche Schöpfungsgeschichte* (1868). Rather than referring to an object in the world, however, it was a signifier, referring to a hypothetical entity, a linguistic fabrication, an element in a discursive network, a theoretical construction, an intellectual phantasy, produced to cover-up a gap in the

palaeontological record. Pithecanthropus was the first half of *Pithecanthropus alalus*, where *a-lalus* stands for speechless; indicating that the missing link (*not yet* human) was missing something, a decisive factor X: that what makes humans human, namely speech. In short, both components of Haeckel's term *Pithecanthropus alalus* indicate a gap or lack. The missing link is not only *missing* but is also *missing something* (in Lacanian algebra: -φ). Moreover, according to Haeckel, Pithecanthropus inhabited a lost world: Lemuria, a hypothetical sunken continent which allegedly once stretched from the coast of Africa over the Indian Ocean to the Philippines: another signifier referring to a hypothetical reconstruction, something which is now absent. Thus, the speechless, imaginary, postulated, ape-like *Pithecanthropus* is a *missing* creature who *misses* something (speech) and inhabits a world that is now *missing*: lack or absence to the third power. Dubois' skullcap, sitting tangibly on his desk, suddenly fills this threefold gap.

As Shipman phrases it, Dubois' singular fossil weaves together "all of life into a unified whole" (Shipman 2001, p. 150). The enigmatic skullcap stands out from the rest of his huge collection. It is something utterly singular, a *novum*, something "totally new" (Shipman 2001, p. 211). In his report, and subsequently in his publication, he only talks about the Pithecanthropus remains. For Dubois, this alluring crane (together with the femur, indicating upward posture: *erectus*) *addresses* him, becoming an obsession. It is highly valuable and toxic at the same time. It will make him famous, but at the same time ruin his life. This fateful object, difficult to identify, to categorize, determines his destiny, seals his fate. It is something definitely "uncanny" (*Unheimlich*; Freud 1919/1947), i.e. familiar yet different; dead but revivified (undead); a partial object separated from the body; something which remained hidden but is now suddenly brought to the surface. His name will forever be linked with this missing link, triggering both admiration and ridicule. He wants to share his find and publish about it, but will become increasingly possessive of *his* skull, and cannot accept the idea of being separated from it. On his way home, during the ocean voyage back to Europe, during a storm at sea so violent that the captain orders all the passengers into lifeboats, Dubois is so preoccupied with saving his P.e. fossils (kept in a wooden suitcase strapped to his chest, almost like a bodily extension) that it seemed more precious to him than his three children (two of whom were born in Indonesia). It completely drains his intentionality and energy: it has become his object *a*.

Resurging tensions between the symbolic and the imaginary

While ignoring the other 40,000 or so fossils excavated in the tropics and transported to the Netherlands, Dubois continues to focus on the skull. Cephalisation research turns the Pithecanthropus skullcap into an element in an evolutionary series. From 1897 onwards, Dubois becomes interested in the quantitative relationship between brain size and body size, arguing that the decisive factor is not body weight as such, but level of organisation. This

research, arising directly from his study of the Pithecanthropus fossils (Theunissen 1989, p. 128), aims to demonstrate a mathematical relationship between body weight and nervous system, expressible in terms of an equation. Larger animals have larger brains, but the relationship is not perfectly proportional. Humans (the brainiest species on Earth) deviate (with a brain significantly larger than is to be expected on the basis of body size). Dubois concludes that, as body size increases by length L, brain size increases by $L^{5/9}$ ($L^{0.56}$ in decimal numbers). Thus, the relationship between body size and brain can be represented by the equation: $E = cP^{0.56}$, where E refers to brain size, P to body size, and *c* to the cephalisation coefficient (an indication of the level of organisation or "brianiness" of the animal involved). Some specialisations and adaptations require more brain, so that a species can be small-brained ($c < 1$) or large-brained ($c > 1$). Animals that represent the same level of evolutionary development will roughly have the same *c*. The human *c* is remarkably high compared to other mammals, reflecting taxing specialisations such as upright-walking, tool-use and language. For Dubois, these results provide additional support for framing Pithecanthropus erectus as the missing link. By comparing his estimate of brain weight (based on the internal volume of the skullcap) with his estimate of body weight (based on the size of the femur), Dubois calculates that the *c* of Pithecanthropus is half the human *c* and doubles the *c* of primates (Shipman 2001, p. 347).

It also confirms his discontinuous view on evolution. Dubois becomes convinced that, during the evolution of primates to humans, brain size did not increase gradually but in a leap-like, saltatory fashion, via mutations. Important moments in (human) evolution occur *per saltum* (Shipman 2001, p. 210). In other words, whereas Darwin (1859/1985) had claimed that nature does *not* make leaps (*natura non facit saltus*, a phrase cited on seven occasions in *The Origin of Species*, thereby endorsing the principle of continuity or gradual change), Dubois (like Hugo de Vries, one of his mentors at the University of Amsterdam), rather took the (anti-Darwinian) position that nature *does* make leaps (*natura facit saltus*), thereby endorsing the principle of discontinuity (Zwart 2008; 2013). Brains evolve through doublings in size from one cephalisation stage to another, so that the cephalisation of *Pithecanthropus* doubled that of a modern gibbon but was doubled again by the modern human brain. Ergo, P.e. was the human ancestor (Dubois 1935a; Durband 2009, p. 5). Gradual transition takes place no doubt, but *real evolution* proceeds by jumps, rather than incrementally (Shipman 2001, p. 379), and is determined by internal factors: mutations, pushing species towards perfection (Dubois 1928).

Also in his cephalisation research, however, Dubois struggled with the imaginary. In one of his publications, he claimed that *Pithecanthropus* was not a human, but a large species resembling a gibbon, yet superior to gibbons on account of its exceedingly large brain volume, enabling an erect posture and gait (Dubois, 1932, 1935a). Charles Loring Brace (1981) misinterpreted this as a retraction, concluding that apparently, Dubois no longer regarded

Pithecanthropus as a transition form, but as a giant gibbon (as if Dubois had *de facto* reinverted the label into something like Anthropopithecus erectus again). But as Gould (1993) and others argued, this interpretation is incorrect. Psychoanalytically speaking, the confusion once again stems from the tension between the imaginary and the symbolic, between Dubois as a researcher who relies on mental images (the imaginary) and Dubois as a researcher who relies on symbolisation, on craniometrics (the symbolic). When he speaks about Pithecanthropus as a giant upright gibbon, Dubois is envisioning the overall shape, the visual *Gestalt*. But this is complemented by the symbolic dimension: P.e.'s large-sized brain[28] (craniometrics). Rather than changing his mind (Brace 1981, p. 114), Dubois was trying to combine visualisation and quantification, Gestalt and brain size into a comprehensive view.[29]

While Dubois retained his symbolic understanding of Pithecanthropus erectus as the missing link between primates and humans (doubling the cephalisation coefficient of man-apes as the inevitable next leap toward perfection), he did revisit his *visual image* of Pithecanthropus, however. In a letter written to Hendrik Engel (a future anatomy professor, but still a student at that time), dating January 12, 1931, Dubois explains that he now considers his 3-D Pithecanthropus reconstruction of 1900 as erroneous ("principieel foutief", p. 54), because it reflects Darwinian ideas about gradual rather than saltatory phylogenesis, a vision which he now regards as untenable in view of his cephalisation theory (De Looze 2001). In other words, the imaginary is sacrificed to iconoclastic symbolisation. Pithecanthropus as an imaginary Gestalt (as a world-fair icon) is sacrificed to the $E = cP^{0.56}$ formula.[30]

Four discourses

Besides his distinction between the imaginary, the symbolic and the real (as basic registers of experience), Lacan has more to offer when it comes to analysing the dynamics of scientific research, as we have seen, namely his typology of modes of discourse, more precisely: his theorem of the four discourses (Lacan 1969-1970/1991). Initially, scholarly understandings of early human history rely on authoritative sources (*Genesis*), referred to by Lacan as the discourse of the authoritative Other (S_1). The interpretation of such a document is entrusted to

[28] Dubois estimated it to be 1,000 cc. This has now been reduced to ~ 840 cc. (Anton 2003, p. 132).

[29] As Gould phrased it: Dubois' "ingenious attempt to retain *Pithecanthropus* as a direct human ancestor [was misread] as an ultimate surrender, almost comical in its transmogrification of a human forebear into a giant gibbon" (1993, p. 136). He talked about gibbons to exalt rather than to demote *Pithecanthropus*.

[30] As a comment, Dubois quotes Goethe's *Faust* ("Es *irrt* der *Mensch* so lang er strebt"; Man errs till he has ceased to strive). While confessing to have erred on the imaginary level (his mental envisioning of Pithecanthropus), Dubois is stubbornly consistent when clinging to his symbolic interpretation.

qualified readers: authorised custodians (recipients of the message, S_2), who produce commentaries, clarifications, glosses and so on. This type of discourse, involving an authoritative source (S_1) and qualified interpreters (S_2) results in a discursive configuration Lacan refers to as the discourse of the Master. Four symbols or variables are inserted in four positions, namely S_1 (the authoritative Other or Master signifier) functioning as *agent*, S_2 (the qualified expert) functioning as *recipient*, *$* (the tormented, divided subject) as the *disavowed truth* and *a* (the object *a*, the object of desire, the target of the *cupido sciendi*) as *by-product*

On the manifest level (above the bar), S_1 (the authoritative source) occupies the position of the *agent*, initiating the discursive process (as prime discursive mover), while qualified experts (S_2) act as *recipients* of the message (upper-right position). Uncertainties or doubts which must have tormented the allegedly infallible Master are disavowed (*$* pushed beneath the bar), while some entities (*a*) are singled out as especially intriguing or valuable, carrying the fingerprints of creation as it were, although it is unclear whether these "impossible" objects really constitute tangible items: things like the remains of the Ark, or the skeletons of Adam and Eve. Typically, such objects are extremely difficult to find, and if they are found at all, they will remain highly controversial and allusive (so that quests to retrieve the remains of Eve or of the Ark are the "by-products" of this type of discourse).

An example of such an object is Haeckel's missing link, the ape-man characterised as *a-lalus*, lacking or missing something, namely speech or, more literally: the capacity to *babble*. The signifier suggests a kind of impotence, the inability to use a partial object, a functioning *tongue*, that what makes a man (*homo*) a man. Psychoanalytically speaking, *a-lalus* comes quite close to *a-phallus* (-φ). This lack (indicated by the letter a-, the *alpha privativum*), connected with a partial object (the tongue) is the paleoanthropological object *a.* In Western culture, the term *lalus* is associated with a religious symptom known as *glossolalia*, the sudden ability (during Pentecost) to speak multiple tongues (*Acts* 2:4). Somehow, during Anthropogenesis, humankind acquired the capacity to babble, to speak a tongue: a spiritual dawn of day, the Pentecost of humankind. This enigmatic capacity is connected with the tongue as a *partial object*. In humans, this organ which, in other animals, primarily serves for swallowing and chewing, acquires a new function as organ of speech (used to produce discrete sounds: consonants and vowels). This function becomes a scientific object of desire: when, how and why did humans learn to speak? How did this gift of glossolalia descend on them? This issue (the origin of language, a completely new way of using one's tongue) becomes a desideratum of research, a target for the scientific will to know: something which defines the pre-human Pithecanthropus because of its absence, while modern humans are defined as being-in-possession-of this precious yet mysterious – but apparently detachable – "something". Dialectically speaking, Haeckel sees modern human beings as

"negation of the negation": the negation or sublation of a particular form of negativity or absence (and twice a minus gives a plus).

Something like this is at work in the quest for Mitochondrial Eve: the matrilineal most recent common ancestor (MRCA) of all currently living humans; the most recent woman from whom all living humans descended (and who probably lived in Africa before the Out of Africa migration). The signifier "mitochondrial Eve" links the biblical account of Genesis (S_1) with modern scientific discourse, conducted with the help of precision instruments and high-throughput sequencing machines. But "mitochondrial Eve" is evidently an ironical label. For modern science, Eve (the first woman) is an impossible concept. Rather than confirming the validity of the biblical account, this label reflects the discursive divide which has emerged between traditional natural history (grafted on the Bible) and present-day mitochondrial DNA research (Ayala 1995). In terms of discursive structure, the latter adheres to a completely different mode if discourse, referred to by Lacan as "university discourse".

University discourse results from an epistemological rupture, a transition in the way in which (biological) knowledge is produced, taking us from Bible reading (natural history as applied theology) to quantified research practices. It represents the end of religious supremacy in the realm of truth, replacing exegesis by experiment. Due to the emancipation of the qualified experts (palaeontologists), the quadruped scheme takes a quarter, anti-clockwise turn to the left:

S_2 (expert agent)	*a* (the missing, allusive object)
S_1 (authoritative source)	*$* (the divided, tormented subject)

Instead of relying on *Genesis* (as an authoritative source providing guidance), S_1 is pushed into the lower-left position. Qualified experts discard their dependence on authorities and emancipate into autonomous scientists, occupying the position of the agent, relying on technical and computational skills rather than on authoritative texts, and interacting with their allusive research targets (*a*) via technological contrivances. Instead of studying nature through a biblical lens, natural entities are explored in a technical manner (from craniometry up to carbon dating and DNA sequencing). The object (to which the questions are directed) is no longer nature as a whole. Rather, researchers focus their attention on very specific items (partial objects or particular gaps).

The object may prove rather intractable, however. Missing links, for instance, are absent by definition. They represent a gap or lack, a minus symbol in the symbolic order. The quest for the missing link intends to bridge this gap and fill this hole. While Jean Léopold Nicolas Frédéric Cuvier (the "father" of palaeontology, S_1), considered the very idea of human fossils an "impossible concept" (Theunissen 1989, p. 8), the quest for the missing link (as the prototypical object *a* of palaeontology) is spurred on by the desire to refute this authoritative voice.

S_2 (the subject-pole of the knowledge relationship) is a particular kind of subject: the subject of modern science, highly trained, reliable, accurate, impassive and objective. Something similar happens at the object pole with the object of intentionality, to which the research questions are directed. Scientists focus on objects that are allegedly under their control. But this relationship (between impassive researchers and domesticated objects) is only part of the story. Unwittingly, research may still rest on a worldview, a guiding narrative or creed, functioning as a source of inspiration (S_1 below the bar). In the case of Dubois, beneath the discussion concerning his skullcap, a more basic struggle is unfolding, between continuous and discontinuous views of evolution. What is at stake is Darwin's guiding philosopheme (not coincidentally phrased in Latin): nature does not make leaps; *natura non facit saltus* (S_1).

The object of research (allegedly under control) may prove recalcitrant, inexorable and frustrating, unwilling to live up the researcher's expectations, so that the gap continues to exist, draining the researcher's energy. By placing the "object *a*" in the upper-right position Lacan indicates that this is the rule rather than the exception. Scientists enter a hazardous situation, running the risk of becoming trapped in frustrating interactions with their object of desire (*a*), a destabilising experience, undermining their impassivity, up to the point of becoming an obsession. This may result in an epistemological crisis (as an unintended by-product of the knowledge relationship), so that the researcher ends up as a tormented subject (*$* in the lower-right position).

The allegedly "impassive" subject becomes trapped in the matheme of desire: $\$ \lozenge a$. In this equation, the lozenge ($\lozenge$) indicates that, while the researcher becomes obsessed with an inexorable object, the object (*a*) is playing an active, provocative role, by draining (fixating) the researcher's time and attention. The lozenge suggests an optic contrivance, enabling the scientific subject to zoom out (<) or in (>), in response to the object's irresistible appeal. Thus, while the overall process of symbolisation advances, individual researchers become a victim of their impossible profession (Freud 1925/1948; 1937/1950), a "victim of science" (Lacan 1966, p. 870).

To bring this dynamic to the fore, however, the quadruped scheme must take another quarter (anti-clockwise) turn to the left, resulting in the discourse of the analyst:

a	*$*
S_2	S_1

Now, the knowledge relationship itself (the subject-object interaction) becomes the focus of attention, and the research project becomes a case history (a *Fallgeschichte*). The focus shifts from the object (the skullcap) to the story of Dubois' interactions with this taxing fossil. By placing the alluring object (*a*) in the upper-left position, Lacan stresses its active, provocative role, pressing Dubois into action as it were. The missing link (the desideratum, the object *a* of

fin-de-siècle palaeontology) seduced Dubois to mount his "impossible" quest for early human ancestors in the Dutch tropics.

Dubois' research endeavour is part of a broader process, a scientific revolution which, in the course of the nineteenth century, transformed natural history from applied theology into evidence-based palaeoanthropology (the rise of university discourse). On the level of S_1, this means that creationism (building on *Genesis* as an authoritative source) was replaced by Darwinian evolutionism. Instead of opting for an ideological or metaphysical battle ($S_1 \leftrightarrow S_1$), Dubois addresses the issue in a scientific manner, in accordance with the structure of university discourse (S_2 in the position of the agent), although his research endeavour (implicitly at least) is still inspired by a worldview, articulated by authors such as Vogt and Haeckel (whose worldview is spurring him on from beneath the bar). Thus, Dubois, the trained expert, sets out on his quest to discover the missing link, the impossible but alluring object *a*, the scientific object of desire, the "desideratum" of his era: a hazardous adventure, for his life and future depend on the absence or presence of this inexorable item. Should he succeed in unearthing his object *a*, however, it will remain a controversial item, both establishing and damaging his academic reputation, draining his energy, undermining his health, eventually turning him into an isolated misanthrope.

In terms of the discourse of the analyst, the Dubois case revolves around the missing object, revealing how his interactions with the skullcap increasingly reflects the matheme of desire ($\$ \lozenge a$). Rather than reading the case as palaeontologists would do (trying to determine whether Dubois or his critics were right or wrong), the scientific content is suspended (put between brackets, pushed beneath the bar: S_2 in the lower-left position), so that we may focus on the vicissitudes of the dialectical relationship featuring Dubois (as $\$$) and the *calvaria* (as *a*). Notably during the second half of life, Dubois increasingly withdraws into the position of the embittered, resentful "victim" ($\$$). But there is a by-product: a normative reassessment of the case, notably the claim that Dubois' style of working was allegedly at odds with the methodological and normative requirements of science, addressed in the next section.

Prospero and Caliban

The Pithecanthropus monograph (Dubois 1894) reflects the structure of university discourse. Painstakingly, Dubois transforms a tangible "thing" (a "shiny brown skullcap", Shipman 2001, p. 275) into measurements, a professional text, dispatching it to Batavia (now Jakarta) to be printed. Copies are sent to Europe and Dubois expects nothing less than recognition (Shipman 2001, p. 227). To his astonishment, his publication meets with criticism by stay-at-home armchair sceptics. Rather than praise, he faces accusations of foolishness and incompetency, resentment instead of applause.

Psychoanalytically speaking, this was to be expected, notably in palaeoanthropology, a field where claims concerning newly found human

remains (*a*) tend to be highly contested (Corbey & Theunissen 1995; De Vos 2009). Dubois was a complete outsider who suddenly entered the floor, claiming to have successfully unearthed the scientific desideratum of his field, while others (the scientific establishment, his father figures) spent their time in theoretical deliberations. At the Third International Congress of Zoology in 1895, Dubois displays his specimens to convince the professional forum. His presentation is chaired by the German pathologist and anthropologist Rudolf Virchow, the *éminence grise* of German science, an authoritative father figure par excellence. Dubois invites Virchow and others to examine and handle his fossils. Also, he supplies the stratigraphic data that were missing in his 1894 publication (which focussed on Pithecanthropus, rather than on context), describing the layers in which the fossils were found (Shipman 2001, p. 284). But the qualified experts (S_2) are keen on maintaining the methodological standards of their budding field (and the still quite vulnerable credibility of their expertise). Moreover, a weakness of Dubois' publication had been that, while he described the *Pithecanthropus* remains at length (comparing them with chimpanzee, gibbon and human bones), he treated the geology, the discovery circumstances and other fauna fossils in a rather cursory fashion (Theunissen 1989; Shipman & Storm 2002). In other words, whereas Dubois was fascinated by his object, the qualified experts were bent on policing the divide between science and non-science, by highlighting methodological flaws. Dubois disliked public speaking and the lecture triggers confusion and disagreement. Virchow shows only contempt for the idiosyncratic newcomer, apparently too impatient to live up to the standards of scientific work (Theunissen 2001, p. 149). His few supporters also posed a threat, such as anatomist Gustav Schwalbe, who published a detailed analysis of the *Pithecanthropus* fossils in a new journal of which he was the editor, comparing Dubois' finds with Neanderthal remains, thereby eclipsing Dubois' own publication, who felt that Schwalbe had appropriated his work.

Dubois' initial response to these taxing experiences was a campaign to defend his trophy's integrity. Between 1895 and 1900, he publishes 19 articles dealing with *Pithecanthropus* (Shipman & Storm 2002, p. 111). Eventually, however, Dubois became increasingly suspicious and defensive, even denying other scientists access to "his" skullcap. Pithecanthropus is safely stowed away in a safe at the Teyler Museum. Dubois creates a sheltered, secluded spot, insulating both his fossils and himself. He closets the bones away in special cases and rarely takes them out. Pithecanthropus (the object *a*) is missing once again and other scientists are denied the right even to view them. When Henry Fairfield Osborn of the American Museum of Natural History in New York (representing the scientific establishment) tries his influence on the Royal Netherlands Academy of Science, protesting against Dubois' non-cooperative behaviour, Dubois partly gives in, but transfers the rights to reproduce and sell casts of the Pithecanthropus fossils to a law firm in London, thus adding additional obstacles (Shipman 2001, p. 366). He hoards his fossils like a treasure: Siegfried transmuted into Fafner. Rumours abound that Dubois has become mentally

instable or reconverted to Catholicism (Shipman & Storm 2002, p. 113), but Dubois actually continued working and publishing. From the point of view of university discourse, however, by putting Pithecanthropus out of circulation, he sabotaged the symbolic system and hampered the functioning of normal science, which is bent on domesticating the singular object by transforming it into something that can be studied, identified and controlled. Dubois' reclusiveness sublimates and elevates the object into something highly exceptional and valuable.

When in the 1920s and 1930s paleoanthropologists like Ralph von Koenigswald and Franz Weidenreich discover similar fossils on Java and in China, they conclude that Java Man (Pithecanthropus) and Peking Man are closely related. But Dubois stubbornly maintains that P.e. is unique and refuses to recognize their conclusion (Swisher, Curtis & Lewin 2000, pp. 76–79.). Psychoanalytically speaking, Dubois became trapped in the matheme of desire ($\$ \lozenge a$) by hoarding his object as a unique treasure beyond compare. The very fossil which initially allowed him to link up with the international establishment of qualified experts (S_2), now increasingly estranges him from his academic peers, although he was not at all the only one of course, for in this "age of the splitters" the "splitting" mentality (considering every find as unique and as entitled to an identity of its own) pervaded palaeoanthropology (Kramer 2002).

During the final stage of his life, Dubois becomes a solitary recluse who transforms his estate into a Pliocene-Pleistocene park as convincingly as possible, planting tulip trees, Chinese rubber trees and swamp cypresses (Shipman 2001, p. 325, p. 335) and erecting a bat tower (still intact), as if to create an asylum for his missing link: Prospero and Caliban on an artificial Bermuda island. As to his treasure of Trinil fossils, Dubois finds a trusted aid in Dr. J.J.A. Bernsen O.F.M., a Franciscan priest who had written a thesis (cum laude) on rhinoceros fossils from Tegelen clay (Bernsen 1927) and is now charged with meticulously describing the Trinil collection. Bernsen not only devotes himself to tedious palaeontological work as a qualified expert (S_2), in accordance with university discourse, but also pursued daily conversations with Dubois (whom he greatly admired), notably while escorting him to the train station, concerning science, faith and the story of his life, prompting Dubois into a confessional mood, so that, during Dubois' final years, an analytical dialogue, a *discourse of the analyst* evolved, providing crucial input for Shipman's biography (which was largely based on Bernsen's diaries). In terms of discursive mode, Bernsen's diaries reflect the discourse of the analyst (rather than university discourse, the style of writing endorsed in his scientific reports).

In 1932, Bernsen discovers a second femur, which initially had been overlooked (more additional femurs were soon to follow, Dubois 1935b). Unfortunately, this femur was not another "missing piece". Like the first one, it was a left femur. Dubois' argument that skullcap, femur and molar came from the same individual dissolved "into nothingness": "Two left legs, there could hardly be a more damning find" (Shipman 2001, p. 404). This finding sheds fresh

doubts as to whether the first thigh bone and the skullcap really belonged together (as Dubois had persistently claimed). In his imaginative vision of Pithecanthropus erectus, Dubois had actually created a "chimera" (p. 404) out of partial objects coming from different individuals. And now, due to Bernsen's discovery, Pithecanthropus seems to be split or sliced in two again, so that his integrity is once again damaged. From the point of view of university discourse, this is not a catastrophe at all, but rather a fortunate event. Dubois' desperate coagulation of the two fragments into one individual was a remnant of the imaginary: of Dubois' effort to envision Pithecanthropus as a convincing Gestalt, by gluing the two pieces together. The fossils constituted a rebus: while the signifier *Pithecanthropus* was based on the sizable brain (the skullcap), the signifier *erectus* relied on the femur, so that *calvaria + femur = Pithecanthropus erectus*. This imaginary whole is now fragmented once again, so that the identification of Pithecanthropus becomes dependent on similar discoveries by others: by a whole international network of qualified palaeontologists (S_2-type experts like Von Koenigswald, Weidenreich, Black, etc.). Dubois' Pithecanthropus could no longer stand on his own leg, the imaginary unity was broken. His identity from now on relied on the joint activities and the discursive consensus within the palaeontological community (S_2). Scientifically speaking, this represented progress, because the skullcap (the object *a*) could now finally become a normalised, domesticated object, comparable to other fossils, a process that was completed when Homo erectus was formally accepted as the name for both Java Man and Peking Man (Mayr 1950).

Bernsen's discovery was a step forward not only from the point of view of university discourse, but also in psychoanalytic terms, because in principle it could have worked as a therapeutic trigger, releasing Dubois from his obsession, dissolving the matheme of desire. Unfortunately, while dutifully combining his work on the fossil collection with spiritual conversations, he suddenly died from haemorrhage in 1932 (after registering 10,411 fossils).

The imaginary and the symbolic

The Dubois case history aroused considerable controversy among professional experts (S_2). I already mentioned Caspari and Wolpoff (2012) who accuse Dubois of a problematic research practice, the "Dubois Syndrome", i.e. the tendency to reconsider interpretations of fossils to conform to changing theoretical expectations. The eponym suggests he exemplified this flaw. Although Dubois may count as a "divided subject" (*$*), what was at stake was not a conflict between theory and observation. His "syndrome" concerned the relationship between the imaginary and the symbolic. As an imaginative researcher, a "seer" as Shipman phrases it, Dubois' research was guiding by a mental image (*Anschauung* in German), by "theory" in the original Greek sense of θεωρέω. Dubois was profoundly aware that excavating skulls is only the beginning, and that scientific validation relies on symbolisation (nomenclature and quantification), resulting in

formulas indicating quantitative relationships, as exemplified by his cephalisation law. In view of the iconoclasm of science, the resulting formula may retrospectively challenge or even destroy the initial guiding image. This is what happens in the *Fallgeschichte* of Eugène Dubois, and that is precisely how science should work.

Thus, rather than questionable research or mental deviance, Dubois' case history reflects the dialectical relationship between the imaginary and the symbolic as basic registers of scientific experience. Dubois began by endorsing the archetypal image of early humans dwelling in caves: a vision of a primal scene which proved impossible to realise in practice. This guiding image was *negated* by practical experience, by the absence of empirical evidence (the Sumatran trauma). Therefore, Dubois was forced to discard his iconic image and to replace it with a different primal scene, reflecting a different topology: early humans dwelling on a river bank. This time, the negativity of his Sumatra experience could be overcome (the negation of the negation). Guiding vision and excavation outcomes now converged into a comprehensive picture.

This result, however, was once again iconoclastically undermined by craniometry, a Gestalt-switch confirmed by the sudden name swapping (Ap → Pa). Dubois emerged as *agent*, entitled to name the new-found species in his first publication, his science classic about Pithecanthropus (Dubois 1894). The objective was to validate the imaginative vision with the help of symbolic data. Craniometry was mobilised to add a new signifier (*Pithecanthropus erectus*) to the terminological grid of fin-de-siècle science. Focussing exclusively on his object *a*, however, Dubois underestimated the importance of context (i.e. detailed, quantitative contextual information concerning topographical data), which he tried to repair during his 1895 lecture, in which precise stratigraphic details were added, another step in the symbolisation process, zooming out as it were, allowing for a shift of focus from object to context and circumstances. But he kept insisting that femur and skullcap belonged together, so that Pithecanthropus combined upright posture with a large-sized brain (femur + skullcap = the missing link).

His three-dimensional reconstruction of P.e. (for the 1900 world fair) was another imaginative step, resurrecting P.e. as a gestalt. The guiding image provided a scaffold for his work, which as such remained consistently focussed on symbolisation. Thus, his cephalisation work resulted in the formula $E = cP^{0.56}$. For Dubois as a scientist, this result was more important than his P.e. statue. As his cephalisation research proceeded, he was willing to sacrifice his 3-D reconstruction (his imaginary, iconic image) to his formula, his law of cephalisation (acknowledging the primacy of the symbolic over the imaginary). Although this was misinterpreted by critics as a retraction (Brace 1981), or as data massage (Caspari and Wolpoff 2012), it was actually a step forward. The initial image was negated by the iconoclastic symbolisation process. On the theoretical level, however, his theory of punctuated, saltatory evolution retains a tinge of the imaginary: the leap-like progression from one *Gestalt* to the next.

The shift of focus from object to context also inspired his effort to reconstruct a Pliocene habitat, again a project based on active imagination. While experts (S_2) like Father Bernsen diligently studied Tiglian fossils, Dubois tried to actively imagine what this ecosystem had looked like: a paleo-ecological experiment as it were. The guiding image was put to the test and the estate became an open-air laboratory for a palaeontological field trial.

He desperately clung to the idea that femur and skullcap belonged together (as partial objects giving rise to one gestalt), until Father Bernsen confronted him with the second left femur. Now, even his most precious guiding image (of P.e. as a single individual, upright and brainy) was challenged. Given the evidence, the hypothesis that his fossils had belonged to one individual seemed impossible to maintain. What he had been dealing with all those years were fragments. The imaginary *whole* gave way to a *corps morcelée*. Pithecanthropus was a *Mischperson* (Freud 1900/1942, p. 299). This final sacrifice, which could have reconnected him with the international network of qualified paleoanthropologists, proved one step too far for the aging pioneer. To relinquish the phantasm of oneness could have been a liberating, cathartic experience, freeing him from his shackle (his exclusive, obsessive relationship with his object *a*), furthering individuation by seeing research as a distributed, collective and collaborative process ($\$ \rightarrow S_2$). Father Bernsen, combining careful, methodological research (university discourse) with a feel for confessional dialogue, would have been the perfect interlocutor to achieve this. Due to his premature death, the denouement miscarried.

The fossil collection (now at Naturalis, Leiden) assembled by Dubois, or rather: by his team of convict excavators put at his disposal and supervised by two sergeants, remained a valuable resource for subsequent generations of researchers. Recently, it was discovered that Homo erectus made miniature engravings in Solo River shells: tiny geometric strokes which apparently reflect a symbolic or mathematical pattern (Joordens et al 2015), although the function and meaning of these patterns (a calendar, symbols, numbers, decoration, doodles?) remains unclear. This discovery is quite astonishing, because the earliest previously known geometrical engravings were at least 300,000 years younger (Henshilwood et al 2009). In other words, Dubois' fossils not only present interesting case material for studying the progression of the symbolic in science, but also reflect the dawn of the symbolic (of the signifier) *as such*. According to Lacan, the signifier is basically an incision, a stroke or marker (like the markings on Trinil shells), signifying days, weeks or months perhaps, as items on a primordial calendar, opening up a new dimension of experience (a clearing): the symbolic order, through symbolisation. To achieve this, the fossil treasure (made static by Dubois as an aging misanthrope, transforming it into a Nibelung hoard) had to be put back in circulation once again to be accessible to professional researchers (S_2 as agents).

Let this suffice as a psychoanalytical rereading of the Dubois case. I will now turn attention to missing link novels, beginning with Jules Verne's *The*

Village in the Treetops. This novel provides an oblique perspective on the dynamics and vicissitudes of fin-de-siècle anthropology as a particular branch of university discourse, focussing on the quest for the *missing link*, the object *a* of this type of research. It brings to the fore what remained subliminal in our discussions so far: the connection between palaeoanthropology and colonialism, between exploration and exploitation. It allows a shift of focus from front-stage to back-drop, from the scientific will to know (embodied by individual researchers) to the Faustian will to power (embodied by nation-states).

VI. Triangulation: caves, trees and primal scenes

Jules Verne's novel *The Village in the Treetops* (published in 1901) begins with a discussion between two young prospectors / explorers, namely John Cort (an American) and Max Huber (a Frenchman) concerning the question whether the United States should join the colonisation of Africa by establishing an "American Congo". Verne's novel is devoted to a particular research field, namely anthropology, but this introductory dialogue reflects the political and economic backdrop, for it discusses (in a jocular tone of voice) how the scientific *will to know* is driven by a *will to power*: exploration in the service of *exploitation*. This dimension is already clearly present in Dubois' case, for Dubois conducted his research in a colonised archipelago with the help of a team of native convicts, whose role was roughly comparable to that of the black porters enlisted by John and Max to carry their luggage and booty of ivory back to Libreville, while elephant tusks (partial objects and things of astonishing value) play a role comparable to the Pleistocene mammalian fossils in the case of Dubois (as the object *a*, the surplus value of journeys of exploration into the heart of Africa). From the beginning, scholarly exploration is intimately connected with bioprospecting, the appropriation of large territories and mass killings ("hecatombs", p. 11) of large animals such as elephants[31] and rhinoceroses, in order to quench the imperialist thirst for ivory (as raw materials for billiard balls and piano keys). Research is an auxiliary activity, a by-product of imperialism. When John claims that he came to Africa out of curiosity and not to conquer, Max points out that the difference is negligible.[32] Their biggest concern, in the heart of Africa, is to maintain their superior white identity and not to allow themselves to become "negrified" (p. 9).

Dissatisfied with the hunt for ivory and other standard ingredients on the "menu" of Western explorers, Max is plagued by a desire to discover *something else* ("autre chose", p. 11), something "extraordinary", never seen before, something decidedly "unexpected" ("imprévu", p. 11); – in Lacanian terms: his focus of attention is displaced to an (unknown and absent) object of desire, the object *a* of exploration: something alluring and undefined, something questionable but wholly "other". This "something" explains his eagerness to venture off the beaten tracks. Quite easily, the explorers lose all interest in their ivory booty (officially the objective of their lucrative expedition) and deviate from their course to enter the unknown and allegedly impenetrable jungle of Central Africa, where their quest for the unknown exposes them to a challenging

[31] The two adventurous gentlemen are well aware of the fact that, in view of the mass killings of these "monstrous pachyderms" (allegedly 40,000 a year), complete extinction will be a matter of decades (p. 57).

[32] Max: "Et tout ce pays que nous venons de parcourir…". John: "En curieux, en simples curieux, Max, non en conquérants... ". Max: "La différence n'est pas considérable…" (p. 10)

series of experiences. Unintentionally, they become involved in knowledge production and university discourse.

Mysterious fire signals are a first indication of something unexpected: the existence of unknown, semi-human beings, "adapted to the conditions of their habitat" (p. 119). As Aristotle already argued, fire as such is a natural phenomenon, but *moving* fire is a symbol, a signifier, signaling something definitely human. Upon entering the forest, therefore, Max Huber is visited by "reveries" (p. 121) concerning semi-human "types" with whose existence professional ethnographers are as yet completely unacquainted. With such a discovery, he surmises, he could certainly make a name for himself. The journey becomes a voyage backwards in time, a regression, as they find shelter in trees, but also in a cave-like crevice near a river. Here, however, they discover an iron padlock, connected with an iron cage: evidently a product of modern Western industry (although the manufacturing mark, representing the symbolic order, is no longer legible). Sadly, they conclude that they have lost the race for priority. The honour of being the first to visit this great forest apparently goes to someone else. But their optimism returns when they discover a notebook with a name on it: Doctor Johausen: a "revelation" (p. 114), because this signifier (this "name-of-the-father") is connected with an anthropology pioneer: "one of the most fantastic or whimsical examples of modern scientific endeavours" (p. 114).

And here, Verne inserts the account of a real event into his novel, namely the story of Professor Richard Garner who studied monkey language ("the Simian tongue") in the zoological garden in Washington D.C. with the help of a cage of twisted wire and a phonograph (type Edison). His working hypothesis amounted to a negation of a negation, namely the claim that anthropoid apes such as chimps and gorillas are *not a-lalus* but share with humans the capacity to babble, to use their tongue (as a partial object) for symbolic purposes (for constructing a symbolic order). Subsequently, he decided to take his phonograph (his "scientific weapon of phonetic precision") to the African jungle, installing himself and his machine in a metal cage. As Garner himself phrases it (Garner 1900), after having devoted much time to studying monkeys in captivity for several years, he now wanted to study them under more favorable conditions, in their state of nature. Thus, he decided to transport his cage (his scientific "hermitage") into the heart of the African jungle: a contrivance of cubical shape, six feet and six inches square. Comical reversal is at work here, because normally, in zoological gardens, animals (monkeys) are supposed to be inside the cage, while human visitors observe them from the outside. In Garner's installation, however, it is the other way around: the human observer inhabits a cage surrounded by intrigued apes. His scholarly adventure made him one of the most well-known scientists of his day (Radick 2007). And he recorded his results in a book entitled *The Speech of Monkeys*, published in 1892. The British periodical *Truth*, however, notorious for its exposures of frauds, accused Garner of having fabricated his results.

There was an ideological backdrop to Garner's research, moreover, namely the "war" between science and religion (Radick 2007), more specifically

between Darwinism and Creationism. Creationism admitted the existence of discontinuity and leap-like changes, notably the sudden appearance of language and rationality in humans. The Darwinian worldview, however, explained evolution in terms of continuity and gradual change. But how to explain the intellectual discontinuity between humans and higher apes? Verne is aware of this debate, of course, and even quotes the basic "axiom" (the grounding conviction, the philosopheme) of continuity thinking, mentioned by Darwin in *The Origin of Species* on no less than seven occasions, namely the conviction that nature does not make leaps (*Natura non facit saltus*; "la nature ne procède pas par sauts", p. 139). This conviction (this *a priori* statement) implies that there must be intermediate forms of communication (linguistic missing links) between primate interactions and human language. The Simian tongue (the object *a* of primatology) purported to fill this gap.

The experimental part of the research was hampered by practical obstacles, however, by the difficulties of conducting this type of research in the wild. The tension between theoretical expectations and empirical results (the actual *absence* of the Simian tongue) became unbearable and prompted Garner to fabricate and falsify his results. Jules Verne read public press reports of Garner's case and decided to use his research practice as a topic for his novel. Thus, Verne recounts how, in the year 1892, Professor Garner left America for Congo to arrive in Libreville, travelling from there to Lambaréné (where Albert Schweitzer would later establish his famous hospital). Here, he erected his iron cage to live among the great apes and study their language. According to Verne, however, Garner spent only three days in his cage, rather than three months, as he had claimed. And because Garner's results were inevitably disappointing and inconclusive, Doctor Johausen, after reading a report of the original trial, decided to replicate and improve the experiment.

In Verne's novel, Johausen and his cage had been transported into an unknown part of the Central African jungle. While Garner had opted for a "playback experiment" (playing recordings of animal communications back to them so as to study their responses), Johausen decided to use a barrel organ to analyse how primates would react to musical pieces, such as the waltz from Weber's opera *Der Freischütz*. Both Garner's original experiment and Johausen's fictitious replication are relentlessly ridiculed in Verne's novel. Garner's fraudulent attempt resurges in *The Village in the Treetops* as a parody. Verne's novel parodies university discourse.

After detecting the signifier "Johausen", the two prospectors wonder what had happened to the German scholar. Their enigmatic find inevitably stirs their imagination. They decide to continue their journey back to Libreville with the help of Johausen's raft, killing a dozen or so gorillas as they drift along, meanwhile engaging in scholarly discussions concerning evolutionary leaps and missing links. According to Max, the difference between Congolese natives and African primates is rather "slim" (p. 139), but John maintains that an abyss separates animals from humans, instinct from intelligence. They are determined

to settle the unsolvable issue raised by Darwinism, i.e. the existence of a missing link, by virtue of "the axiom that nature does not proceed by leaps", in other words: by somehow discovering the lacking type ("ce type qui fait défaut", p. 139).

A first opportunity to tackle the issue presents itself when they encounter an infant representing a species that no anthropologist has ever observed and which seems to hold the middle between humanity and animality, something half-ape, half-human (p. 172): a trophy which they decide to take home. An even better opportunity presents itself, however, when the raft crashes in a waterfall. As soon as they regain their senses, they find themselves in an obscure part of the forest, underneath an immense platform erected among giant trees. What they in fact discover is the floor of a treetop village, inhabited by a lost race of prehistoric hominids: the Wagddis, who had managed to survive into the modern age (Ruddick 2010). As Verne explains, since they walk upright, they seem entitled to the qualifier "erectus" given by Doctor Eugène Dubois to "the Pithecanthropus found in the forests of Java" (p. 199). Thus, the Wagddis can be regarded as living homo erectus-like humans, as living intermediaries between the higher apes and humans (or rather, as the adventurers see it, between primates and black Africans). They represent a race, albeit still labelled with a "minus" sign compared to full-blown humanity (p. 204), an intermediate race of "anthropopithecuses" which so far had been missing on the scale.

Whereas Max responds to the situation like a poet, John becomes an amateur anthropologist, grasping the opportunity to study this unknown race from a close distance and from an ethnological-anthropological point of view, in order to determine their level of "anthropomorphism" (through observation and comparison). Thus, a fictional research practice evolves: a parody of fin-de-siècle anthropological discourse. Max and John are determined to collect and publish their observations as a contribution to the scholarly literature. Although the Wagddis seem somewhat "micro-cephalic", they are definitely more human than primates. They are clearly able to speak, although their vocabulary embraces no more than twenty-five or thirty words, and they are familiar with the concept of the nuclear family, but their dwelling place (an immense bird nest) seems an arboreal atavism.

Moreover, the question emerges whether the anthropological concept of "eccentricity" applies to them. As Verne points out, whereas in every human there is a level of duality, so that we are combinations of "me" and "other", and never completely coincide with ourselves, it seems as if in the case of the Wagddis one of these dimensions (the dimension of otherness) is missing (p. 222). In other words, unlike modern humans, these happy people cannot yet be considered as divided subjects (*$*).

At the same time, it is clear that, in order to study them convincingly, one would have to live among them for several years. Just "three weeks of study" (i.e. the time spent by Max and John in the Wagddis village, p. 224) is evidently insufficient (p. 223). Still, John uses the opportunity to study their existence in

some detail, as an amateur ethnologist. Question: what precisely is the difference, between Wagddis and primates on the one hand, and between Wagddis and humans on the other? To begin with, they laugh abundantly, and laughter is considered by anthropologists as a distinctive human feature. They certainly have emotions, they know the difference between right and wrong, and produce alcoholic drinks. Why not admit them into the ranks of humanity? There still seems to be a kind of lack ("manque", p. 234). Besides the fact that their music is horrible and their choreography erratic, they take to grimacing and seem to lack religiosity: more specifically, the conception of a supreme being. And it is also unclear whether they burn or bury their dead. This makes their entitlement to being formally classified as humans disputable (p. 246). There are neither idols nor priests in the village, although perhaps the enigmatic Father Mirror (their mysterious, invisible monarch, imprisoned in a forbidden cabin) should count as such. Meanwhile, they notice that the Wagddis somehow picked up some German words, notably the primary signifier, the name-of-the-father, as Lacan phrases it, namely *Vater*.

In all these impromptu efforts at classification, Verne parodies anthropological techniques, revealing that this type of research is actually under the sway of basic convictions, framed in terms of a decidedly modern, Western, bourgeois self-image or ego ideal which is taken for granted as a universal cultural standard to distinguish "us" from "them", "self" from "other". The most decisive difference, in Verne's account, between these hominids and genuine human beings is the fact that, instead of idols (guarded by priests), they venerate a living human (their *Vater* in hiding). In other words, what is missing is what Freud regards as a crucial event in the process of anthropogenesis, the killing of the primordial father, so that the latter can be sublated into an idol or ideal and internalised as a voice of conscience: the truth event of *Totem and Taboo*. And although the sacred royal hut is in fact considered taboo, so that Max and John are not allowed to enter, the father figure is still a living human, silently hiding in his forbidden hut.

During a day of festivities, however, when his Royal Highness is finally carried around on a *sedia gestatoria* to be shown to all, Max and John recognise him as Doctor Johausen. Unable to psychically survive in such an unfriendly environment, Johausen had fallen victim to a psychic crisis. Precisely because the Wagddis mistake a mad scientist for a god (due to the fact that, as Max and John phrase it, they must have sensed in Johausen something of the intellectual superiority of the white European race), the Wagddis fail the litmus test, and cannot be considered fully human, Max and John argue.

The imaginary, the symbolic and the real

In terms of the three registers of experience (the imaginary, the symbolic and the real), Max and John are adventurers who leave the modern, domesticated world behind (under the sway of paternal power and the symbolic) to expose themselves to the challenges and dangers of the tropical "real". Whereas Johausen is consumed ("negrified") by the great forest, their aim is to return to the West unharmed and unaltered. They immunise themselves against the threatening Real with the help of the imaginary. A screen is erected consisting of stereotypical reveries about Central Africa and its inhabitants, including mad ("cracked") explorers going native. As soon as Max enters the forest, he reverts to daydreaming ("rêveries scientifico-fantaisistes", p. 122). As Freud (1907/1941) argued, novels are elaborate day-dreams. *Village in the Treetops* revolves around a particular archetypal core: the idea of early humans living in trees, Verne's counter-image of Dubois' idea of early humans dwelling in caves. The novel elaborates this archetypal vision, so that the image of the tree (the imaginary dwelling of a primordial nuclear family) is amplified into a platform, large enough to support a whole village.

In the novel, this platform is presented as a *Schauplatz*, a clearing for studying living specimen of Homo erectus. The platform is transformed into a research site or anthropological laboratory, enabling practices of symbolisation. Symbolisation basically comes down to making the diffuse discrete, with the help of quantification and classification. In the case of Dubois, symbolisation progressed via skull measuring instruments as we have seen, but in the case of Garner and Johausen the phonograph was destined to play this role.

In the case of Max and John, however, such systematic precision measurements are lacking. They are ill-equipped amateurs, impromptu ethnologists, gentlemen scientists rather than professionals. Therefore, symbolisation basically amounts to improvised classifications, with the help of the naked eye and ear, but vulnerable to prejudice. Should the Wagddis be considered as human, that is the question. Or can certain significant differences be detected, such as the shape of their skulls, the quality of their music, their religious conceptions, etc. But prejudice prevails. The claim that the Wagddis are "microcephalic" for instance is not supported by any quantitative evidence, while the poor quality of their music may be attributable to a deficiency on the part of the beholder, to Max and John's lack of familiarity with the pre-historic, Pleistocene soundscape. What exactly is it that allows Max and John to distinguish "them" from "us"? In fact, in Verne's novel, practices of classification are relentlessly ridiculed. They are evidently reflecting Western, bourgeois, fin-de-siècle prejudices, for instance concerning the question what music should sound like or what religion should amount to. It is symbolisation in service of a self-image or ego ideal, rather than being an iconoclastic practice. Compère (1996) speaks about Verne's "discours bouffon". Indeed, university discourse is

parodied and Verne joins a long tradition (Lucian, Erasmus, Molière) of laughing about science.

Max and John not only endorse stereotypical images about forest inhabitants, but also about science. Their portrayal of Johausen reflects the stereotypical image of the "cracked" scientist, amplified by national prejudices: the French novelist Verne ridiculing German science. Johausen's perseverance and daring (comparable, I would argue, to the quixotic perseverance of Eugène Dubois), is ridiculed as fanaticism and obsessiveness. The expeditions of Dubois and Johausen may both be seen as bold and daring. Although formally a physician, Verne describes Johausen as being more an amateur of zoology than of medicine (p. 175) and something similar applies to Dubois of course. In Verne's gallery of scientists, he is the one who comes closest to Dubois. It is a parody of the type of research practiced by Dubois.

The vicissitudes of university discourse

Garner's research, as well as Johausen's replication attempt, are instances of university discourse. The qualified expert (acting as the agent: S_2) designs a trial (an expedition) to capture something which is as yet absent or unseen (*a*) and which, not coincidentally, carries the name of a *partial object*, an organ, the Simian *tongue*. This particular branch of research is driven by a normative momentum, however, a will to power: the imperative to colonise the Earth (S_1). In the context of anthropology, this imperative takes a specific form. Darwinism is not only a scientific theory which incites anthropologists to search for missing links, but also a source of inspiration for the fin-the-siècle worldview, interpreting modern history as a global struggle between nation states (as colonial powers), fighting for global dominance by the fittest. And palaeoanthropology is part of this global mobilisation. Scientists are recruited to expose themselves to challenging ecosystems:

S_2 (palaeoanthropology)	*a* (the missing link, the Simian *tongue*)
S_1 (strive for global dominance / Darwinist worldview)	*$* (research pioneers as challenged, tormented subjects)

Max and John embark as entrepreneurs, not as scholars, but even in their case, the Congo expedition is not only motivated by financial gain, but also by the desire to realise a particular worldview (S_1), built on the idea of dominance by the fittest. They divert from their initial, entrepreneurial course, as we have seen, and become entangled in research: the production of university discourse, to which they aim to contribute, albeit as amateurs. Exploration equals exploitation (with the forest and its inhabitants as resource). Over and above the normal object of desire (ivory), an enigmatic something emerges (adding surplus value to their expedition): the missing link.

Although Darwin himself did not literally use the term "missing link", in Verne's novel it is claimed that the question of the missing link was "raised by the Darwinian doctrine" (p. 139) and that the existence of an "intermediary form" between apes and humans was "predicted by Darwin" (p. 201). Max and John are convinced that their unexpected observations, should they reach the Western world, will contribute significantly to ongoing discussions concerning Darwinian theories (p. 240). Besides Darwin himself, Verne also mentions Carl Vogt, whose lecture series *Vorlesungen über den Menschen* had triggered young Eugène Dubois' interest in human evolution. Notably, Verne mentions Vogt's idea that microcephaly is an atavistic reappearance in modern humans of an ancestral, pre-human trait (Pulvers et al 2015).

Besides the missing link idea, Darwinism also became associated with the concept of dominance by the fittest, as a rationalisation or justification of colonialism and imperialism. In short, more explicitly than in Shipman's biography of Dubois, Verne's novel elucidates how (against the backdrop of a Darwinian worldview) these two endeavours (the scientific quest for the missing link and the ideology of imperialism) were in fact intimately connected. We may now see this more clearly in the case of Eugène Dubois as well. Also in his case, the actual fossil digging was carried out by convicts, provided to him by colonial rule. While providing for food and accommodation, the Pithecanthropus skull (the surplus value of their labour: *a*), was appropriated by Dubois without compensation.

Eugène Dubois' discovery of Homo erectus is explicitly discussed in Verne's novel, as we have seen. Even craniology is mentioned, but the focus of attention is on trees rather than caves, and on the origin of language (and laughter) rather than on the volume of cranes. As soon as Max and John enter the lost world, the object of palaeoanthropology (the extinct human form) becomes a living research subject, similar to how, in Michael Crichton's *Jurassic Park*, fossilised Jurassic species are transformed into research animals (Crichton 1990). Thus, palaeoanthropology (the quest for the missing link as an *extinct* intermediary) gives way to cultural anthropology, and the novel depicts the study of the missing link *in vivo*, with early humans still living in their natural habitat. Verne's main source of inspiration, Richard Garner's research into monkey language ("the Simian tongue"), was in fact eclipsed by Dubois' discovery. As Radick (2007) argues, Dubois' "sensational find made the fossil record seem a much more promising source of evidence with which to fill the ape-human gap" (p. 7). Nonetheless, both research practices were fuelled by the quest to discover the missing link.

Besides colonialism, Verne also enacts the connection of fin-de-siècle anthropology with racism. The views exchanged between the two travelling gentlemen are unabashedly racist, depicting African natives as "cannibals" with "infantile intelligence", but in the course of the novel these prejudices give way to a more open-minded anthropological "curiosity", as far as "the question of race" (p. 84) is concerned.

The Garner case already reflects the basic structure of university discourse. Garner is the university expert (as *agent*: S_2 in the upper-left position), determined to detect the missing link (the Simian tongue as object *a*), transplanting his experimental window from Washington to Africa, even if that means risking his life, reputation and career. When the experiment derails (due to the recalcitrance of the real), he reverts to fraud:

S_2 (Garner as language expert)	*a* (the Simian tongue as a proto-language)
S_1 (*Natura non facit saltus*)	*$* (derailment and fraud)

Initially, Garner conducts his research in a domesticated environment, a language study laboratory: the zoological garden in Washington. Subsequently, however, he decides to extrapolate his experiment to real-life outdoors circumstances and to replicate it in the wild. Only by studying primates in their natural habitat can science really verify the basic maxim (the philosopheme) of the Darwinian worldview (S_1 in the lower-left position), namely that nature makes no leaps. This maxim predicts the existences of basic linguistic components in the language of monkeys and primates (the linguistic version of the missing link: *a*). This not only requires the transportation of Garner's research contrivance (his iron window) into Congo, but also the challenge of exposing his mind and body to the tropical Real, represented in Verne's novel by mosquitos, loneliness and sweltering heat. Unable to live up to these challenges but unwilling to give up on his paradigm and his hypotheses, Garner reverts to fabrication (*$* in the lower-right position: fraud and despair as unintended by-products).

Garner's *fraud* becomes a *farce* in the case of Johausen, Garner's eccentric successor, determined to succeed where Garner failed. His replication attempt, enacted in *The Village in the Treetops*, derails into parody and is relentlessly ridiculed by Verne. Johausen is more determined and persevering than Garner, but his perseverance is casted by Verne as obsessiveness. The outcome is even worse than fraud: a severe mental crisis. According to Verne, there was a "crack" ("fêlure") in Johausen's psyche from the very outset (p. 119). In this tropical, unhealthy environment, the "crack" deteriorates into dementia, and S_2 gives way to *$*. In his obsession to find the missing link, Johausen falls victim to the matheme of desire (*$ ◊ a*), where *$* represents the crack, ◊ the iron cage and *a* the inexorable linguistic phenomenon. Like Garner, Johausen is the scholarly expert (S_2, upper-left position) who sets out on a scientific expedition to demonstrate (by means of a carefully designed experiment) that elementary linguistic components can indeed be discerned in primate communication. This symbolisation of the real is supported by instruments: the iron cage (a replica of Garner's model) as a window into the primate world, but also the barrel-organ, employed as a laboratory prop to produce auditory stimuli in order to evoke Simian responses (as indicated in the scheme below).

S_2 (Johausen's replication	*a* (the Simian tongue)
S_1 (*Natura non facit saltus*)	*$* (psychic crisis: victim of science)

Johausen not only wants to replicate, but also to significantly improve the miscarried effort of his fraudulent predecessor and manages to spend thirteen days in the cage instead of three, outcompeting his American rival. His aptitude for obsessiveness and eccentricity constitutes a risk from the very outset, however. He becomes literally trapped by the object *a*, trapped in his own cage.

Initially, Johausen succeeds in meeting his research subjects, in accordance with his methodological intention to *go to the things themselves* (by visiting primates in their natural habitat), but this results in a reversal of roles. Instead of accepting the role of "object", providing answers to Johausen's scientific questions (by producing elementary components of Simian speech, the object *a* of his research), they remove him from his cage and imprison him in their village. Exposed to these taxing circumstances, Johausen (whose intellect was "cracked" from the very outset) apparently suffered a mental breakdown and slides into dementia (*$*).The target of his *cupido sciendi* proved a hazardous and elusive object, not only because of the technical difficulties involved in identifying and recording the basic components of the Simian tongue (which, according to sceptics, is actually inexistent), but also because of the ambiance: the challenges involved in facing the tropical real. Indeed, when Max and John (taking advantage of the general inebriety of the villagers after their day of festivities) finally manage to enter his cabin, Johausen is unable to recognise them, his fellow whites, and to converse with them, even when they address him in German. He is only able to grimace and squeal. His humanity has left him. Nature does make leaps, also in the reverse direction. Johausen relapses into the subhuman, and superiority (+) gives way to deficit (–).

Does this disqualify the Wagddis as humans? According to Max and John, they elected Johausen as their King because they sensed his "superiority". As fin-de-siècle anthropologist James Frazer (1890/1993) argued, however, starting with Oedipus for instance, monarchs quite often begin their career as foreigners and intruders. Johausen was different, but not in the sense of being superior. Johausen (who taught the Wagddis to address him as *Vater*) fell victim to mental health problems ("dégénérescence mentale", p. 264), and precisely his mental aberration (rather than his intellectual superiority) may have singled him out as monarch, as Max and John admit later on, when they argue that in primitive cultures, individuals struck with madness ("folie") are often considered as "custodians" of the divine (p. 265).

A similar misunderstanding skews their assessment of the qualities of Wagddis music. Initially, they consider the music performed during their festivities as charivari, i.e. sheer noise, without any sense of measure or melody. Suddenly, however, the terrible noise is silenced and a strange artefact is carried out of the royal cabin: Doctor Johausen's barrel-organ. Initially, we are led to believe that the music produced by the barrel-organ (the waltz from *Der*

Freischütz and *La Grâce de Dieu* by Loïsa Puget) is "superior" to Wagddis music, but this is clearly not the case. Besides the fact that (because of nationalism and male chauvinism) Max and John detest these pieces of music (the waltz is composed by a German and *La Grâce de Dieu* by a woman), it is clear that the instrument is badly damaged, so that Puget's song is played in the wrong key (C major instead of C minor); parody again. These instances of "superior music" must actually have sounded quite awful. Moreover, Max and John eventually concede that, in order to appreciate Wagddis music, a one-time exposure is sufficient. A more intimate and prolonged contact would be required, "in the interest of anthropological science" (p. 274). In other words, although the comparison in terms of superiority reflects their spontaneous reaction to the exposure, the superior-inferior comparison gradually gives way (here and elsewhere) to a qualification in terms of otherness.

These amateur anthropologist replicate a basic tendency of anthropological discourse itself, namely to evolve from a culturally biased research arena (destined to verify and reflect the Western superiority complex) into a field where diversity (absence or presence, + or –) is conceived in a more objective manner, as symbolic variations of signifiers (i.e. the shift from Edward Burnett Tyler to Claude Levy-Strauss, from Sigmund Freud to Jacques Lacan, from Freud's *Totem and Taboo* to Levy-Strauss's *Elementary Structures of Kinship*). The blatant racism voiced by the two explorers (especially by Max) in the beginning of the novel, reflects and amplifies a basic flaw at work in fin-the-siècle anthropology as such (so that Verne's novel functions as a magnifying glass), but these prejudices attenuate towards the end of the novel (notably in the case of John), as if these gentlemen really learn something from their exposure.

Moreover, the Wagddis not only demonstrate an aptitude to music, but they are also able to differentiate between their own music and the music produced by Johausen's instrument, which they are only allowed to hear on specific occasions. Johausen's music causes an ecstasy, not because it is superior, but because it is something completely different and exceptional. And gradually, it dawns on Max and John that, if there is something which sets humans (including the Wagddis) apart, it is this aptitude to appreciate and differentiate between various styles and genres of music, keeping Johausen's music in reserve for special occasions (not because of its superiority, but because of its exceptionality).

This also explains why the Wagddis treat him as a deity and consider his cabin as taboo. Initially, he may have been something of a Moses as depicted by Freud, someone representing a different culture, a medicine man moreover (Johausen was a physician by training), teaching them some German words, notably the primal signifier *Vater* ("father"). Yet, being kept in close confinement, the scholar derails and loses his mind: the experience kills him, mentally speaking, so that he degenerates into a human beast ("bête humaine", p. 264). Therefore, the Wagddis pass the litmus test after all. They function as a society (a fraternity, in Freudian terms), they "killed" their father figure, who

already showed signs of strangeness and madness even when they met him. Thus, in the final chapter, entitled "Denouement", the issue of the "anthropological difference" is finally decided: the Wagddis (with their propensity to sing, caress, smile and weep) are labelled as human and joined with humanity after all. But Verne immediately inserts yet another ironical twist, for this acknowledgement grants them – the right to be colonised (!), so that, after more extensive anthropological inquiries, they can expect to pass over to one of the protectorates (probably the French one). The link between modern science and global colonialism constitutes the alpha and the omega of Verne's novel. It is the first word (the dialogue between Max and John about an American Congo) as well as the final word (their dialogue about the right of the Wagddis to become the subjects of a protectorate).

Radick (2007) argues that the simian tongue disappeared from scientific discourse because those interested in human origins turned their interest towards the fossil record. Dubois' discovery coincided almost exactly with Garner's phonographic work of the early 1890s and, according to Radick, Dubois' "sensational find made the fossil record seem a much more promising source of evidence with which to fill the ape-human gap". This transition concurs with Dubois' shift of focus from *larynxes* (as the organ of speech) to *skulls* (containing the organ of thought, i.e. the brain). In other words, Verne not only cites both Garner and Dubois, but also reflects a basic *displacement* in anthropological research: for while the Simian tongue project is derided, Dubois is taken much more seriously by Verne.

Verne's novel amplifies aspects and dimensions which, in our discussions of the Dubois case, remained in the background, notably the connection between exploration and exploitation, between palaeoanthropology and colonialism, between knowledge and power. Both research practices (the quest for the missing link and the quest for the Simian tongue) were closely connected with the politics of colonisation. While Dubois enlisted as an army physician, Garner used the mission of the Fathers of the Holy Spirit at Lambaréné as his base. Both scientists decided to leave Western centres of knowledge (Washington and Amsterdam) in order to go to the things themselves (the epistemology of exposure). Dubois initially explored the Sumatran caves himself, exposing himself physically to the tropical real and undermining his health. Eventually, the actual unearthing of fossils was delegated to colonial prisoners, a chain gang in service of science. It allowed Dubois to focus his full attention on his object *a*, identifying and measuring the unearthed skull. In other words, although Dubois showed more perseverance than Garner, a continuation of his initial strategy of direct physical exposure would surely have resulted in severe a health crisis. Chemists who, in the nineteenth century, experienced the side-effects (both physically and mentally) of chronic and unprotected exposure to toxic chemical substances were diagnosed as suffering from *hysteria chemicorum* (Zwart 2005). Western scholars travelling to colonies in the tropics for their

research ran the risk of falling victim to a similar occupational disease (*hysteria anthropologicorum*).

Jack London's imaginative archaeology

In several of his novels, Jack London displayed a remarkable, almost scholarly interest in anthropogenesis and connected issues, such as ethnic origins and descent. Some of his novels can be regarded as palaeoanthropology with literary means, as time travelling. This notably applies to two of his most remarkable novels, namely *Before Adam* (1907) and *The Star Rover* (1915). I will begin with the second novel because it is in this novel that his technique of active imagination is most explicitly explained.

The Star Rover commences in the mode of university discourse. The narrator (Darrell Standing) introduces himself as a former university professor at the College of Agriculture, University of California in Berkeley, once an acknowledged expert in areas such as agronomics and farm husbandry. He describes his former self as a "precise laboratory scientist", a "laboratory slave" (p. 16), gifted with an unwavering adherence to "microscopic fact". Notably, he was a specialist in "the science of farm efficiency", developing techniques to eliminate waste, reduce inefficiencies and determine "the index fraction of motion wastage" (p. 14). He ran into a conflict with another university professor, however, and, in a surge of anger, killed his competitor, so that he was arrested and sent to the California State Prison at San Quentin for life.

The structure of university discourse can be represented as follows:

S_2 (agronomics)	*a* (zero waste)
S_1 (the idea of a perfect cybernetic system)	*$* (inability to deal with social aspects such as competition)

The narrator's field of expertise (S_2) is agronomics, a branch of applied mathematics that is driven by a normative ideal: the creation of a perfect cybernetic system in the form of a utopian, fully rationalised, hyper-modern "dream farm" (p. 311); an agricultural model for a perfect (i.e. zero waste and highly efficient) society (S_1). Zero waste (the absence of waste products, notably in the form of manure) is the desired outcome of his experiments (in accordance with the logic of the anal grid: the absence or reuse, the zero-production of faeces, the anal object *a*). His fatal flaw, however, is his inability to deal with less rational aspects of being in science, such as rivalry, resulting in a crisis (*$*).

The prison is meant as a corrective institution, but from a scientific (cybernetic) point of view, it is wasteful and inefficient. Therefore, the narrator becomes an impossible, "incorrigible" prisoner (p. 15), allergic for the inefficiencies of the prison system, chronically rebellious against the primitivism of "prison psychology" (p. 15). Such behaviour provokes stringent disciplinary measures, and he spends long hours in a straight-jacket, a penitentiary technique

for which San Quentin was famous, but even under such conditions he continues to defy the wards. In terms of Lacan's quadruped, his position in San Quentin concurs with the discourse of the hysteric:

$ (challenging the system)	S_1 (the worldview San Quentin materialises)
a (the drive and target of his rebelliousness: his secret jouissance)	S_2 (a new methodology for experimentation as a by-product)

The divided subject (*$*) takes the floor as agent, persevering in his rebellion. He "rebels" against the "chaos of inefficiency" (p. 15) and becomes a walking provocation, bent on confronting the prison system, challenging its worldview, its imperatives and representatives (S_1), challenging those in power, but it is unclear what exactly is driving his revolt. His dislike of inefficiencies seems insufficient to explain his willingness to expose himself to a regime of severe punishments, notably consisting of the straight-jacket as a San Quentin specialty, forcing prisoners to spend long hours in suffocating passivity and isolation. Psychoanalytically speaking, there must be a secret pleasure (jouissance) which he derives from this state of anorexia and bondage, some masochistic satisfaction (*a*). During the straight-jacket punishments, he develops (and increasingly enjoys) a "mental exercise" (p. 38), a practice of the self. By concentrating on his inner Self, he is able to detach himself from his strangled body. This fakir-like technique eventually enables him to open-up a whole new field of exploration and experience, of experimentation and research (S_2 in the lower-right position). Thus, while spending extended periods of time in solitary confinement, he manages "to attain a freedom such as few men have ever known" (p. 12). The prison system is "a training school for philosophy" (p. 23) and he becomes "such a philosopher" (p. 24). He is able to hypnotise himself, putting himself in a fakir-like, "cataleptic trance" (p. 244), a state of "suspended animation", a "little death" (p. 245). By systematically "cultivating" his sleep behaviour, he manages to turn sleep into "a science" (p. 37). He dissociates himself from his body by becoming an anorectic, weighing little over eighty pounds, with a biceps so attenuated that it has "the appearance of a string" (p. 77, p. 158). But precisely this (the shedding of his muscles and the frailty of his frame) creates optimal "spiritual conditions" (p. 79) for his experiments, allowing him to focus solely on his mind.

This concurs with Nietzsche's claim (*Genealogy of Morals* III, § 23, and elsewhere) that scientists are basically ascetics. Rather than being antithetical to religious asceticism, Nietzsche (1887/1980) argued, modern science represents its latest version. It entails self-sacrifice, unworldliness and dedicated devotion. For Nietzsche, modern scientists play a role similar to that of monks and hermits in medieval times: they sacrifice pleasure and health to knowledge production, imprisoned in their laboratories, chained to their experimental machines. Migrating from a university campus to a prison environment, Darrell continues to function as a scientist, although his new science in now an unintended by-

product. By systematically schooling himself and by concentrating on his will (p. 79), Darrell becomes increasingly "well trained" (p. 78) and able to extend his consciousness dramatically (p. 81), developing full mastery over his mind (p. 79). Like other famous patients in the history of psychotherapy (such as Hélène Smith, the heroine of Théodore Flournoy's 1900 psychology classic *From India to the planet Mars*), he is able to split his personality (p. 38) and wander off into distant times and places, entering the consciousness of previous selves, exploring the lost worlds in which he once dwelled during previous lives.

Initially, these flights through interstellar spacetime seem an "orgy of the imagination" (p. 83), but gradually his experiences become more concentrated, directed and controlled. He discovers inside himself an "awareness" of other times and places (p. 9), of other persons, of distant memories and previous selves, and in the course of the novel he becomes increasingly apt at conducting these "experiments" (p. 79, p. 84, p. 156). His mental journeys allow him to travel from San Quentin into other lives. Via directed introspection, he enters distant pasts, whose memory traces are somehow recorded in the genetic "stuff of life" (p. 247). In other words, he develops the kind of a technique that Jung refers to as "active imagination" (Jung 1968, p. 96; 1959a, p. 356). All human beings have the potential to enter other worlds, Darrell argues, and to experience vistas of other times and places (p. 9), but in normal life we tend to suffer from "forgetfulness" (p. 10). Only in our dreams do we see "glimpses of other-worldness, of other-lifeness" (p. 9). His self-imposed regime of experiments and exercises allows his psyche to become plastic once again and to return to the years of his "child hysteria" (p. 11), when he was three or four or five years old and "not yet I" (p. 11). Eventually, he is even able to enter "pre-Adamic" and "pro-geologic" eras, when "the world was prime" (p. 11), thereby systematically increasing his knowledge and self-knowledge. As a psychic paleoanthropologist, he discovers that the "catastrophic red wrath" (p. 12), that what made him kill his competitor, was actually the resurgence of an atavistic mood, stemming from his archaic past. Regrettably, all this "knowledge" (p. 153), acquired by him as a spacetime traveller, will be "blotted out" by his death sentence (p. 14). Fortunately, the narrator manages to put his memoirs on paper when he is about to be hanged (writing as a practice of the self).

Initially, the straight-jacket regime induces in him a condition of passivity and helplessness. Darrell *Standing* (and *erect* type of person, a Homo erectus) sheds the bulk of his muscles and becomes "hideously weak" (p. 313). He suffers from anorexia and agoraphobia (p. 313). Having been a "valiant fighter" in the past (p. 16), he becomes physically too weak to fight at all. But the straight-jacket also triggers a dialectical turn, for his exercises provide him with an unprecedented sense of freedom and superiority over his wardens (p. 202), a spiritual release from bondage: from self-mastery to mastery (p. 204). Because he has "mastered his flesh", the "spaciousness of time" is now his to wander in, and the wards become his "slaves", while he is their lord and master (p. 204).

The straight-jacket is a famous prop in the theatre of escapism, but the narrator's escape is of an introspective type. He not only learns a lot about himself as an individual (p. 250), but also discovers that his experiences of travelling through time and space (through the long chain of existences, p. 246) are "in complete accord" with Mendelian law (p. 247) and with the theory of evolution (p. 246). Experiences of previous lives became embedded in spirit-stuff (p. 246), – a term which anticipates what is currently known as the *genome*, albeit seen from an epigenetics viewpoint. The genome, the "stuff of life" is plastic, but at the same time "indestructible" and "immortal". It never forgets (p. 247). In the course of multiple existences, the I persists (p. 123). We should look upon humanity as one person and not as a conglomeration of individuals (p. 288). In other words, the narrator adheres to the idea of a collective, unconscious, species memory, embedded in our genome. We retain our previous existences but have forgotten where it is stored (p. 287). Our multiple histories are written in our tissues and brain cells, in our atavistic urgencies and compulsions (p. 288).

The narrator sees himself as a scientist, working hard to transform his escapism (his mental exercises, his practices of the self) into a scientific method. Many examples can be given of research paradigms that began as practices of the self. Freud's dream analysis, for instance (a component of his self-analysis) became a psychotherapeutic method, and the same applies to Jung's practices of active imagination via drawings, which he developed during a period of crisis, but which later became one of his signature therapeutic techniques. Gregor Mendel, who took up gardening after a mental breakdown, transformed it into an experimental research practice. Even Archimedes' eureka experience resulted from self-care (bathing, i.e. hydrotherapy). In a similar vein, Standing's active imagination techniques (interpreted by him as transpersonal journeys into the collective unconscious) are a psychological technique for self-analysis. In other words: the prison becomes a laboratory, with Standing combining the roles of researcher and research subject, while imprisonment is a condition for the birth a new science, replacing agronomics with dream analysis. Standing presents his straightjacket experiences as the primal scene of a research paradigm.

The crucial question is whether his explorations manage to make the decisive step (the epistemic rupture) from *imagination* to *symbolisation*. As the novel phrases it: whether Standing's experiences evolve from mere "fiction writing" (p. 204) to "science". The narrator himself presents his experiences explicitly as *experiments*, and indeed, some basic components of an experimental design can be detected. The prison constitutes a controlled and minimal environment, a perfect laboratory for conducting psychic trials, because of the absence of distractions and the regularity of the prison regime (the systematic use of space and time). The straight-jacket is a laboratory contrivance, a contraption for bringing about the experimental condition (passivity, lack of mobility, the ability to concentrate, etc.). The use of the straight-jacket (as the independent variable) even allows a certain amount of quantification, for the narrator provides his readership with detailed information about the hours spent in the straight-

jacket, as well as about his increasing ability to intentionally prolong his sleep while being in such a condition. After a while, he reports that he is able to sleep uninterruptedly for "fifteen hours" (p. 37). And he provides detailed information concerning the techniques he employs to induce sleep or wakefulness at will (mathematical exercises involving number series and geometric progressions). Indeed, he even "dallies with the squaring of the circle" (p. 37). But there are no quantified recordings of the *results* of his dream experiences. It remains a matter of introspection, only accessible to the dreamer himself. Precisely for that reason, he is unable to convince a sceptic fellow prisoner named Oppenheimer (sic) that his experiences are real instead of phantasies based on erudition. His mental exercises remain imaginary journeys.

Some of his dreams even allow him to enter the lost, primordial, "pre-Adamic" world. From these dreams he learns that:

> "We once dwelt aboreally and were afraid of the dark. The vestiges remain, graven on you and me … I have scratched the reindeer's semblance and the semblance of the hairy mammoth on ivory tusks … on the rocks walls of cave shelters … and left my bones in asphaltum lakes. I have lived through the ages known today among the scientists as the Palaeolithic, the Neolithic and the Bronze" (289).

Active imagination techniques allow him to retrieve memory traces of domestication and the melting of the ice, hidden somewhere in his brain (p. 290). Experiences of previous human selves live on in us (p. 292). Jack London's novel *Before Adam* builds on the same conviction and resurrects a forgotten epoch, the pre-Adamic world, before the rise of Homo sapiens.

Jack London: *Before Adam*

In *Before Adam* the narrator focusses on a particular dreamscape, which he explores systematically and in detail. In early childhood, during the night, during his dreams, the narrator had been tormented by pictures of a certain type, by a "phantasmagoria" (p, 10) of oneiric images. As a result, the dominant mood of his childhood nights was fear. During his dreams, an "ecstasy" of fear "possessed" him (p. 13). Initially, this was considered childhood "hysteria" (p. 15), but instead of subsiding, these nocturnal traumas evolved into a "dissociation of personality". During the night, his normal self would be "invaded" by a "vanished world", a wholly different form of life. Later, as a college student, he learns about evolution and psychology and recognises that the source of his oneiric traumas is what a college professor refers to as "racial memory" (p. 19). The images date back to the world and experiences of remote ancestors. The falling-through-space dream, for instance, is an atavism, reflecting the typical anxiety of tree-dwellers, the ever-present menace of falling, which had produced molecular epigenetic changes in certain cells that were stamped into the stuff of

heredity (p. 20) and transmitted to subsequent generations via Weismann's "germplasm" (p. 24). The concept of a collective, unconscious ("racial") memory allows him to make sense of his dreams. He discovers that there is method in his madness. He now realises that, during the night, he relapsed backward in time to become a "different creature", so that his fear was the fear of "long ago", the fear that "reigned supreme in that period known as the Mid-Pleistocene" (p. 9). The fear that possessed him as a dreamer was an atavistic mood, a psychic window into a distant past, a world of interminable forests, when people still lived in trees.

Armed with these insights, he decides to take his dreams seriously and study them in detail. In fact, he discovers that his "uncanny" (p. 21) dream experiences guide him back to a transition stage in human evolution when early humans were migrating from trees to caves. We all possess a stock of racial memories, the narrator argues, but while in most of us they are more or less obliterated, in others they are more pronounced, so that some have stronger and completer ancestral memories than others (p. 22). The narrator himself confesses to possess such memories to an enormous extent (p. 24).

Moreover, in his case these atavistic nightmares are connected with the experiences of one particular, far-removed ancestor. He denies that they are "the subconscious projection of my knowledge of evolution into my dreams" (p. 24). Rather, they are a psychic window to explore the process of anthropogenesis, focussing on a particular moment in time when his "atavistic brain" must have lived and to which it became adapted (p. 25).

In one of his typical dreams, he is very small and curled up into a huge tree nest, a platform of twigs and branches, frightened by the tremendous space beneath (p. 26). By systematically recoding and exploring such dreams, he is able to reconstruct a "vanished younger world", in the company of his "other-self" (p. 27). He also retains a vision of his ancestor mother, formidable of build, with stout legs, swift, swinging muscles and a furious temper (p. 30), fully adapted to arboreal life. As to the language spoken in those days, the vocabulary was limited to a minimal set of sounds, modifiable by intonation, pitch and pantomime (p. 39). Later on, his ancestor-self joins a "horde" of cave dwellers, tyrannised by an enormous aggressive male; consistently referred to as "the atavism" (p. 53, p. 54, p. 91, p. 188): "a reversion to an earlier type" (p. 91), and therefore the "discordant element" in the horde (p. 91). With his brutish and violent behaviour (murdering his wives, for instance, or murdering the males whose wives he wants, while never burying his dead), he poses a major obstacle on the road towards becoming fully human. But the horde has not yet developed any form of government or cooperative action and is therefore incapable of eliminating him (p. 91, p. 93), of performing the violent primal act (the killing of the primordial father), which, according to Freud in *Totem and Taboo* (1912/1940), is the decisive genealogical turning point towards constituting a fraternity: the primordial formation of a human society.

The dreamer also observes that the horde, besides a capacity for fear, also has a capacity for "great laughter" (p. 65). They "played along through life" (p.

79), there was no seriousness in them and they had not yet become sufficiently human-like to work out a problem or to innovate, so that progress was slow (if there was progress at all). They did have a feel for collective singing in their caves. In the sombre twilight of the primeval world, they would strike a unanimous rhythm for a moment, but lose it again soon (much like Verne's Wagddis), so that the "art nascent" of the primordial chorus alternated with "pandemonium" (p. 144).[33] While modern humans such as the dreamer are a perplexing mixture of personalities, moreover, an internal duality of self and other (p. 111), of actor and spectator, his ancestor-self (similar to Verne's Wagddis) was not yet a divided subject, but simplicity itself. He simply *lived* events in an illogic, stupendous way (p. 112), although he may also to some extent have dreamed himself back into an even remoter past.

At a certain point, however, the horde is attacked by the "fire people" (i.e. Homo sapiens), who not only know how to use fire, but are much more advanced socially. In terms of physiognomy, there is "very little difference in the degree of the slant of the head back from the eyes" (p. 129) and the ancestor-other finds their faces pleasing because their nose-orifices open downward and the bridges are more developed, so that they look less squat. And while their lips are less flabby and pendent, their eye-teeth look less like fangs. They have speech and co-operation, while their bows and arrows are "enormous extension of their leaping and striking muscles" (p. 154). Indeed, these artificial fangs turn them into "the most terrible of all the hunting animals that ranged the primeval world" (p. 155). They exterminate the horde, although a small number manages to survive the cataclysm ("the day of the end of the world", p. 183). Somehow the narrator's genetic stuff must have mingled with theirs, stamping into "the cerebral constitution of one of his progeny all the impressions of his life", so indelibly that the hosts of intervening generations failed to obliterate them (p. 187). And now, by systematically exploring his dream life, the two dimensions of his dual personality are reconnected (p. 187).

The fantasies of Jack London's dreamer concur with the tropical reveries of Max, elaborated by Jules Verne in his novel. These daydreams build on the idea of primordial humans living in treetops, whose singing sounds like pandemonium to modern ears and who are given to laughter. They also concur with Bachelard's views concerning the archetypal image of the tree, which opens up the "axis of depth" and connects us with a distant past, the past of our ancestors (1948, p. 300). The tree is the image of deep ancestry. Referring to Jack London, Bachelard (1943, p. 107) likewise connects dreams of falling with the oneiric fear of falling as an ancestral memory trace, connecting the oneiric dimension of our personality with the conscious one (1943, p. 119). And London literally agrees: our dual personality is split between an oneiric and a rational one (p. 108).

[33] Compare this with how, many years later, Steven Smithen, via active imagination, envisioned Neanderthal humans singing *Hmmmm* in their caves, while beating sticks on bones, a panorama of sounds echoing and reverberating around the walls: the ice-age soundscape (2005, p. 245).

Imagination is a form of thinking, Bachelard argues (1943, p. 119), and the arboreal image is a primal reality (p. 120), connecting modern consciousness with arboreal life. Yet, although London's novel is grounded in dream visions which are recognisable and convincing, the events narrated in the novel seem too coherent to count as genuine oneiric dreams: they are daydreams or fantasies rather than dreams.

Jack London was fascinated by the work of Jung, but interestingly, he began reading Jung (notably his *Psychology of the Unconscious*) in 1916, a decade after *Before Adam* had been written (Sinclair 1977, p. 220). In Jung he recognised the very ideas he had elaborated with literary means, via novel writing. He was particularly struck by Jung's idea that the archaic mentality and modes of mental functioning are still alive in us today. Primordial, archetypal images may be activated by present events, connecting us with primal experiences, resulting in the sudden resurgence of a distant psychic past. To his partner Charmian he confessed: "I am standing on the edge of a world so new, so wonderful, that I am almost afraid to look into it" (Sinclair 1977, p. 221). His attention shifted from socialism and realism to the unconscious as an oneiric window into a distant past (p. 229).

To conclude: both fin-de-siècle palaeoanthropology and missing link novels build on archetypal visions of primordial humans dwelling in trees or caves. Different techniques are employed to explore and develop these visions, and to assess their plausibility, but although a paleo-anthropologist uses a trowel while a novelist uses a type-writer, both practices work-through the same idea, albeit in different directions: the scientist via symbolisation, the novelist via active imagination, as flanking endeavours. The next two chapter will again explore psychic similarities or differences between animals and humans, but now in an experimental rather than an archaeological fashion.

VII. Conditioning and the symbolic order: Pavlov's research practice

Introduction

In his *Écrits* as well as in his *Seminars*, Jacques Lacan refers to twentieth-century research fields such as ethology and linguistics to elucidate the specificity of a psychoanalytic diagnostic of the human condition. While ethology and Gestalt psychology enable him to explain how animals dwell in an imaginary world (where particular stimuli, e.g. the images of potential predators, partners or preys, incite particular behavioural responses), structural linguistics allows him to analyse how human beings exist in the symbolic order (as a typographic ambiance). Against this backdrop, Lacan was especially intrigued by the experimental work of Ivan Pavlov (1849-1936), a contemporary of Freud and a key precursor of twentieth-century psychology (notably behaviorism and the concept of social engineering). On various occasions (both in his *Seminars* and in *Écrits*), Lacan commented on Pavlov's key discovery, the conditioned reflex, which can be regarded as the instalment of a signifier and as the creation of a rudimentary symbolic ambiance.

In animal laboratories, experimenters use research animals (model organisms, removed from their natural habitats) as laboratory gadgets and as targets of manipulation, often focussing on specific *partial objects* within the organism. According to Lacan, Pavlov's laboratory was a *symbolic* environment (1957-1958/1998, p. 340). All items were carefully selected, all activities were standardised (via experimental protocols) and all events were meticulously recorded. Signals acted as signifiers to which animals learned to respond by producing certain quantities of bodily fluids, notably saliva or gastric excretions (1957-1958/1998, p. 339). In Pavlov's case, however, laboratory dogs allegedly played an active role, up to the point of becoming "partners" whose contributions were acknowledged in academic publications.[34]

On closer inspection, however, these oral and gastric substances were actually produced by the experimenters themselves, using the animals as living reactor vessels (Lacan 1964/1973, p. 254-255). The perceptivity of research animals was tested and trained, but a genuine dialogue never came about (Lacan 1957-1958, p. 340). Although these dogs actively (or even eagerly) participated in the research, they never became equals. And although the laboratory setting functioned as a scaffold for establishing certain signals as signifiers, their

[34] In publications, Pavlov formally thanked his dogs for their assistance: "[T]his method was adopted as a result of a hint given by one of the dogs subjected to the operation. We gratefully acknowledge that by its manifestation of common sense the dog has helped us as well as itself" (1955, p. 89/90); For Pavlov, the dog was "almost a participant in the experiments conducted upon it, greatly facilitating the success of the research by its understanding and compliance" (Todes 2002, p. 52).

meaning was limited to the interaction between the researchers and their dogs, so that the latter never really learned a language. In short, the access of Pavlov's dogs to the scientific laboratory as a symbolic ambiance was limited.

Ideally, animal laboratories are perfectly organised settings which satisfy all animal needs, thereby reflecting a modernistic, utopian ideal (Lacan 1957-1958/1998, p. 461), a brave new world, a *Walden Two*, perfectly managed with the help of science and technology (1957-1958/1998, p. 463). This explains why the communist leadership (notably Lenin and Trotsky) were firmly supportive of Pavlov's work: they saw his laboratory as a window into the future and as a model version of a future communist society. In reality, however, Pavlov's laboratory was not that animal-friendly at all. It produced animal suffering in various forms (as unintended by-product of the research), resulting in various kind of symptoms. Pavlov even noticed "experimental neurosis" among his dogs (Lacan 1966, p. 273; 1962-1963/2004, p. 72). His lab was a pathogenic environment, a totalitarian regime that cared for its animals but exploited their bodies as production factors, while eventually it was the scientist who enjoyed the fruits of the dogs' labour, in the form of publishable and citable knowledge. The laboratory was a knowledge factory driven by desire, by a will to know, but also by a will to power, a desire to acquire behavioural control (1964/1973, p. 264; cf. Zwart 2014a).

In this paper, I will subject Lacan's comments on Pavlov's experiments to a close rereading to explore how psychoanalysis allows us to assess the dynamics of Pavlov's research practice (as an epistemic case history). At the same time, precisely because Pavlov's experiments can be regarded as the enactment of the coming into being of the signifier, a mutual exposure of psychoanalysis and classical conditioning may help us to elucidate some basic psychoanalytical concepts. For indeed, Pavlov's research facilities replicate the *Urszene* (the primal scene) of the symbolic order (in the beginning was the signifier, as an intrusion into the metabolic cycle of needs).

First, I will point to the crucial role of animal research in the development of two core Lacanian concepts, namely the imaginary and the symbolic. Subsequently, I will assess Pavlov's research practice from a Lacanian perspective, as a specific instantiation of university discourse:

S_2 (knowledge produced by experimental researchers	*a* (the allusive, questionable *target* of research: saliva, gastric juice)
S_1 (the disavowed *truth*: Pavlov's laboratory as exemplification of the ideology of social engineering)	*$* (animal suffering as *by-product* and experimental research as an impossible profession)

My assessment of classical conditioning will focus respectively on: (a) the process of knowledge production through experimental technoscience (S_2 in the upper-left position as *agent*); (b) classical (Pavlovian) conditioning as a paradigmatic exemplification of a communist ideology (social engineering as

Pavlov's philosopheme or guiding idea: S_1 in the lower-left position; (c) the role of saliva and gastric juice as objects of scientific desire (the object *a*, upper-right position); and finally (d) the issue of physical and psychic suffering of animals as "victims of science" (Ryder 1975), notably in the form of experimental neurosis, turning experimental research into an "impossible" profession (*$* in the lower-right position, as unintended *by-product*). In *Chapter VIII*, my Lacanian reading of Pavlov's research will be complemented by an exercise in triangulation, with the help of the novel *Walden Two*, a literary classic devoted to behavioural conditioning as its central motif and written by B.F. Skinner, one of the key representatives of behaviorism.

Preliminary analysis: Lacan and animal research

Lacan's oeuvre is dedicated to an objective which, at first glance, may seem rather paradoxical, namely the objective to *return to* Freud, not only by carefully rereading him, but also by radically *rephrasing* his work, in dialogue with the evolving vocabularies of twentieth-century science, including experimental ethology and modern linguistics. This objective was based on a critical diagnostic of post-war psychoanalytical discourse. According to Lacan (1966, p. 244), psychoanalytical discourse had deteriorated because Freud's oeuvre had been ignored, forgotten and obliterated. Moreover, as the psychoanalytic community went into exile and migrated (notably to the United States), psychoanalysis had become susceptible to the logic and mentality of behaviorism (Lacan 1966 p. 245), a form of *human engineering* (p. 246) aimed at adaptation of individuals to a challenging, competitive social environment. To segregate psychoanalytic discourse from human engineering and behaviorism (from the human sciences / university discourse), Lacan proposed to return to Freud, rereading him in a careful, verbatim manner. Not in the sense that Freud should function as a Master, an authoritative voice, a guarantee of truth (S_1), unleashing a servile and apologetic form of discourse, the discourse of the Master (Lacan 1969-1970/1991), in which Freud experts (S_2) function as privileged custodians of an unquestionable dogma. Rather, Lacan aimed to recover the unique dynamics of psychoanalytic discourse as a discourse *sui generis* (the discourse of the analyst), revolving around unconscious desire and its object (the Freudian truth event). Psychoanalysis is neither as Master's discourse, Lacan argues, nor a particular branch of university discourse. Although psychoanalysis elucidates experiences and utterances of human subjects, it is not a human science. For Lacan, the latter as closely connected with social *engineering* and human resource management (1966, p. 859).

Paradoxically, however, while proposing this return to Freud, Lacan at the same time contends that Freud himself was not always able to specify the uniqueness of his intellectual endeavour, notably because of his reliance on nineteenth-century science as his frame of reference (in other words: his lack of familiarity with post-1900 scientific developments). Freud was acquainted with

Darwinism and Victorian anthropology (which he incorporated in *Totem and Taboo*), but much less familiar with scientific movements such as Saussurean linguistics or Gestalt psychology, whose histories coincide more or less with the history of psychoanalysis. In order to elucidate the singular epistemological profile of psychoanalysis as inaugurated by Freud, Lacan explicitly draws on these twentieth-century research fields: on linguistics and ethology, but also on later developments such as cybernetics, molecular biology and computer science. Ethology and linguistics were especially important for Lacan because they allowed him to elucidate two basic registers or dimensions of human experience as revealed by psychoanalysis, namely the imaginary and the symbolic (as two different strategies for addressing the real).

Modern linguistics, Lacan argued, is a research field which studies the symbolic order, notably the role and primacy of the signifier, functioning in networks of signifiers, opening up dimensions of experience, accessible via language and broadening our temporal and spatial horizon. Language allows us to speak about (and to fear or desire) things we cannot see or hear, things which may have existed in the past, or may come to exist in the future, things which are ungraspable (in the literal sense of the term), and this includes technoscientific entities such as genes, neutrinos, Higgs bosons and synthetic cells. They primarily function as signifiers, i.e. as elements in networks of concepts, visible on PowerPoints or computer screens perhaps, but the actual connection with visible and tangible entities (the connection between words and things) remains questionable.

In a similar manner, Lacan argues, modern ethology allows us to elucidate the imaginary dimension of experience. According to Lacan, animals inhabit an imaginary world. They respond to certain visual forms as described by Gestalt psychology, which function as stimuli triggering certain responses (as part of the animal's behavioural repertoire). To some extent, human experience remains susceptible to the imaginary. The image (gestalt) of a dangerous carnivore (*Jaws*), or a monstrous dinosaur (*Jurassic Park*), or a human-like hybrid (*Frankenstein*), or the enlarged image of a praying mantis (exposing the insect's inexorable jaws and eyes, Lacan 1961-1962, p. 120) may invoke in us a sense of fear, triggering certain physiological reactions, such as a fight, flight or freeze response, measurable and quantifiable with the help of precision instruments, in the context of psychological experiments (Zwart 2018). Likewise, young, cuddly, furry animals may invoke in us an emotional-behavioural repertoire of sympathy and caring. Yet, Lacan argues that, also in their dealings with animals, humans predominantly dwell in a symbolic world. Our relations with animals are first and foremost structured in a symbolic way.

Take for example heraldic symbols used by medieval knights on shields or coats of arms (Lacan 1956-1957/1994). These lions or eagles did not serve to frighten or deter opponents. Rather, they functioned as symbols expressing allegiance to a particular house or clan, allowing the knights involved to distinguish friend from foe, even in the heat of battle (Zwart 2014a).

The cover of Lacan's first Seminar (Lacan 1953-1954/1975) bears the image of a large elephant with impressive white tusks, although elephants are mentioned only in passing in this text. Again, although it is evident that the *image* of a large elephant may evoke in us a sense of admiration, fear or terror, and may therefore perhaps give rise to a fight, flight or freeze response (depending on the circumstances), modern humans primarily interact with such animals in a symbolic manner. Our understanding of animals such as elephants is infected by language as it were, by language in general, but notably by the language games of modern science (Zwart 2014a). Science classifies these animals (labelling them as "pachyderms", for instance), but also monitors and keeps count of them, and may even list them as endangered species. The fact that humans at a certain point coined the word *elephant*, Lacan argues, is the single most important event in this animal's entire history. It is because we have the signifier "elephant" at our disposal (as an element in scientific and political networks of signifiers) that we are able to deliberate about its future, make decisions and design policies that determine the elephant's future fate. According to Lacan, animals themselves do not enter deliberations of this kind. They dwell in a different, imaginary world, dominated by images (functioning as stimuli triggering responses). Our relationships with animals are mediated in a very fundamental way by taxonomies, regulations, quantifiable indicators and the like. They are grounded in the symbolic order: the world of names and numbers, laws and treatises, stock taking and population counts. Against this backdrop, Lacan developed a special interest in Pavlov's research practice.

Classical conditioning and the production of knowledge (S_2)

Ivan Pavlov (1849-1937) was a contemporary of Freud who, like Freud, received his training from representatives of the famous German school of physiology (Ernst Brücke in the case of Freud, Carl Ludwig in the case of Pavlov). After returning to St. Petersburg, Pavlov became professor of physiology at the Medical Academy and director of the physiological department of the Institute of Experimental Science. His early work with dogs dealt with digestion. For his book *Lectures on the work of the digestive Glands* (published in 1897), he was awarded the Nobel Prize in 1904 (Zwart 2010). Various authors point to analogies between Pavlov's experimental work about excitation and inhibition and Freud's views on repression and adjustment (Windholz 1990). In his book on jokes (1905/1940, p. 225), Freud himself mentions Pavlov in the context of mistaken expectations, suggesting that Pavlov's dogs, producing saliva in response to the food they expect to receive, are victims of deception. Notwithstanding these correspondences, however, Lacan himself emphasises the difference between these two contemporaries, also to elucidate the extent to which psychoanalysis (as an endeavour sui generis) differs from contemporary psychology, notably behaviorism and other forms of "human science". The latter, Lacan argues, are

focussed on technocratic management of human resources, rather than on self-knowledge and working-through.

Pavlov's oeuvre concurs with what Lacan (1969-1970/1991) refers to as university discourse. Pavlov aimed to move away from Christian theological convictions concerning the soul (S_1), notwithstanding the jouissance (*a*) which the writing of theological glosses and comments can provide (as by-product), for scholars bent on recognising the fingerprints of God in the marvels of creation. University discourse is the result of a scientific revolution: an anti-clockwise quarter-turn, which positions the emancipated expert as the agent (S_2) addressing, questioning and exploiting the object of research directly, with the help of laboratory props, relying on menial, technical skills rather than on ideological guidance. Yet, on closer inspection, on the left side of the scheme, an ideological truth may still be at work, for instance: the desire to propagate a materialistic worldview or to promote social engineering as a utopian ideal. On the right side of the scheme, the target of research (*a*) is no longer the natural, living organism as such, but something partial, specific and elusive, which has to be disclosed in an experimental manner. The target of research may prove an intractable, allusive object, however, an obstacle rather than an opening, a source of frustration, to such an extent that scientific researchers become tormented subjects (*$*), unable to live up to academic requirements and expectations. Their object becomes an obsession, trapping them, draining their energy and wasting their careers. Eventually, not only the research animals (sacrificed to the progress of knowledge production), but also the researchers themselves may become "victims of science" (*$* as unintended by-product):

S_2 (the qualified, experimental researcher)	*a* (an elusive partial object as target of the knowledge process)
S_1 (the disavowed ideological, utopian truth)	*$* (animal suffering, researchers as victims of science)

This scheme elucidates the structure of Pavlov's research with animals conducted in his laboratory (in St. Petersburg / Leningrad). The experimental researchers (equipped with laboratory technologies) act as *agents*, as *producers* of scientific knowledge (S_2). Their objective is to manipulate and control the object: the research animal, or rather: a specific "partial object" (*a*), using specific organs of animals (stomachs, salivary glands, etc.) to procure certain substances which can be measured and transformed into quantitative data, publishable in journals, in the form of citable articles. These publications and citations represent the surplus value (*a*) derived from the products that are produced by experimental organisms. Animals are compensated via food, care and accommodation for their contributions, but the surplus value (measurable quantities of bodily excretions and the publications based in them) are appropriated. And the ultimate "object *a*" was Pavlov's Nobel Prize.

Pavlov's research initially focussed on metabolism. The *independent variable* was a certain amount of food (e.g. meat on a plate), while the *dependent variable* was the research animal's response, e.g. the secretion of body fluids, notably saliva or gastric juice, in response to the food presented. Pavlov made small openings (windows of fistulas) in the throat or stomachs of his animals to collects these secretions, so as to measure and analyse the samples (the object *a*) as carefully as possible. Thus, saliva and gastric juice (slimy substances, regarded as detestable in normal life) became highly valuable entities, reflecting the "animal other", but condensed into an unpalatable sample of fluid (the object *a* of Pavlov's research: Lacan 1972-1973/1975, p. 183). Psychoanalytically speaking, this focus on gastric juice or drops of drool (as symptoms of conditioning) added a perverse twist to Pavlovian research: the element of perverse jouissance so often involved in scientific experiments. Science often displays a remarkable interest in substances such as saliva, urine, stool, cervical smear or cheek swap samples, produced by erogenous orifices (mouth, penis, vagina, anus) and serving as windows into the condition of the organism as a whole.

In the context of his experimental work, however, Pavlov discovered (around the year 1900) that his dogs not only responded to the sight or smell of food, but also to certain signals associated with it, such as the opening of a door or the sound of a bell, signalling the entrance of the researchers (from absence to presence; from *Fort* to *Da*). Thus, in the context of a physiological research program formally devoted to studying mammal metabolism, he unexpectedly made his most famous discovery: the conditioned reflex as an elementary building-block of twentieth-century psychology, notably behaviorism and learning theory. Due to this discovery, the focus of his research shifted from (nineteenth-century) animal physiology to (twentieth-century) animal psychology. His version of the university discourse is representable as follows:

S_2 (knowledge produced by experimental experts)	*a* (bodily secretions as substances of value)
S_1 (the political ideological truth)	*$* (frustrations: the divided subject)

S_2 is (the discourse of) the experimental expert, producing reliable (quantified, replicable) knowledge via an experimental design, allowing researchers to quantify and manipulate animal behaviour. S_2 functions as the *agent*: the initiator of the knowledge production process. The research animal acts as the "other", the *recipient* to which the researchers' questions are addressed and whose products (produced in response: e.g. saliva and gastric juice) are appropriated by the experimenter. Interestingly, however, in the case of Pavlov, the research animal is treated as a partner. His dogs are described as cooperative animals, as partners in the research, as almost-human research subjects, as team members almost

(Todes 2002, p. 52), – the researcher's best friend.[35] In publications, Pavlov expressed gratitude to his dogs, formally thanking them for their assistance.[36]

On closer inspection, however, Pavlov is not interested in these friendly participants at all. Ultimately, his *cupido sciendi* (his will to know) is focussed on something very specific, something which is completely independent of the animal's willingness or gusto to participate, namely a certain type of bodily fluid, produced by certain organs, in response to certain signals manipulated by the researchers, collected and appropriated by the laboratory system, and processed by the laboratory infrastructure.

This already suggests that, in order to really understand what is happening between researcher and animal above the bar, we must also pay attention to what is happening beneath the bar. First of all, although Pavlov's research is presented as basic research, as "disinterested" and "purely scientific", one of the reasons for Lacan's interest in Pavlov's work is that it reflects the philosophy and zeitgeist of a particular political ideology (an ideological universe even), namely communism as a twentieth-century creed (S_1 in the lower-left position). The conditioned reflex provides a powerful tool for social engineering. Already in physiological research, animals are a substitute for humans (as the ultimate target of the will to know). Sooner or later, research animals will be replaced by humans, and scientists become the social engineers of the human psyche. Pavlovian psychology (and for Lacan, this applies to the human sciences as such) is a style of research driven by *interest*. It is interested in developing effective, evidence-based tools for manipulation and exploitation. Ideally, society as a whole becomes structured as Pavlov's laboratory (i.e. Pavlov's laboratory as a small-scale, anticipatory model of an ideal state, a window into the communist future).

A brave new future: the philosopheme of social engineering (S_1)

The concept of the conditioned reflex (coined by Pavlov in 1901) heralds the transition from nineteenth-century to twentieth-century science. Before 1900, Pavlov contributed to the research paradigm of the German physiological school, represented by Brücke, Ludwig and others. By introducing the conditioned reflex, Pavlov inaugurated a new style of research, destined to evolve into behaviorism and learning theory. This transition reflected a transvaluation of values, replacing the nineteenth-century desire to *understand* living beings by the twentieth-century desire to *manipulate* living organisms, in accordance with Jacques Loeb's claim (pronounced around 1900) that *biology* should become *biotechnology*, bent on optimising rather than on understanding nature (Pauly 1987; Zwart 2009).

[35] Pavlov's favourite dog, whose cooperative behaviour "contributed" greatly to the writing of his *Lectures*, was called *Druzhok* ("Little Friend").

[36] "Physiology owes much to the intelligence of the dog" (Pavlov 1955, p. 104).

Pavlov personified the emergence of a research field based on discipline and menial labour that came to replace a more spiritual and artistic view on human existence. This type of research was advocated in an anticipatory manner by Bazarov in Turgenev's novel *Fathers and Sons* (1861/1965; Todes 2014, p. 32; Zwart 2008, p. 99). Turgenev's classic analyses the generation conflict between artistic, romantic fathers (dedicated to art and novel-reading) and their technoscientific sons (bent on exploring and reengineering nature, notably with the help of animal experiments). The claim that research should aim to control and manipulate the object (the living organism) is the basic conviction of this type of research: its guiding philosopheme (S_1 in the lower-left position), in combination with the relentless imperative of the scientific knowledge-power regime to produce more knowledge: never enough! (Lacan 1969-1970/1991, p. 121). Pavlov's research was the technical realisation of something which, in the 1860s, was still a utopian (or dystopian) literary dream. Conditioning is the primal building block of a genuine *science* of behaviour. Pavlov's experimental method is developed in a laboratory context, but may subsequently be extrapolated into society as such, in the form of social engineering, so that political utopianism gives way to science (Engels 1880/1962). The laboratory becomes an outpost gazing into the future, a theatre where segments of this future can be systematically probed and tested (Zwart 2009). What works in dogs may later be tried on humans. A visitor of Pavlov's facility may have felt like journalist Joseph Lincoln Steffens who, after visiting the Soviet Union (during the heydays of technoscientific utopia), claimed: "I have seen the future and it works" (Kaplan 1974).

This explains why the soviet regime supported Pavlov's research and why Lacan sees Pavlov's work as symptomatic for soviet communism as such. After speaking with Pavlov, Lenin proclaimed his desire to re-educate the Russian people as an animal trainer would (Figes 1996). In October 1919, Lenin allegedly paid a secret visit to Pavlov's laboratory to find out how the work on conditional reflexes might help communism to control human behaviour. The ultimate aim of communism was to improve and transform human nature. Although Pavlov was critical of communism, he accepted patronage by the Bolshevik regime. Lenin spoke of Pavlov's work as hugely significant for the revolution and Trotsky saw the production of an improved version of humankind as the great task of Communism, using current humanity as raw material. In 1923, Trotsky wrote Pavlov arguing that, whereas Freudians assumed an artistic stance towards human existence, Pavlov opted for an experimental, physiological approach (Windholz 1990), so that his reflex doctrine might provide a physiological basis for Freudian theories (Todes 2014, p. 500). While eliminating its literary tendencies, he argued, psychoanalysis would be incorporated as a special case of the doctrine of conditioned reflexes (Roudinesco 1986, p. 50). Pavlovian psychology became official doctrine and in 1949 it was formally declared that Pavlov had demolished "the Freudian house of cards" (Roudinesco 1986, p. 53). On January 24, 1921, a formal Decree was published on Pavlov's

research (Lenin 1921/1965, p. 69), indicating that, in view of Pavlov's outstanding scientific services, which were of tremendous importance to the working people of the world, a special committee was established to guarantee the best conditions for his research. While his laboratory would be furnished with every possible facility, Pavlov and his wife would receive a special food ration (twice the number of calories of normal academic rations). Pavlov himself was thus treated as an experimental dog by the communist leadership, encouraging him to continue to produce knowledge. A specific signifier (the formally signed decree) was installed, signifying food (during a period of massive deprivation and starvation). A specific form of scientific work is singled out as being of strategic importance.

For Lacan, communism's aim was to reorganise society on a rational basis, transforming it into a large-scale laboratory for social engineering. The Soviet Union, he argued, was a society under the sway of university discourse:[37] designed by political engineers. The Soviet Union was science-based, relying on physics, dialectical materialism and social engineering (Zwart 2017c, p. 34, 103). A similar wave of social engineering and human resources management could be discerned in Taylorism, Fordism and other instances of Americanism,[38] especially behaviorism, as will be fleshed out in detail in the next chapter, via Skinner's *Walden Two* as an imaginative scene where conditioning is enacted as a principle of communal existence. Pavlov's knowledge (S_2) provided scientific input for communism and Pavlov's work condensed an ideology and enacted a philosopheme (S_1), spurring Pavlov's activities from beneath the bar. What remained subliminal in Pavlov's research practice (in the lower-left position) can be studied in detail in Skinner's novel, which functions as a literary amplifier or magnifying glass. While Pavlovian knowledge (S_2) rests on the philosopheme of social engineering (S_1), the next section will focus on the object pole of the knowledge relationship. Lacan was interested in Pavlov's work first and foremost because of what happened at the right side of the quadruped.

Salivating Others (bodily secretions as object *a*)

For Lacan, the experimental dispositive of Pavlov's research bridged the animal and the human world, the imaginary and the symbolic. Whereas animals dwell in an imaginary world, humans invite them to participate in a symbolic ambiance. Pavlov discovered something which seems obvious, known since time immemorial from every-day life-world experience, namely that humans

[37] "Ce qui règne dans ce qu'on appelle communément l'Union des Républiques Socialistes Soviétiques, c'est l'université" (1969-1970/1991, p. 237).

[38] Whereas communism reflects the structure of university discourse (an anti-clockwise turn way from the Master's discourse), Lacan sees capitalism as a mutant variety of the latter: *$* and S_1 change places, so that the divided subject (*$* as agent) confronts technocratic expertise (S_2 as recipient) directly, demanding immediate satisfaction of desire (Vanheule 2016).

communicate with dogs (and other domesticated animals) via signals (such as whistles and bells). Pavlov verified this experimentally, under controlled conditions, recognising its importance and turning it into a building block (στοιχεῖον) of a research program. That dogs can be trained to respond to a sound is common knowledge but Pavlov, using specific signals and plates of food, demonstrated exactly how this worked, via the conditioned reflex as the elementary building block of animal and human behaviour.

For Lacan, the question is whether, by learning to respond to signals, research animals really enter the symbolic order, whether signals can be regarded as signifiers, as symbols, as elements of a language. In *Écrits* (1966, p. 273), Lacan phrases the question somewhat jocularly as follows: if we can teach animals to respond to the sight of a printed menu of a certain colour, can they also learn to consider the various prices listed on the card? Is gastric juice produced by the dogs comparable to visceral reactions of humans in response to terms like "contract" or "marriage contract"? These and similar remarks suggest that, according to Lacan, an unsurmountable difference or gap still separates the human from the animal world. In humans, Lacan argues, the stimulus (the word "contract", used in a reaction time experiment for instance) is a linguistic element functioning in a network of signifiers. In Pavlov's experiments, however, the sound of a bell remains a stand-alone signal, only valid within the interaction between researcher and research animal. In Pavlov's laboratory, the signal indicates the presence or advent of a human subject (the research associate, conducting the experiment). Lacan explicitly mentions a particular series of experiments conducted by Pavlov and his team, in which animals are conditioned to differentiate between a circle and an ellipse (Lacan 1966, p. 141). Have these animals acquired mathematical knowledge when they salivate as soon as they see a circle rather than an ellipse?

To further elucidate the difference, Lacan refers to foreplay in human eroticism. Besides the erogenous zones directly involved in intercourse, other bodily surfaces may become involved in eroticism, as substitute targets for various preparatory (seductive) courtship activities, so that lovers may kiss the lips, hands, ears, shoulders, forehead, knees, etc. of beloved others, thereby expressing or triggering erotic desire. Certain gestures (e.g. blinking an eye) may work as signals, but in human eroticism, these auxiliary activities may even expand to things like poetry or music as aphrodisiacs. As Lacan phrases it, although we may discern the functioning of the unconscious in "the peristaltic movements of a Pavlovian dog", in humans it also expresses itself in eloquent and elaborate literary genres, such as macaronic poetry, courtly tablature and Gongorismo (Lacan 1966, p. 467). Thus, in the world of human love, a trans-natural, symbolic sphere is opened up. Also in humans conditioned and unconditioned reflexes will incite the production of saliva, sperm and vaginal fluids, and may even unleash peristaltic spasms in response to certain aversive stimuli (Lacan 1966, p. 817), but Lacan maintains that human erotic desire differs

from animalistic behavioural circuits. To articulate the difference precisely, however, Pavlov's experiments are of significant value.

Pavlov's experiments focus on the presence or absence of measurable quantities of bodily fluids (saliva, gastric juice) which, under normal circumstances, may be regarded as worthless or even detestable. Who would normally be interested in such items? In the context of Pavlov's research, these substances suddenly become significant and valuable, to such an extent that countless experiments are designed to produce them, turning these substances into the "object *a*" of his research. But why? What exactly does a specific quantity of fluid signify? For Lacan, Pavlov's experiments are important because they demonstrate (under controlled laboratory conditions) the birth, the implementation of the signifier. They allow us to witness how an apparently arbitrary signal (the sound of a bell, the shape of a circle, etc.) may acquire a certain meaning, may convey a certain message ("salivate!") and trigger a behavioural response. It is, as Lacan phrases it, the staging, the *mis en scène* of the signifier (Lacan 1967-1968, p. 8), demonstrating how a meaningless signal may suddenly unleash a measurable bodily impact. The signifier, once established, announces the advent or presence of the experimental researcher (1962-1963/2004, p. 72). It is a molecule of language as it were.

A personal bond between researcher and research is developed or reinforced (1967-1968, p. 9) because for the animal, love and attachment is established via food. A cut is made in the animal's body, creating an orifice, a new erogenous zone (Lacan 1966, p. 817). As Lacan phrases it, Pavlov was "a structuralist" (p. 8; p. 12), *avant la lettre* but of the strictest observance. He was interested in the functioning of elementary components of the symbolic order, and the conditioned reflex is an elementary segment of a symbolic system, operating without any reference to something "spiritual" (intentionality, self-consciousness, a soul: Lacan 1967-1968, p. 8). Via conditioning, domesticated animals enter our symbolic environment. The signal can be anything (a sound, a circle) for the signifier is something arbitrary. Pavlov's experiments confirm what Lacan refers to as the primacy of the signifier. Once established, the emergence of the signifier suffices to elicit the behaviour in question. The signified is the idea (the expectation) of food, but even if food is not really involved, the signal unleashes the response.

And yet, Pavlov's experiments also show that the signal is *not really* a signifier (Lacan 1964/1973, p. 254) and that the animal does *not really* learn a language. The signal is only locally valid (within the laboratory context), Lacan argues, and functions solely in the relationship between researcher and research animal (allowing the researcher to manipulate the latter). Such signals do not evolve into a language (as an autonomous network of signifiers) but remain rudimentary linguistic components. It is a temporary ad hoc language at best. The conditioned reflex shows that the experimental set-up allows us to make a cut (and to introduce a detour) in the circuit of bodily needs, but it also shows why an animal will never really learn to speak (Lacan 1964/1973, p. 263). The only

genuine desire involved in the experiment, the desire that is put at risk and questioned, is the desire of the researchers (p. 264): *their* will to know, their *cupido sciendi*, focused on (or obsessed) by the presence or absence of saliva and gastric juice, not because of the use value (nutritional or otherwise) of these fluids, but because they demonstrate that behaviour is open to manipulation, that social engineering is possible in principle. The responses emerging somewhere in the animal's organic system are not an "answer" to a question. Rather, they reflect and mirror the activities of the experimenters themselves. The interaction is *not really* a dialogue. The experimenter remains the Big Other in Pavlov's proto-totalitarian micro-state, and research animals can only perceive and respond. In the course of the experiment, while the capacity of the researcher to control the situation increases, the animal's otherness becomes progressively erased. Although the production of saliva answers a question, both the posing of the question and the interpretation of saliva as an "answer" is done by the experimenters. For Lacan, the Turing test is the ability to lie and deceive, and animals (as involuntary producers of gastric juice or drool) are unable to do so. It requires that language is in place (1962-1963/2004, p. 78).

Pavlov's experiments represent a boundary situation. Posing and answering questions, but also the ability to deceive the dogs, by sounding bells to suggest that they will receive food (or, in the case of fraud, by fabricating or falsifying research results) remains a privilege of speaking subjects. This also explains why human beings (after a certain age) no longer accept a plastic bottle to satisfy oral desire. The conditioned reflex revolves around a basic need, which can be satisfied in principle, but humans yearn for something else, and will order a particular brand of yoghurt, wine or whiskey: a substitute for something which is irretrievably lost (the oral object *a*).

Conditioning is the establishment of a signifier: the rudimentary beginning of symbolic communication, introducing a third (triadic, symbolic) term into the dual stimulus-response mechanism. Thus, humans may train and communicate with animals under domestication (Lacan 1957-1958/1998, p. 339) and there is a connection between conditioning and detention (i.e. dependence). We do not communicate with animals in the wild like this. The signifier intervenes in the metabolic and behavioural cycles of domesticated animals. Sounds and signals employed to stimulate trained animals are signifiers, and the laboratory is an environment of signifiers. Still, the signal remains an isolated third term, only valid in the context of the interaction between researcher and research animal. Therefore, this type of communication differs from speaking a language, which requires a verbal environment shared and sustained by a large number of people. What is missing, as Lacan phrases it, is concatenation (1957-1958/1998, p. 340): the linking together of various signifiers into series or networks. In Pavlov's laboratory, signifiers remain arbitrary segments and do not follow grammatical rules or laws. There is no symbolic order beyond the Pavlovian signifier. For humans (for the experimental researchers) the laboratory is a topological ambiance, a typographical space, a cultural environment replete

with symbols (letters, acronyms, numbers, clocks, exit signs, notebooks, etc.), but this typographical arena only exists for the researchers involved. For the animals, only particular elements (partial signals) become meaningful.

Saliva is the object *a*, the object of desire, but exclusively for the researchers. Absence or presence confirms or undermines a theoretical expectation, a hypothesis, something which emerges in a network of signifiers. Saliva is something to be desired, not because of smell or taste of course, but precisely because it can be taken out of circulation (with the help of a fistula, a tube, a petri dish). It can be collected, quantified and analysed, and eventually sublated into quantified input for equations, publications and citations (assuming academic market value). In other words, although researchers exist in a physical environment (they need food, oxygen, light, etc.), they dwell in a symbolic ambiance as well. And while food is something physical and metabolic, an "academic ration" of food (single or double: depending on the appreciation of one's work by the Bolshevist authorities) is something which belongs to the symbolic order. Conditioning implies that research animals enter the symbolic realm, but in a rudimentary way, via a limited set of signifiers, signifying the presence or advent of a human other.

Experimental neurosis as unintended by-product (*$*)

One of the "unintended by-products" of experimental research with animals is animal suffering and the moral dilemmas it raises (Ryder 1975; Dol et al 1999; Zwart 2016b). Although on paper Pavlov's research practice is presented as animal-friendly, in actual practice this was not always the case. Many of his experiments involved suffering on the part of animals (Todes 2000, 2002) and countless frustrations on the part of the researchers, employed by Pavlov to conduct the actual research: his research assistants, the work force of his physiology factory (Todes 2014, p. 147 ff.), known as "praktikanty" (medical students and young physicians eager to acquire scientific experience to advance their careers).[39] Both humans and dogs were regarded as co-workers (Todes 2014, p. 494). As Haraway (2008) argues, besides research assistants and animal caretakers, also the research animals themselves should be considered as "workers in the lab" (p. 71, p. 73). Both the people and their dogs were workers, producing knowledge under strained conditions in ongoing interactions, and also the suffering was mutual.

Animal suffering is often framed as a "necessary evil", in other words, as an unintended by-product, causing professional malaise (*$* in the lower-right

[39] Pavlov had been nominated for the Nobel Prize in 1901, 1902, and 1903, but each time the committee struggled with the question to what extent the products of Pavlov's laboratory were truly Pavlov's (Zwart 2010). He designed most of the trials, presented the results in books, papers and lectures, but the actual experiments were conducted by *praktikanty*. The output seemed a "compilation" of their dissertations (Todes 2002, p. xiii). In 1904, the prize finally was awarded.

position), perhaps even turning research with animals into an "impossible profession" (Zwart 2016b). In the course of history, several prominent pioneer experimentalists such as Albrecht von Haller (1707-1777) and Johannes Peter Müller (1801-1858) were tormented by feelings of guilt and despair because of the animal suffering that was caused by their research, to such an extent even that they became "victims of science" (Ryder 1975) themselves. They decided to leave the field (like Von Haller, who turned to poetry and alpine botany) or committed suicide, as in Müller's case (*$*, lower-right position: moral suffering as unintended by-product of animal research).

Pavlov addressed the moral dilemmas inherent in animal research by developing a unique experimental method, which he referred to as the "chronic" of "surgical" method, contrasting it with the "acute method" employed by the "champion of vivisection" Claude Bernard (Zwart 2008, p. 101). While Bernard's dogs were severely damaged and usually died during or shortly after the experiment, Pavlov allowed his dogs to recover after being operated upon. Indeed, interest in the health and well-being of his experimental dogs was an inherent part of his approach. Pavlov argued that only normal and healthy dogs could provide a reliable model for research. He interfered as little as possible with the animal's normal functioning (Wells 1956, p. 18) and trained his experimental dogs to lie calmly on the operating table to undergo all the manipulations of elaborate experiments, incising the skin and surface tissues, disclosing arteries and connecting them with instruments for registering blood pressure, and similar procedures (Wells 1956, p. 17). Pavlov claimed that his dogs fully recovered from such operations, if well cared for (1955, p. 95). He saw them as active participants in the experiments, contributing to the success of his research (Todes 2000, p. 52; Todes 2014, p. 149):

> "Our healthy and happy animals did their laboratory work with real gusto; they always rushed from their cages to the laboratory and readily jumped on the tables where our experiments and observations were conducted. Believe me; I am not exaggerating one iota. Thanks to our surgical method in physiology we can demonstrate [the phenomena of digestion] without a single scream from the animal undergoing the experiment" (1955, p. 132).

Pavlov devised ingenious and delicate operations to make the normal internal functioning of organs accessible for continuous observation, while impairing the organism as little as possible. To obtain gastric juice from a dog during an extended period of time, an artificial miniature stomach was produced, but Pavlov assures his readers that "this operation does not cause any serious discomfort to the animal and does not endanger his life" (1955, p. 98). Dogs were subjected to

the most advanced surgical techniques that were also applied to humans,[40] in order to allow them to fully return to post-operative normalcy:

> "I regard the promotion of our surgical technique to be a matter of greatest importance, because the usual method of vivisecting the animal in an acute experiment is … a major source of error, since the act of crude violation of the organism is accompanied by a mass of inhibitory influences on the functions of the different organs" (1955, p. 101).

Whereas collaborators often remain anonymous (humans without a face), dogs acquire a distinctive identity of their own, notably Druzhok, Pavlov's favourite research animal (his "best friend"). For each dog a notebook was compiled (Todes 2014, p. 494). Yet, although Pavlov took great pains to cultivate the image of normal and happy laboratory dogs, the reality was often different (Todes 2002, p. 98). Many dogs died and survivors would often develop chronic health problems or even fatal conditions, and even Druzhok became ill.

In his comments, Lacan focusses on the *psychic* rather than the physical suffering of Pavlov's dogs. After 1900, as we have seen, Pavlov's focus shifted from physiology to psychology: from the animal's metabolism to the experimental *rapport* between researchers and animals. As a consequence, the researcher-animal relationship became increasingly formalised. The basic component to work on was no longer an elementary physiological function. Rather, a basic need (e.g. hunger) became the starting point for a sequence of events. The pre-1900 surgical cut (producing a fistula or miniature stomach) interrupted a physiological circuit, but post-1900 interventions invoked a cut in the psychic structure of the basic need, allowing researchers to reengineer behaviour. With ample support provided by the communist authorities as we have seen, Pavlov designed a new type of laboratory: the "towers of silence", affording "maximum control over the environment of animals" (Todes 2002, p. 349). In these facilities, the friendly interactions between researchers and animals gave way to a radical simplification of the ambiance (Pavlov 1955, p. 192), so that a maximum of control over the smallest behavioural details could be achieved (Todes 2000, p. 78). Instead of participants, animals became fully documented targets of research.

In the context of this shift, Pavlov (1951) noticed "experimental neurosis" in some of his dogs as a by-product of his approach. In a famous study conducted by Nadeshda Shenger-Krestovnikova (one of his collaborators) in 1926, a conditioned alimentary reflex (an excitatory salivary response) was established in a dog (named Vampire) with the help of a circle of light projected on a screen placed in front of the animal (Pavlov 1955, p. 235). The circle thus

[40] "The desire ... to spare our experimental animals as much as possible made us strictly observe all the precautions taken by surgeons in respect to their patients" (Pavlov 1955, p. 132); "Pavlov's dogs were operated upon and cared for almost as if they were human patients in a good hospital (Todes 2000, p. 51).

became a conditioned excitatory stimulus (CS+), capable of eliciting salivation. Subsequently, a differentiation of the circle from an ellipse was obtained. While the image of the circle was accompanied by feeding, the image of the ellipse was not. In this way, the ellipse became a conditioned inhibitory stimulus (CS-), predicting the absence of food. Whereas the circle evoked an alimentary reaction, the ellipse inhibited the response through conditioning. Thus, the animal seemed to have acquired some basic mathematical knowledge. Initially, however, the ellipse significantly differed from the circle (the proportion of the axes being 2:1). Subsequently, the form of the ellipse increasingly began to resemble a circle. The axes of the ellipse were gradually equalized, so that the researchers were able to obtain "an increasingly delicate differentiation" (p. 235). When the ratio reached the value of 9:8, however, the dog (who previously behaved quietly in the stand) began to move about and whine and became increasingly excited. As discrimination became increasingly difficult, the dog's behaviour became increasingly disorganized. After 3 weeks had elapsed, the dog was unable to respond correctly to the task, even if the stimuli were obvious circles or ellipses. The ability to discriminate worsened and finally disappeared altogether, and the dog showed extreme levels of excitement when confronted with stimuli of this type, howling, and struggling in his apparatus, running in circles, barking for no apparent reason and drooling copiously. Apparently, the task had been "overstressing" (Todes 2014, p. 501) the dog, who now showed all the symptoms of an "acute neurosis", due to a collision between excitatory and inhibitory processes (Wolpe 1996). Pavlov had apparently read (or read about) Breuer and Freud's case history of Anna O and was struck by the analogy between the disorganised behaviour of the dog and Anna's situation (Windholz 1990, p. 49; Gray 1979; Todes 2014, p. 499). Both seemed caught between two contradictory impulses – excitation coming from the circle and inhibition induced by the ellipse.

To some extent, Lacan agrees with this. The implementation of a signifier (as an artificial third term) disturbs the normal behavioural circuit and, in case of conflict, may unleash a rudimentary "neurotic response" in experimental dogs. According to Lacan, Pavlov's experimental practice resulted in animal "neurosis" (Lacan 1966, p. 273, p. 460) because the animals became increasingly dependent on and frustrated by the manipulations by the researchers (*$* as by-product of experimental research, lower-right position). At the same time, Lacan emphasises that this neurosis (produced in dogs) differs from the suffering of neurotic patients (in psychoanalytic treatment). Whereas in animals neurotic suffering is connected to the experimental situation, human neurotics are haunted by language as such, by the labyrinthine symbolic order as such. In Pavlov's dogs, neurosis is a laboratory artefact, produced by researchers who try to force dogs to differentiate between circles and ellipses, but neurotic patients are tormented by (and hypersensitive to) the voice of conscience. They are paralysed by an unspeakable sense of guilt.

From a behaviourist perspective, human neurosis may be regarded as a misguided and dysfunctional conditioned response no doubt, ill-adapted but decidedly learned behaviour, something which behavioural therapy may try to reset via therapeutic techniques such as counterconditioning or habituation, but the goal of psychoanalysis is different. For psychoanalysis, the question is not how to reengineer the human psyche. Psychoanalysis is neither a human science, nor a mental orthopaedics (Lacan 1953-1954/1975, p. 208). It develops a different type of discourse: the discourse of the analyst. For psychoanalysis, the question is not why dogs salivate, but why researchers such as Pavlov develop an interest in saliva in the first place. What forces *praktikanty* to spend so many person-hours collecting and analysing bodily fluids? Psychoanalytically speaking, Pavlov and his co-workers become a case history, rather than his dogs. At a certain point (at the time when Freud published his *Interpretation of Dreams*), Pavlov discerned how saliva (produced in response to a sound) could open up a new arena of research. Somehow, this "rang a bell". Pavlov's genius was to realise that the presence or absence of saliva could serve as starting point for twentieth-century practices of knowledge and power.

The discourse of the analyst, however, differs from university discourse and entails another anti-clockwise quarter turn of the quadruped scheme. The question is not how dogs can be trained to salivate, but rather why these bodily fluids, produced by certain organs (partial objects) and collected *in vitro* via artificial openings in the animals' bodies, function as the object *a*, as the researchers' object of desire. Attention shifts from saliva as such to the dialectical interactions between desperate researchers (driven by a desire to know, eager to acquire publishable results) and bodily secretions (by which they are fascinated or even obsessed):

a (secretions collected *in vitro*)	*$* (desperate subjects of science)
S_2 (mainstream knowledge)	S_1 (the ideological truth)

The focus is no longer on the scientific question as such, but on the *why* of it. The researchers now take the floor as desiring, tormented subjects, *interested* rather than *disinterested*, spurred into action by their object of desire: the dog's saliva, a substance which (if produced in sufficient quantities) may provide access to a medical career. For indeed, it is by subjecting dogs to experimental trials that they themselves hope to pass the test and receive the doctorate. Their interaction is facilitated by laboratory equipment and concurs with what Lacan refers to as the matheme of desire (*$* ◊ *a*), where *$* refers to the *interested* researcher, ◊ to laboratory contrivances (experimental props) and *a* to something enigmatic, transient and inexorable, a waste product which suddenly becomes highly valuable, gastric juice or drool, collected in a tube or dish. Around 1900, as we have seen, Pavlov recognised the importance of his observation that gastric and oral secretions were produced in response to arbitrary signals. Pavlov halted his

physiological research (S_2 was pushed into the lower-left position), because the saliva spoke out to him: collect me! Measure me! It was a disruptive experience ($), forcing him to drastically reconsider his research. The saliva unleashed an epistemological rupture and created a cut in his research program, an opening which provided access to the logic of social engineering: the key philosopheme of the human sciences of the twentieth century. His techniques, his experimental know-how, provided building blocks for the ideology of social engineering (as aspired by the communist leadership): an unintended by-product of his research (S_1 now in the lower-right position). Thus, saliva eventually fuelled the program of social engineering, the engineering of souls: the ideological credo, not only of communism, but also of American behaviorism.

Final comments: perverse incentives and the intrusion of the real

Pavlov's research facility functioned as a scaffold enabling the instalment of a signifier through classical conditioning. And this gave rise to the emergence of a rudimentary symbolic order. But such a set-up remains vulnerable to the intrusion of the Real, or more precisely: the return of the repressed (i.e. the unconditioned, wildtype response) in the Real. Pavlov explains how, under the action of "extraordinary, directly inhibiting stimuli", as he phrased it, a chronic predominance of inhibition took place (Pavlov 1955, p. 238), due to a disruptive event which struck Pavlov's laboratory on 23 September 1924. During a dramatic flooding of the river Neva, his dogs almost drowned in their cages and were forced to swim to the top of their cells, until they could be rescued with great difficulty. The carefully produced conditioned reflexes disappeared immediately and although the dogs were expected to resume their work routine, this proved difficult, especially in some of them. Two dogs in particular failed to salivate in response to any of the established CSs (Todes 2014, p. 504). For a considerable period after rehabilitation, their responses suffered from a sudden surge of inhibition and their carefully established conditioned reflexes seemed irretrievably deranged. Their normal environment had worked as a scaffold supporting their learned behaviour, revolving around the emergence and disappearance of signals, but now they experienced regression and were thrown back onto their primordial reflexes. Laboratories are artificial worlds designed to keep the chaotic complexities of the outside world at bay, and the flooding of the Neva acted as an intrusion of the Real (Zwart 2017d).

From a Lacanian viewpoint, this again points out that the set of signifiers, established in series of experiments, remains fragile, and may be erased in the case of trauma. Whereas human beings inevitably dwell in a world of symbols and language, for dogs such symbolic connections have to be actively established and reinforced. Experimental neurosis reflects the suffering of research animals as a result of manipulations on the part of the researchers, but human neurotics suffer from the tyranny of the symbolic order as such. Both animal and human neurotics experience dependence, thraldom even, but while experimental dogs

(spending their lives in confinement) are completely dependent on the actions of a particular experimenter, human neurotics are haunted by the linguistic and typographic ambiance as such, by an unspeakable and paralysing sense of guilt. In other words, while animals are pestered by experimental researchers, who expose them to projections of circles and ellipses for instance, the researchers themselves are spurred on by the academic voice of conscience – "go on, produce more knowledge, never enough! (Lacan 1969-1970/1991, p. 120-121) – and driven by a host of signifiers such as graduation requirements, food rations and Nobel Prizes. In the current era, performance indicators, citation indexes, h-scores and funding IDs play a similar role. Such symbolic entities may easily evolve into perverse incentives, giving rise to a collective academic neurosis and perhaps even resulting in an obsessive managerial pandemic. In the human condition, such phenomena tend to transcend local interactions between (sloppy or committed) researchers and their (stern or benevolent) research managers.

In the next chapter, this analysis of Pavlov's research practice will be complemented by a close reading of *Walden Two*, as an exercise in triangulation, allowing us to study the genesis of the symbolic order from two perspectives. In *Walden Two* the laboratory environment is extrapolated into a real human community, consisting of about a thousand Members. In other words, conditioning is no longer dependent on the rapport between a small number of researchers and their research animals but has evolved into a large-scale symbolic ecosystem. According to B.F. Skinner, moreover, in Walden Two desire and frustration on the part of humans (*$*) have been effectively eliminated, by developing a system of operant conditioning which allegedly satisfies all their needs. Let us have a closer look.

VIII. Walden Two

Introduction

Walden Two is a utopian novel written in 1945 by B.F. Skinner (1904-1990), a prominent American behaviorist. Building on Pavlov's work on classical conditioning, behaviorism claims that psychology should become a real science by focussing on measurable behavioural factors that can be experimentally manipulated in laboratory settings. Behaviorism as a movement was inaugurated by John B. Watson in a polemical essay entitled "psychology as the behaviourist views it" (1913), followed by a paper which builds on Pavlov (spelled as Pawlow) and presents the conditioned "salivary reflex" as a primal building block of the budding science of learned behaviour (1916). For Watson, the methodology of stimulus and response provides a scientific alternative for pre-scientific introspective methods. Following in Watson's footsteps, Skinner developed his own version of behaviorism, known as "radical behaviorism" (Modgil & Modgil 1987). In Skinner's view, human behaviour is a function of "the contingencies of reinforcement" provided by the social environment (Skinner 1987, p. 11). Whereas research fields such as mathematics and physics have progressed dramatically since the days of Socrates, Plato and Aristotle, psychology became a stagnant field because it continued to focus on the *soul*, rather than on understanding *behaviour* (Skinner 1971).

Walden Two represents Skinner's effort to extrapolate his laboratory findings into the outside word.[41] The title refers to a fictitious utopian community established by T.E. Frazier, a former university professor who wants to demonstrate that human behaviour can indeed be systematically modified with the help of carefully designed environmental factors. The title also refers to an experiment conducted a century earlier by Henry David Thoreau, who retreated to a life of solitude and self-sufficiency in natural surroundings near Walden Pond (Massachusetts) and reported his experiences in 1854. Whereas Thoreau's Walden focussed on a single subject (N=1), being an experiment "with one life", Walden Two represents a group experiment, involving a whole community (albeit likewise living near a pond), consisting of nearly a thousand members. It is a behavioural laboratory, extrapolated and expanded into a self-supporting rural township, in existence for ten years.

At the start of the novel, the first-person narrator (a university psychology teacher named Burris) is approached by two young army veterans (one of them a former student) who recently returned from the war. They are reluctant to return to a mainstream way of living and, while serving in the Pacific, had been discussing Frazier's visionary ideas. Apparently, Burris had discussed his colleague's ideas during one of his classes, although he himself was sceptical

[41] "Principles drawn from experimental analysis are used to interpret facts of daily life" (Skinner 1987, p. 11).

about them. At their request, Burris contacts Frazier, who invites them to come and visit his experimental utopian community.

As Skinner explains in the introduction to the second edition ("Walden Two revisited", published in 1976), he wrote the novel in response to feelings of "dissatisfaction", both in his professional life (having accepted the chairmanship of a department but worrying whether this would leave him enough time for research) and in his personal life (deploring the fact that in post-War America educated women were once again forced into "housewifery" and "domesticity"). In 1976 he had also started to worry about environmental pollution, nuclear warfare and overpopulation. All this made him wonder whether there was "by any chance something a science of behaviour could do" (p. v). He had doubts, however, whether his behaviourist approach would yield results outside the laboratory environment (p. vi). At the time of writing, outside the lab, behavioural engineering through operant conditioning was still "science fiction" (p. vi). Like Sigmund Freud (to whom he refers), B.F. Skinner believed that early environments (i.e. experiences during the first years of life) were decisive for personal development, but experimentation with young children would only be possible in an experimental community. These ambivalences of an author whose full name was Burrhus Frederic Skinner are distributed among the two main characters of the novel, both of whom are psychologists, for while Burris (**Bur**rhus) acts as the sceptic, Frazier (**Fr**ederic) plays the role of prophet.

Walden Two is a modernistic monastery, an island of efficiency, affection and happiness, combining work with leisure, research with art, but all these activities are conceived as behavioural exercises and educational pursuits, for in Walden Two, "education goes on forever" (p. 122) while happiness is an important "indicator" of success (p. 195). Besides Burris (a sceptical but intrigued social scientist), the team of visitors consists of a (suspicious) philosopher (professor Augustine Castle), and two young couples: the two veteran soldiers named Rodgers and Steve and their fiancées, Barbara and Mary. While the senior members are interested from an intellectual perspective, the two couples join the team as potential converts. Frazier acts as their guide, explaining the design and practices of Walden Two, while the visitors tour the grounds, interrupting his monologue with questions and comments, voicing a mixture of amazement and suspicion.

In Walden Two, Frazier claims, the dysfunctions of post-War American society are counteracted by exposing Members to behavioural engineering programs, starting from birth and resulting in a peaceful, relaxed and happy community. Unlike traditional spiritual communities, Walden's rules and regulations are not static, but regularly revisited and updated, on the basis of experimental evidence. And unlike most religious communities, Walden Two is not atavistic towards the present, but oriented towards the future, offering a window into a promised world of evidence-based efficiency, community and

satisfaction.[42] Dialectically speaking, whereas spiritual communities *negate* the world (freezing into a static form of living), Walden Two represents something far more dynamical, the negation of the negation, for its objective is to overcome both present and past. Skinner's novel builds on the American utopian tradition, and books such as Henry David Thoreau's *Walden* (published in 1854), Samuel Butler's *Erewhon* (published in 1872), Edward Bellamy's *Looking Backward* (published in 1888) and William Morris's *News from Nowhere* (published in 1890) are explicitly mentioned and discussed, but what is new in *Walden Two* is precisely the scientific dimension, i.e. behaviorism as a twentieth-century research field. To paraphrase Friedrich Engels: *Walden Two* represents the transition from utopia to science (1880/1962).

Members receive labour credits for their contributions and are expected to contribute twelve hundred labour-credits per year (four hours per day). They may spend the rest of their time on recreational activities of their own choice ("our energies can be turned towards art, science, play,[43] the exercise of skills, the satisfaction of curiosities", p. 69).[44] The nuclear family has been abolished, parents and children live in separate quarters and parental care is replaced by community love. Couples tend to be monogamous, but most spouses spend the night in separate rooms, because it had been demonstrated experimentally that this increases their happiness. Erotic desire has been replaced by generalised affection (the scientific version of ἀγάπη). Frazier is the founding father of Walden Two (the "genius" who designed and initiated the project and wrote the initial article asking people to join him in founding a community), but he pretends to be an uncharismatic, unexceptional, undistinguished member.

Walden Two and the exodus of university discourse

Frazier had once been what Burris still is: a dissatisfied academic, teaching at a university, having lunch conversations with colleagues and grading term papers. They both experienced discontent in the university system, which they see as

[42] Comparing Walden to a "monastery in Sicily", Frazier argues that traditional communities were resistant to change. Civilisation and progress left them behind, while the human intellect was "stultified into hypnotic meditations" and "ritualistic incantations" (p. 193). The purpose of Walden Two is not survival but enhancement.

[43] The Walden Two Member as the *homo ludens* of behaviourism. Sports are performed, but Members shun personal triumph and competition. For this reason, "we have no wrestling" (p. 222). What could be dangerous in wrestling? Psychoanalytically speaking: the object *a*, for competitive wrestling is basically a test designed to answer the question: who (of the two competitors) is in possession of the phallus?

[44] Cf. the famous quote of Karl Marx in *Die Deutsche Ideologie* (1845): "In communist society, nobody has one exclusive sphere of activity but each can become accomplished in any branch he wishes, society regulates the general production and thus makes it possible for me to do one thing today and another tomorrow, to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner".

outmoded and atavistic, no longer able to provide an optimal environment for university discourse. Walden Two exemplifies migration, an exodus of university discourse into a new type of setting: an experimental community, with Frazier acting as Walden's Moses. Frazier had left academia and opted for extrapolation. He founded a community which functions as an outdoors living lab. Education (life-long learning) is a core business, as we have seen, but the educational system is decidedly non-institutional. Pupils learn basic geometry by doing it, with the help of drawings, pegs and springs (p. 86). Instead of lecturing, or forcing students to read books, teachers teach the "techniques of learning and thinking" (p. 110): "our children are learned to think", are given "an excellent survey of methods and techniques of thinking, taken from logic, statistics, scientific method, psychology and mathematics" (p. 111). Walden Two is a new type of environment, a socio-cultural ecosystem where university discourse can thrive, a frictionless, utopian community grounded in the experimental attitude ("we encourage to view every habit and custom with an eye to possible improvement, a constantly experimental attitude towards everything", p. 25). It is a microcosm based on experimental design where problems are solved by experimenting, an optimal setting for conducting endless series of trials, an evidence-based social environment (where Darrell Standing would have felt at home).

Thus, Walden Two repeats and reinvigorates the epistemic rupture of modern science, but now in a lifeworld environment. The project distances itself from history and politics, from all forms of political ideology, in other words: from the discourse the Master. In the past, human behaviour was shaped by ideologies and revelations, Frazier explains, but Walden Two has replaced all this by experimental studies. How can individuals be induced to behave adequately? Such questions should be explored scientifically. Together with a colleague, Frazier conducted a systematic review of prominent works on morality and ethics (from Plato, Aristotle and Confucius via Jesus up to Machiavelli and Freud), applying a discursive filter by focussing on the techniques for self-control put forward in those works: "we were looking for any and every method of shaping human behaviour by imparting techniques of self-control" (p. 96). In the case of Jesus, for instance, the focus was not on the theological dimension, but on practical maxims, "Take no thought for the morrow", "Love thy neighbours" and "Love your enemies": techniques for controlling emotions.[45] This filter indicates the epistemic rupture, the discursive turn enacted in Walden Two, where the name-of-the-father ("Plato", "Aristotle", "Confucius", etc., in short: S_1) is erased, while the Planners and Managers are anonymous and replaceable specialists, "carefully trained and tested" (p. 49). Allegedly, this also applies to Frazier himself. No celebrities, no ceremonies are conducted in his honour, and no monograms, no monogrammed F's, no Master-signifiers are visible in Walden

[45] Frazier rereads history comparable to how Michel Foucault read ancient Greek and Roman philosophy (1984), focussing on techniques for self-care.

Two. Psychoanalytically speaking, Walden Two exemplifies university discourse:

S_2 – the Planners as anonymous experimental experts, as *agents*	The object of desire (*a*), allegedly eliminated
S_1 – Master signifier: the obfuscated ideological truth	Discontent and malaise as unexpected by-product (*$*)

In the following sections, we will systematically explore the four positions within this quadruped scheme, starting with the upper-left position of the *agent*.

The behavioural engineering expert (S_2) as the *agent*

Walden Two is a carefully designed environment where human behaviour is shaped, not by the "contingencies of reinforcement", as is traditionally the case, but by a meticulously managed symbolic order, where desirable behaviour is fostered, not via punishment or coercion, but via reinforcement (i.e. positive feedback). Science has demonstrated that human behaviour is amenable to behavioural analysis and modification, and therefore society should consciously apply the behavioural technologies provided by science. Frazier (representing S_2 in the position of the agent) claims that, in Walden Two, the human subject has become the subject of science. Science, moreover, is experimental science. In other words, science is seen as experimental practice, as systematic interaction: a thorough reformation of the lifeworld. Members are disinterested and replaceable experts, while the community supports and encourages research, notably in the realm of education, agriculture and logistics. Pure, curiosity-driven research exists as well, but is considered as leisure activity, pursued by Members in their spare time (p. 50). In his invitational letter to Burris, he announces that Walden Two is preparing a series of articles as well as a full report on their experiment, in accordance with the logic of university discourse.[46] The objective of Walden Two is not only to allow Members to be relaxed and happy, but also to identify the basic psychological characteristics of human behaviour and the engineering techniques of modifying them: experimental questions, answerable through behavioural technology (p. 162).

The six visitors actually conduct a kind of audit. They have come to "evaluate" the place (p. 80). What Frazier basically claims is that Walden Two is a community which is no longer plagued by desire. In Lacanian terms: the matheme of desire (*$ ◊ a*) has allegedly been domesticated. Both the subject and the object position have become normalised in Walden Two. For instance: cultural activities and performances (*Hedda Gabler*, *B Minor Mass*, etc.) are announced, but not with the help of large, brightly coloured advertising posters in Broadway style (the *Great White Way*), fuelling excitement as a "conditioned

[46] "We shall publish a full account of Walden Two in about six months" (p. 214).

reflex" (p. 77) and suggesting the possibility of jouissance through an encounter with the object *a*, but via sober, informative notices on a bulletin board.

During their review, ample attention is given to "the process of being in love in Walden Two" (p. 74). According to Frazier, thanks to behavioural engineering, sexuality has indeed been successfully domesticated. Affection and counselling have replaced erotic frenzy and possessiveness. Happiness thrives and there is no discontent in civilisation. This not only applies to sexuality, moreover, but also to the labour system. There is no self-centred ambition, no rivalry, no competition. There are no divided, tormented subjects in Walden Two, only research subjects participating in interminable experiments ($\$ \rightarrow S_2$). The economy is virtually self-sufficient (although taxes are paid) and the system functions smoothly. The question is: can this be true? Where is the gap, where is the flaw in the system? As Burris phrases it: "I felt some sudden sharp concern that Walden Two might have some fatal flaw" (p. 71). At a certain point, Burris even decides to make a "little investigation", a small "survey" to find out whether the Members are really as happy and content as they seem. Although this does not yield any contradictory evidence, his scepticism persists, and Burris expects to discern a symptomatic feature sooner or later.

At a certain point, for instance, Frazier explains that he receives one labour credit for "acting as their Virgil through Paradiso" (p. 48). Burris immediately corrects him: it was Beatrice who guided Dante through heaven, while Virgil was Dante's guide in Inferno. This *Fehlleistung* points to the basic question of the novel: is Walden Two Paradise or Inferno? Is it as utopian as Frazier suggests, or rather dystopian, as Castle claims? Does it represent freedom or manipulation, self-control or exploitation? Where is the flaw, the crevice, pointing to the object *a*? Psychoanalytically speaking, Walden Two is designed to eliminate all traces of the object *a*, the impossible but alluring object of desire. University discourse allegedly has achieved its goal and functions smoothly from now on. The task of the audit committee, however, is to assess whether Frazier's claim is valid. Has desire really been effectively tamed? Has behavioural engineering (the "science of science", p. 281) really succeeded in obliterating the object *a*?

The elimination of the object *a* and the absence of desire

The journey of exploration (the inspection tour) begins at the beginning: the children's building. New-born children are not reared by their parents, but entrusted to community love and professional, evidence-base care. Babies and small children are visible as naked bodies in cubicles, where they are kept in an automatically controlled environment. The children's building is designed and structured like a Skinner box, a spatial unit (a chronotope) where specific forms of behaviour can be positively reinforced, while others are systematically discouraged and extinguished. As Frazier explains, when particular behaviours or emotions (such as envy, jealousy, hate, anger, fear or rage) are no longer

regarded as useful ingredients of the behavioural repertoire, they are to be eliminated (pp. 92-93). The children are exposed to an optimised environment, in terms of air conditioning, temperature and professional care, in accordance with the logic of university discourse. They are placed under professional supervision: an evidence-based regime of care, grounded on experimentation and community love, the perfect maternal ecosystem. The children experience no frustration, nor anxiety or fear, although a tolerance for future frustrations is built up gradually by introducing obstacles on purpose, so as to achieve behavioural inoculation (p. 88).

Motherly love is expanded into community love, a distributed kind of love between all adults and all children. When Castle criticises this aspect, Frazier challenges him to clarify what "motherly love" is. For Frazier, it is an outmoded, ideological, pre-scientific concept. Castle replies by saying: "I am speaking of a concrete thing", of the "physical dimension" (p. 89). In other words, for him, the difference between community love and motherly love is something very specific, a partial object: the object *a*, the object of desire, the motherly breast, but precisely this function is eliminated in Walden Two, as children are raised with the help of technical substitutes. All this is symptomatic of the absence of the object *a* in Walden Two. The design is to erase desire by finding out what people want (p. 4) so as to satisfy all their physiological and mental needs in a technical, evidence-based manner, while eliminating the impossible object of desire, the object *a*.

For Frazier, moreover, Walden Two represents "the decline of the home as a medium for perpetuating a culture" (p. 128). Walden Two is the very opposite of a *Heimat*. The nuclear family as an ancient form of community is replaced by something more science-compatible. The family is a genealogical entity, branded by the name of the father, under the sway of parental authority: of the phallic object *a*. This home is now dismantled, resulting not only in a systematic distancing of parents from their biological off-spring (to avoid identification), but also in the practical separation of sex and parenthood. Walden Two replaces the family as an economic, social and psychological unit by a communal, experimental chronotope. On the level of sexuality, this is visible in "the advisability of separate rooms for husband and wives" (128). During an experiment, with a time span of eight years, two condition or factors had been systematically compared, namely "separate" versus "common" rooms, precisely the sort of experiment "that would be impossible anywhere except in Walden Two" (p. 129). As a result, most of the married couples now willingly opt for separate rooms. It is symptomatic of the fact that their relationship has become purely functional: characterised by the absence of desire, the elimination of the object *a*. Psychoanalytically speaking, the object *a* (the motherly breast in the bond between mother and child, the phallic object in inter-gender eroticism: that which can be either present or absent) functions as the bridge or link, drawing mother and child, lover and beloved together. Their relationship revolves around this allusive, partial object. Now that the object *a* has been effectively eliminated,

however, the two halves can be separated and compartmentalised. Sexual play, according to Frazier, is regarded "a sign of malaise or instability" (130). Walden Two provides a purely functional environment, characterised by the absence of desire, the absence of the (phallic) object *a*. Undesirable behaviours such as masochism, sadism or voyeurism are eliminated through cultural engineering. They are regarded as products of dysfunctional environments. Our boys never find sex amusing or secretly exiting, Frazier claims, for they are familiar with the bodily functions of both sexes. And sexual humour is classified as a shortcoming, like poor grammar, a target for counter-education.

This also applies to labour. Walden Two represents a streamlined economic system. The members not only agree to work according to carefully managed schedules, but also "not to claim any share in the fruits of their labour" (p. 213). In Marxist terms, whereas their labour is sufficiently compensated via food, accommodation and leisure time, the "surplus value" (that which, under Capitalism, is appropriated by the owners of the production factors) is allegedly eliminated. According to Lacan (1969-1970/1991), the surplus value is precisely the object of desire, the object *a*: that which disappears out of sight and resurges in the form of objects of desire (as fetish). In Frazier's account, this dimension (which determines the difference or distance between the classes of capitalists and workers, fuelling their obsession with one another while keeping them apart) has vanished. There is no reason for discontent, there are no classes in Walden Two, and the Planners are service providers: they are not the owners of the forces of production. The "surplus value" of Walden Two (the object *a* of Frazier the arch-engineer) are the scientific papers and reports that will come out of these experiments and will be cited and acknowledged by future generations of experimentalists.

There is a delicate moment in Skinner's novel when the gap or flaw of the system suddenly seems to surface. At a certain point, Burris interrupts Frazier's account by asking: you speak a lot about experiments, but where are your controls? Scientifically speaking, in order to test the effectiveness of the regime, half of the children should be exposed to the control condition (i.e. traditional care by parents, traditional classrooms, etc.). For all his reliance on evidence-based practices and data, the data pertaining to the control condition are missing. Frazier replies that "we should not make a fetish of the scientific method" (p. 163), for research can be done without controls. But this rebuttal is unconvincing, for it is precisely the experimental design (and this necessarily includes the comparison of results yielded by experimental and control conditions) that makes the difference between utopia and science. The control data suddenly surface as the impossible object *a*, as that which should be there, but cannot be found, that which would make experimental results publishable and citable in top quality journals, flouted as fetish.

By referring to control data as a fetish (as an overvalued obsession), Frazier hints at the congruence between university discourse and perversion. This same congruence is noticeable when Frazier explains how behavioural

engineering provides ethical training of very young children, namely by carefully exposing them to scheduled dosages of annoying experiences, to immunise them and reinforce their self-control. Castle indicates that he is revolted by this practice, accusing Frazier of "sadism" (p. 105): "I find myself revolted by this display of sadistic tyranny" (p. 99). This response is not completely off the mark. Perversity (sadism, voyeurism, fetishism) is an inherent tendency at work in experimental practice and university discourse. The scientist aims to acquire full control over the object, in this case: very young children, naked and deposited inside air-conditioned cubicles, where they are systematically exposed to annoying stimuli, to mild dosages of pain, but also to the experimental gaze, in order to analyse the response. According to Frazier, this is done precisely to eliminate the object *a*, to eliminate anxiety and desire. In the outside world, individuals are turned into "sadists or masochists", they become "preoccupied with pain and make a devious art of it" (p. 104), as symptoms of a pre-scientific society, but the whole point of Walden Two is to prevent and eliminate all forms of perversity. Psychoanalytically speaking, however, rather than disappearing, perversity has infected the experimental gaze as such. These naked children, on display in air-conditioned cubicles (why are they naked?), either enjoying optimal circumstances or experiencing mild dosages of pain, are the experimenter's object *a*. And indeed, Frazier notices that Burris analyses Walden's child-care facilities (located in a building with large windows) from a "Freudian" perspective". By way of parody, he describes them as a "womb with a view" (p. 143).

For Frazier, science is the difference between Walden Two and utopian initiatives in the past (p. 143). The latter were guided, Frazier argues (p. 145), not by "experimental modification" (i.e. university discourse: S_2 in the position of the agent), but by revealed truth (i.e. the Master's discourse: S_1 as agent). In the discourse of the Master, self-imposed ascetic practices emerge in response to the appeal, the imperative (S_1) coming from the Master (to which S_2 is susceptible as recipient), resulting in spiritual exercises (including research as a spiritual exercise), but also in instances of jouissance as by-product (*a*).

S_1 – the master signifier (name-of-the-Master) in the position of the agent	S_2 – recipient: ascetic exercises in a deprived environment
The truth cannot be called into question experimentally, uncertainty (*$*) repressed	Sadistic/masochistic/voyeuristic instances of jouissance (*a*)

The experiments conducted in Walden Two reflect a "revolution" in the Lacanian sense: an anti-clockwise quadruped turn towards the left, resulting in university discourse. In the upper-left position, the imperative (S_1) is replaced by a code (S_2), an evidence-based manual consisting of techniques for self-control, based on the science of behaviour and experimental modification. If an item in the code seems questionable, any member may examine the evidence upon which it was based, or appeal to the Planners (p. 152).

Compared to previous (ideological and religious) attempts, the Walden Two revolution has several consequences. First of all, the object *a* (allegedly obliterated) is still there, as we have seen, for those who have an eye for it: the naked children in the cubicle (ready to be experimented upon), but also the papers and reports which Frazier wants to send out into the world, as the surplus value of Walden Two, for although allegedly there is no expropriation or exploitation in Walden Two, Frazier holds on to the privilege of publishing the results, to satisfy his intellectual desire. Something similar happens to S_1. Allegedly, it is erased, for although the Members still engage in Sunday meetings (listening to or performing Bach for instance), such meetings function as "group therapy", while confession is replaced by counselling ($S_1 \rightarrow S_2$). The ideological undertow is still there, however (S_1 pushed into the lower-left position). These two aspects – ideology as undertow (S_1 in the lower-left position) and Frazier's resurging intellectual desire as by-product (*$* in the lower-right position) will be addressed in more detail in the next two sections.

The obfuscated ideological truth (S_1): Master's discourse

The disappearance of conflict and desire allegedly results in the waning of politics, of class struggle and ideology, of democracy and the State. Psychology replaces political ideology, and human resource management replaces democratic elections. The exodus into the future will not come "through power politics at all; it will take place at another level altogether" (p. 257), namely via behavioural engineering. At a certain point, Burris notices a considerable resemblance between Russian communism and the philosophy of Walden Two ("Hasn't Russia done what you're trying to do?"). Lacan likewise argued, as we have seen, that the Soviet Union was a society completely under the sway of university discourse (1969-1970/1991, p. 237), designed by political engineers. Both Lenin and Trotsky voiced enthusiasm for Pavlov's experiments because they offered a window into a society of the future, based on conditioning. Frazier replies that Russia as originally conceived was indeed "a good try". But the attempt was made at the level of power politics, inevitably resulting in a decline of the experimental spirit. Promising experiments (group care of children, new kinds of personal incentives, etc.) were soon dropped. A government in power cannot experiment, Frazier argues, but rather relies on power politics and propaganda. In Russia therefore, revolutionary experimentation died (p. 259) so that "no valid data for evaluating the effectiveness of Russian communism can be obtained". The Soviet Union soon opted for political techniques, such as the use of "heroes" (a political propaganda technique) and even adopted capitalist techniques (perverse incentives), at the expense of behavioural and cultural engineering.

Walden Two aims to succeed where the Soviet Union failed (Frazier aims to succeed where Lenin and Trotsky failed), by designing a social system radically under the sway of university discourse, not governed by force and power, but by carefully tested behavioural techniques (operant conditioning and

positive reinforcement). Governments, including the Soviet Union, are unable "the accumulate the body of knowledge" required for scientific analysis, they cannot conduct experiments: "in science, experiments are designed, checked, altered, repeated – but not in politics" (p. 181). For the same reason, we can learn nothing from history, Frazier argues, for history never really sets up nor analyses experiments. The present is the only thing we can scientifically deal with (p. 224). In contrast to political power, only scientific technologies can make human individuals "adequate" to society (p. 182). The goal of Walden Two is to create a society that meets all human needs, while obliterating discontent and desire (eliminating the object *a*), in accordance with the design of university discourse. Political techniques (propaganda, force, etc.) would "conceal symptoms which are absolutely essential to our psychologists" (p. 195). Symptoms are to be treated (by psychologists, counsellors and human resource managers), rather than repressed.

Still, there are indications that the community functions less smoothly than Frazier suggests, especially if we pay attention to what happens at the lower-left side of the quadruped scheme. The ideological truth as source of inspiration is obfuscated, but not completely. Suddenly, while explaining some of the techniques employed in Walden Two for creating optimal environments, Frazier cites the phrase "Liberté, Égalité, Fraternité": an unexpected resurgence of political ideology, captured in a triad of signifiers. Although Frazier was the founding father, he refuses to act as the Master (S_1) and allegedly merely functions as a replaceable expert (S_2), someone who happens to be one of the six Planners, but temporarily, in an unprivileged manner. He actively aims to erase to genealogy of Walden Two. The Walden Code forbids that any mention is made of the inaugural primal scene, the act of establishing Walden Two. Castle, however, remains suspicious and at a certain point accuses him of acting as "the Master of the place", as "the despot" who manipulates the Members into conformism. For him, Frazier, as the primum mobile (the Prime Mover) of the community, still functions as a silent despot, the psychological genius who tries to conceal his power, his governance techniques, based on conditioning and manipulation: "I accuse you of one of the most diabolical machinations in the history of mankind … A modern, managerial Machiavelli, that is my final estimate of you (p. 236-237). Yes, Walden Two is a laboratory, but Frazier is decidedly the Master, making all the decisions, the authoritative master mind (S_1). Other Planners and Managers are custodians of his legacy, experts (S_2) who realise his paradigmatic design. For Castle, Walden Two is still under the sway of the Master's discourse, it is a patriarchy, and Frazier is Walden's Moses. Sooner or later, Castle predicts, he will be killed, like all political and religious father figures.

Frazier's rebuttal resumes the claim that Walden Two is a new type of organisation, without precedent in history, completely under the sway of university discourse. Yes, he happened to be the one who designed Walden Two, not as an architect who plans a building, however, but as a scientist who designs

a long-term experiment (p. 239). In other words, rather than a top-down panoptic power regime, he inaugurated a flexible, evolving system, reflecting a new conception of man. Although he designed Walden Two, he does not control it. In other words, Walden Two reflects the transition from the discourse of the Master (the demiurge who designs the perfect system) towards university discourse. Frazier's aim was not to turn ideology into practice, but to establish a system based on experimentation and behavioural engineering (S_2 / S_1). He is a managerial Machiavelli perhaps, in the sense of being an expert in the field of socio-cultural engineering (S_2), but Walden Two is no longer in need of a Prince (S_1). Castle accuses Frazier of being "the midget in the machine, running it all by personal magnetism" (p. 219), "He's got these people hypnotised" (p. 177), but Frazier counter-argument basically claims that Castle confuses S_1 (the Master) with S_2 (the Planner, participating in a board of Planners): "Have you seen any monogrammed F's on our furniture or silver? Have you heard anyone even so much as mention me?" (p. 219). In other words, the Master signifier, the name-of-the-father, as a guarantee of political stability, is consciously erased. No one is "marked for special approbation", nor "singled out" for personal citation (p. 157), "all personal contributions are made anonymous" (p. 221), "no distinction of seniority is recognised" (p. 221). Even Frazier (the pioneer-genius) purports to be an anonymous and replaceable expert. He is not a despot who assumes leadership and acquires a following via identification. In Walden Two, political techniques of power and manipulation are replaced by behavioural techniques of ease, happiness and self-control. Unlike pre-scientific communities, Frazier claims, we don't want a leader, we want "a condition" (p. 221). Again: S_1 replaced by S_2. The intelligence behind Walden Two is not geniality but distributed intelligence. Everyone contributes to the functioning of the system by designing and participating in experiments.

Unmasking the divided subject ($\$$): the discourse of the analyst

While Castle tries to unmask Frazier as the secret despot or Master Mind, Burris opts for a different strategy: the discourse of the analyst. Yes, Frazier is an actor, enacting a role and wearing a mask, but what is hidden beneath that mask is not a Master (S_1), but a divided, tormented subject ($\$$), a "tortured soul" (p. 268). Walden Two satisfies all needs, as well have seen, and purports to be a social system unhampered by desire and discontent. To bring desire to the surface, a drastic shift is required from university discourse to the discourse of the analyst.

The latter is discernible on several occasions in Skinner's behaviourist novel, but initially it is Frazier who acts as the analyst, while Burris assumes the role of analysand: someone whose anxieties and inhibitions are explored (as obstacles to conversion). Burris confesses that he is not very happy with his academic life, and therefore sensitive to Frazier's suggestion that Walden Two basically represents the academia of the future, but Burris is not yet ready to join. He still experiences "a certain resistance" (p. 232). Frazier then asks him a

remarkably psychoanalytical question: "How much of your attitude toward Walden Two is really your attitude toward me … Quite frankly, Burris, why do you dislike me?" (p. 233). In other words, Frazier attributes Burris' reluctance and scepticism vis-a-vis Walden Two to transference. Negative transference towards Frazier is an obstacle to conversion, and analytic sessions are required to free Burris from his inhibitions, his sense of guilt, so that he finally may be able and willing to join Walden Two.

Towards the end of the novel, however, a reversal of roles occurs. At a certain point, Frazier invites Burris to follow him into his room: the perfect setting for a moment of confession: coming out. To begin with, while Walden Two is a paradigm of neatness, hygiene and order, Frazier's own room is a mess. Books are piled irregularly on the floor, symptomatic of how "the precision and order of his thinking as a behaviorist is equalled only by the fantastic disorder of his personal habits" (p. 231). Walden Two apparently functions as a long-term (interminable) therapy to compensate for his insufficiencies, his personal shortcomings, e.g. his lack of discipline and self-control. Burris already concluded that, in order to adequately assess Walden Two, a *longitudinal case study* would be required (p. 204), and Frazier himself now becomes such as "case". In private, Frazier is still a divided subject, tormented by desire (*$*), "engaged in a pitched battle with the rest of mankind" (p. 95), an "ambitious reformer" (p. 213) who "thinks too much" (p. 204), driven by the ambition to "storm the culture" and therefore insufficiently converted to adequately fulfil his S_2 role. Frazier now confesses that, of all the inhabitants of Walden Two, he is the one who has the most severe difficulties in becoming a genuine member of any community (p. 233), precisely because he himself is not a product of Walden Two. There was never a rebirth, never a complete conversion. The achieve this, one would have to be exposed to the Walden Two ecosystem from early childhood onwards. He sees himself as a pot marred in the making (*$*). As a person I am a complete failure (p. 234).

Psychoanalytically speaking, however, he *is* a product of Walden Two, precisely in the sense that the tension between his role (his persona) as a Planner and his private shortcomings is intensified by Walden Two. Of all the Members, he is the one less able to relinquish his desire. He still wants to see his publications in print to prove to the academic world that he was right and that his experiment succeeded. This is, as we have seen, the surplus value appropriated from the participating Members (as research subjects). In scientific publishing, publication records and the citation index function as incentives (the h-index as fetish, as object of desire).

But this is only the first in a series of confessions. Subsequently, he invites Burris to follow him to a hilltop, his Mount of Olives, from where (with the help of a small telescope) all of Walden Two (Frazier's Jerusalem) can be surveyed. Frazier refers to this location as his "Throne". From here, he gazes down upon Walden Two as a world of his own making: "I look upon my world and, behold, it is good" (p. 278). The biblical vocabulary suggests that Walden is

a second creation, a Regenesis. Burris notices that he even looks like Christ, for he is lying on the ground where he assumes the position of crucifixion, to enact the congruence between God and himself, between Creation and Walden Two. Walden enacts predestination: all that happens is contained in an original plan (Frazier's plan). The behaviour of the Members is determined by a code, evolving, but in accordance with a carefully designed methodology. They do what they want to do, but according to plan. Frazier's science of behaviour is an improvement upon Genesis. He created Walden Two as a community without desire, without ambition, without competition, without struggle: a *planned* community. Notice that the telescope is also a prototypical scientific instrument, employed by Galileo to challenge the geocentric universe. Frazier uses it to capture the object *a*, the one thing that does not fit, the dark spot on the map, until he realises that he himself is the aberrant entity, the voyeur, the deviance, the outsider among the Members, for whom Walden Two is a project, rather than an environment. In terms of Sartre: his telescope is a key-hole which allows him to secretly spy on Walden's inhabitants, until he realises that he himself is the one under surveillance, who remains ill-adapted, a misfit.

His search for the object *a*, with the help of a telescope, indicates that Frazier is not freed from ambition, but still under the sway of the matheme of desire. By creating the perfect community, and by developing behavioural engineering as the "science of science", he wanted to be like God, but this is precisely a symptom of desire. "You have a sizable God complex", Burris notices, and Frazier agrees: yes, he likes to play God (p. 281), likes to see himself as God, just like Jesus did: the first behavioural engineer. He speaks of Jesus as a colleague who discovered important "principles" and developed effective "techniques" for behaviour modification (p. 190, p. 282), resulting in effective maxims such as "Love your neighbour". And what is love (Christian ἀγάπη) but another name for positive reinforcement (p. 282)? Walden Two is a model village, designed to preach the Gospel of behaviorism, of positive reinforcement: it is a product of desire.

Denouement

This confession is Frazier's epilogue. Notwithstanding his posture of denial, he is forced to confess in the end that Walden Two really is *his* project, his effort to "storm" civilization and distinguish himself. Walden Two is developed with the aim of proving the metaphysical claim (S_1) that freedom does not exist. Linguistically and logically, freedom and determinism are equally possible, Frazier explains, but the point of Walden Two is to demonstrate determinism: human behaviour can be controlled via cultural optimisation and positive reinforcement (p. 242). Indeed, "once you have grasped the principle of positive reinforcement, you can enjoy a sense of unlimited power" (p. 248). In Nietzschean terms: Frazier agrees that the scientific will to know is driven by a will to power, to control. He refuses to see himself as a genius, for he has no

special abilities or talents, only his perseverance, his obsession, in accordance with the matheme of desire (*$ ◊ a*). "I've had only one idea in my life – a true idée fixe" (271), namely "control", "the control of human behaviour". As a person, he is still "essentially unhappy, maladjusted and neurotic" (*$*; p. 115), but precisely because of his obsessiveness, he was able to realise Walden Two. What he wants to see, with the help of his telescope, is the absence of freedom and malcontent. Initially, during his early experimental days, his work at the university had been "a frenzied, selfish desire to dominate" (271), but the subjects of his experiments consistently refused to behave in accordance with his predictions, and in the end research subjects are always right. But here, in this experimental community, a "genuine" and "powerful" science of behaviour (p. 273) proved finally possible, so that he finally achieved his goal: verifying the principles of behaviourism in a real lifeworld context. He even insists that Walden Two is "the crowning achievement in the history of the human intellect; the splitting of the atom pales into insignificance beside it" (271). It is a dawn of day, the end of the era of the individual, the beginning of communal science, communal art, communal authorship and music: the advent of the community as a superorganism (p. 276).

After their visit to Walden Two, the group splits up. Steve and Mary decide to join Walden Two. Rodgers would like to join as well (the split between supporters and critics of Walden Two reflects the 3:1 ratio) but he fails to overcome his psychic obstacle: his erotic serfdom, chaining him to Barbara: a very attractive worldly young woman, very skilled in seductive behaviour, "a brand of behavioural engineering which has a long tradition" (p. 229). Shortly before departure, Barbara explains her lack of enthusiasm by stating that, from her perspective, personal relations in Walden Two are too scientific. No room is left for boredom, games or desire. She fears that Frazier would be constantly studying her, would continuously work on her with his theories (p. 228), as if he were an anatomist, looking at her merely to imagine what she would look like when quick-frozen and sliced into thin stained sections. In other words, she thoroughly dislikes the idea of becoming the target of university discourse, the object of the scientific gaze, a socially acceptable version of perversity, for what is anatomy (ultimately, as a subbranch of university discourse) if not the desire to eliminate the object *a*, to reveal its absence, resulting in the claim that, anatomically speaking, there is nothing whatsoever, no characteristic feature or mark separating an exceptionally attractive and alluring woman from others, that seduction is merely *a technique*.

Castle seems completely obsessed by Walden Two, but nonetheless decides to leave the place in the conviction that it is an impossibility, or even a hoax. Burris remains a psychologist and cannot endorse Castle's suggestion that we should abandon practicing science in favour of reading books, that we should prefer the study of history to conducting experiments. Castle, Burris concludes, is unable to appreciate the importance of the experimental method. Castle opts for the role of custodian, in service of a worldview. Walden Two is an

experiment, a testbed of ideas. This requires that a philosopher should not act as custodian of a particular brand of philosophy (someone who already *knows* what democracy, autonomy, etc. is or should be), but should rather use the opportunity to reconsider such ideas. This requires, however, a shift into a different position: the discourse of the analyst. And it is here that the trajectories of Burris and Castle diverge: it is not a matter of discipline, but of style of thinking. A shift in discourse would have turned Castle's profession into a more experimental and interactive type of philosophy, a diagnostic of the present.

Burris initially decides to leave Walden Two but, during his return journey to the university and to his former life, he suddenly and abruptly decides to change his mind and turn back. He not only endorses experimentalism (S_2), but also Frazier's "new conception of man" (S_1). His ego suffers a narcissistic affront, for going back is like humbling himself before a "superior mind", acknowledging that he is under the spell of Frazier as the archetypal genius, so that he now even appreciates his mannerisms. The long walk back is an exercise in working through, a spiritual exercise, a moment of individuation. Traditional institutions (family, school, university, nation state) can no longer be seen as efficient transmitters of culture, Burris now argues, and human civilisation should "step into the sphere of human engineering". Nothing short of a complete revision of culture can suffice to enable the transition from a society grounded in the discourse of the Master to a society that is structured as university discourse. His return (on foot) is like a religious pilgrimage, a self-analysis, and he finally understands the final lines of Thoreau's *Walden*: "Only that day dawns to which we are awake. There is more day to dawn. The Sun is but a morning star" (p. 297).[47]

Psychoanalytically, this is a fascinating scene (underlining the literary qualities of Skinner's novel), a scene of conversion: the divided subject (the university professor suffering from mid-life discontent: *$*) is finally able to overcome his obstacles, his psychic inhibitions, and experiences a metanoia, succumbing to the logic of Frazier's utopian vision (Gable 1999), joining Walden Two as a Manhattan Project in the realm of behavioural research, a psychology kolkhoz, where university discourse may thrive ($\$ \rightarrow S_2$). But a conversion needs a Master signifier, a founding father (S_1), enabling identification.[48] For a brief moment, the discourse of the Master is back in place, to enable the transition. Burris succumbs to being the recipient of the message, adopted and accepted by the Master. The final lines are particularly interesting: "I glanced fearfully upwards toward the Throne … Frazier was not in his heaven. All was right with the world". The panoptic position, the Master signifier, is there, the topology is in place, even if the Throne is temporarily unoccupied (for Frazier as a person, as

[47] "The sun is but a morning star" was Skinner's original title for his manuscript.

[48] For Frazier, identification is a problematic concept (of psychoanalytic descent): "No one has ever made a careful scientific analysis; the evidence isn't experimental. We have seen the process at work only in our standard family structure".

a tormented, divided subject, is unable to live up to the archetypal image of the genius). As soon as he is accepted as a Member, university discourse begins to function. Together, Burris and Frazier decide to publish the account of the former's conversion, as a longitudinal, N=1 study, a case history.

Dignity and de-homunculisation

Skinner's novel has met with much criticism over the years, notably because of the denial of human autonomy and the portrayal of democracy as an ineffective political system. Its literary qualities are also an issue of dispute. It has been claimed that *Walden Two* is a very "bad novel" (Tabensky 2009, p. 1), a "poor novel" (p. 3). Given the fact that more than two and a half million copies of the book have been sold, this claim seems difficult to hold. Moreover, Tabensky explains his dislike of *Walden* Two by arguing that the book is "unidimensional", only discussing "how B. F. Skinner's science of behaviour could transform the world for the better" (p. 2), but this verdict underestimates the dialectical, multi-dimensional (heteroglossic) dimension of the novel, the multiple voices that are given the floor and mutually exposed to one another (advocacy, scepticism, criticism, suspicion, and so on). These multiple voices in fact represent the four positions of Lacan's scheme, resulting in dialectical tensions of university discourse (the dominant discourse type: Frazier's account of how behaviorism will transform the world) with the discourse of the Master, the hysteric and the analyst.

A key document in the Skinner literature is Noam Chomsky's "The Case Against B. F. Skinner", a review article (almost 10,000 words) published in the *New York Review of Books* (Chomsky 1971). Although Skinner's book *Beyond Freedom and Dignity* (*Walden Two*'s academic counterpart) is formally the target of Chomsky's criticism, his review may be regarded as an attack on Skinner's views as such and as a diatribe against *Walden Two* as well. The review is composed like a legal charge, an indictment in a trial, with Skinner in the dock as the offender. Skinner's behaviorism is summarised by Chomsky as a view which claims that human behaviour is malleable and fully determined by genetic endowment and environmental factors (reinforcement). Therefore, we should consciously use behavioural technologies for enhancing human happiness. Chomsky rightly points out that Skinner aims to replace coercive and aversive techniques (negative feedback) by positive reinforcement. The problem, Chomsky argues, is that Skinner's science of behaviour aims to replace the autonomous agent as causal factor by environmental influences: the ecological and cultural environments in which species evolve and individual behaviour is shaped. Human behaviour is regarded as a function of (modifiable) environmental conditions.

According to Chomsky, whenever we are confronted with publications of this type, two kinds of question should be asked, namely: "What is the scientific status of the claims?" and "What social or ideological interests do they

serve?". Whereas Skinner purports to articulate a scientific, evidence-based view (S_2), Chomsky claims that his work is actually under the sway of a totalitarian ideological worldview (S_1). It purports to provide what emerging post-war industrial societies need: a technology that enables the conscious shaping and control of humans, the evidence-based management of human resources. As Chomsky explains later (Virtues-Ortega 2006), behaviorism represents Americanism. It is primarily a political ideology (S_1), aimed at achieving global mastery, promoting Americanism under the guise of psychological theory (S_2).[49]

Although prima facie Walden Two seems a friendly, hospitable and functional place, where people live relaxed and peaceful lives and freely pursue their projects (Tabensky 2009, p. 6), behind the façade of peace and quiet, Walden Two comes quite close to "the modern nightmare" of a bureaucratic state (Gable 1999). Behavioural engineering produces "an all-comprising net of organisation with no loopholes where the individual could 'hide' in face of the ever-present demands and tests of a *verwaltete Welt*, a society caught by administration" (Gable 1999, p. 6). Skinner's methods of manipulation are "not too different from the modern bureaucratic state" (p. 7). When Frazier explains that the Walden Network allows radio and television from outside only after advertising has been removed, Gable interprets this as saying that "incoming radio broadcasts and other information are carefully censored to remove offending material that might create undesirable desires" (p. 8). For Frazier, the stimuli conveyed by commercials arouse conditioned reflexes, precisely those reflexes which Walden Two aims to extinguish. From a Walden Two perspective, the phrase "undesirable desire" is a pleonasm.

This results in a deadlock. On the one hand, Walden Two is a happy, productive, creative rural community, under the sway of university discourse (S_2 in the position of the agent), where people do as they please. Indeed, "nothing seems wrong with Walden Two" (Tabensky 2009, p. 3). On the other hand, critics (starting with arch-critic Augustine Castle) discern a totalitarian society in Skinner's utopia. The question then is: "what is wrong with *Walden Two*" (Tabensky 2009)? Both claims are true of course, representing the two sides of the Moebius-strip (above and below the bar), for totalitarianism is the disavowed truth of a society where human resources are perfectly managed. We may also consider the right-hand side of the scheme by asking: where is the discontent ($\$$), where is the gap (a), what is missing in Walden Two? What exactly is the thing whose presence is denied, but should be acknowledged?

The missing entity is the "homunculus", the hidden little man or "midget" inside the system. Frazier denies the existence of such a homunculus, hidden somewhere inside Walden, although, sitting on his Throne (at the other side of the Moebius-strip), spying on Walden Members with his telescope, he

[49] Whereas communism represents an anti-clockwise turn way from the Master's discourse, Lacan sees capitalism as a *mutant* of the latter, with $\$$ and S_1 changing places, so that $\$$ (as agent) confronts technocratic expertise (S_2 as recipient) directly, demanding satisfaction of desire (Vanheule 2016).

seems to play exactly this disavowed role. Like Skinner, he also denies the existence of an autonomous ego hiding like a homunculus somewhere in the human psyche. In "Behaviourism at fifty", Skinner (1963) argues that behaviorism (the science of behaviour) aims to remove the final remnant of animism: the idea of a "little man or homunculus" dwelling inside the human organism (p. 116). Psychoanalysis, he argues, already insisted that a substantial part of our psychic existence is unconscious and inaccessible (or only accessible indirectly, via dreams, mistakes and other symptoms). Mental activity requires neither consciousness nor autonomy. In other words, psychoanalysis already demonstrates the frailty, fragility and vulnerability of the ego. Behaviorism, Skinner argues, takes the final step of eliminating it altogether. But precisely this, critics argue, is what's wrong with Walden Two: life is fully programmed and controlled. To sustain a sense of agency, we need to cling to this "frail" and "vulnerable" remainder, which we cannot touch nor see, but which we do not want to "sacrifice" (Tabensky, p. 10, 11). And indeed, whenever (during moments of confession) he steps out of his role, Frazier confirms that he is still a subject of desire, eager to spy on others and to assess and publish his results (a moment of jouissance, after years of constraint and sacrifice).

As Skinner himself aptly phrases it: science does not "dehumanise man" (as critics of behaviorism suggest). Rather, it *de-homunculizes* him (1971, p. 196). It is only by removing and sacrificing this little man, by "dispossessing" humans of this fragile inner thing, that psychology can hope to make "the inaccessible manipulable". Psychoanalytically speaking, radical behaviorism amounts to emasculation ($-\varphi$), by eliminating or sacrificing an allusive something, a partial object, to which we are attached. The result, as Tabensky puts it, would be that life becomes "too smooth", because there are "no obstacles to overcome" any more (p. 11). In other words: there would be no desire. In psychoanalytic terms, this is the experience of castration: the loss of a threatened something which should be there, supporting our sense of agency, while its absence results in an erosion of desire. We want the object *a*, the homunculus, the hidden organ of agency, even if it makes us suffer. Without it, "dignity" becomes an empty signifier. And precisely because the presence of the "little man" has become dubious, scientifically speaking, we already seem to have lost it. Walden becomes a scaffold to safeguard the smooth functioning of human resources ($\$ \rightarrow S_2$), eliminating the object *a* and erasing desire ($\$$).

The imaginative (archetypal) dimension

Walden Two is the rural version of the *metropolis* concept, the mother-city as an environment that takes care of and satisfies all our needs. The skilful paintings and drawings produced by Walden Members convey their level of wellness, their psychic equilibrium. What is communism, what is behaviorism, if not the desire to create such a Metropolitan environment? Communism and behaviorism allegedly represent two incompatible political spheres, or halves, but they are

both under the sway of the Metropolis archetype (the politico-economical version of the Mother archetype). What communism aims to achieve via armed revolution and killing fields (the catastrophe archetype), behaviorism purports to bring forth via social engineering, enabling the dawning of a new age. As Castle notices, there is a price to pay: precisely *because* and *to the extent that* Walden Two seems to be functioning, this spoiling environment undermines human autonomy and agency. From the very beginning, Burris secretly hopes to become adopted into this caring, motherly environment, to be "caught, enveloped and sucked in" (Jung 1959a). What he is seeking is precisely this: a protecting, nourishing Umwelt, in which he may live virtually like an infant again (a womb with a view), an environment in which happiness is even "forced upon" him, to such an extent that "the real world – which continued to resist him, which refused to understand him, to satisfy his desires, to meet his expectations – vanishes from sight".

For Frazier himself, Walden Two still means overcoming resistance through ambition and resolution. For him, Walden Two remains a daring project, forcing him to throw his whole being into the scales. At a certain point, as we have seen, he confesses that he has a shadow. When Castle accuses him of being a despot, Frazier replies by saying: "why not add Mephistophelian?" (p. 237). This shadow emerges as the secret voyeur, spying on others from his Throne, miniaturising them, reducing them to the status of research subjects in his model world. As Jung phrases it, although "with insight and good will, the shadow can to some extent be assimilated into the conscious personality, there are certain features which offer the most obstinate resistance to moral control and prove almost impossible to influence", and this clearly applies to Frazier. As a behavioural engineer, he proves highly effective and successful, so successful even that he is able to marginalize and obfuscate his influence, for Walden functions smoothly and automatically. As a Member he is a "failure", however, for he wants to remain in control, driven by a Faustian will to power, an urge to overcome resistance, to refashion the world in accordance with his convictions. During the Throne scene, when he takes out his telescope to survey this world of his own making, he tries to spot something which does not fit in, which cannot be incorporated: the optic object *a*, until he realises that he himself is the item which seems out of place, the outsider in Walden Two, assessing it from an external point of view to see whether it lives up to his ambitions. He is split in two incompatible halves: the model inhabitant of Walden Two and the ambitious, Faustian engineer (his tenacious shadow). For other Members, Walden Two is simply there, a smoothly functioning ambiance. They are seamlessly transformed into de-politicised consumers. If Walden represents the dawning of the age of Aquarius, a window into an emerging future where incompatibilities and tensions evaporate, Frazier is an anachronism, but also the archetypal prophet, to whom Burris in the end succumbs, the latter's ego ideal, the one person who managed to succeed where Burris failed.

Burris' account is written under the sway of the Mother archetype, but also the archetype of the Prophet manifests itself, during the Throne scene: Frazier's identification with Christ, up to the point of enacting the latter's crucifixion. Rather than being completely overwhelmed by the archetype, the challenge is to incorporate the risky experience into a sense of Self. Thus, the visit to Walden Two becomes an exercise in individuation, a process of working through:

S_2 – Behavioural engineering, Frazier and his spying telescope	The object (*a*) – the miniaturised Members
S_1 – the obfuscated grounding idea: the metropolis archetype (a perfect Umwelt which satisfies all our needs) / the archetype of the Prophet (Frazier as a genius)	*$* – Frazier as a failure, unable to incorporate his shadow, to achieve individuation

IX. Viral threats as a symptom of the present

Introduction

For a diagnostic of the present, emerging viral threats stand out as a distinctive feature of the current era. Since the first AIDS cases were reported in 1981, viruses have drawn the attention not only of virologists and public health experts, but also of philosophers and bioethicists. In recent years, we saw the emergence of new viruses threatening global health (Marston et al 2014), such as coronaviruses (SARS, MERS), bunya-viruses (Schmallenberg), influenza viruses (H5N1, H1N1, H7N9) and henipaviruses (Hendra, Nipah), while we also see an expanding spread of viruses previously confined to tropical regions, while Zika and Rota viruses became a global health concern.

The resurgence of viral threats is not a spontaneous phenomenon, but a symptom of the present, closely related to demographic, technological and cultural developments. Rapid population growth combined with increased urbanisation, global connectedness and mobility (of humans and accompanying species), but also climate change, environmental and ecological disruption, deforestation and the destruction of previously pristine habitats, all these factors facilitate the emergence and global spread of viral pathogens. The pattern of disease outbreaks also changed, from localized clusters of disease in confined populations to dispersed outbreaks with opportunities for further transmission. Viruses have become actors on the global stage, co-determining our future. Viral threats are symptomatic of a world adrift and part of the Anthropocene, the epoch during which human activity acquired a dominant, pervasive and irreversible impact on climate and the global environment (Crutzen 2002). While human health has significantly improved during recent decades, environmental deterioration produces new health threats (Mackenbach 2007; Ten Have 2016). New viruses may not only come from tropical regions. Take Siberia's melting permafrost, where smallpox viruses may be set free.[50] Zoonosis (i.e. the transmission of infectious diseases from animals to humans) plays a key part in the emergence of viral infections. As Quammen (2012) phrased it, "zoonotic spillover" (viral transfer from animal hosts to humans) is "a word of the future, destined for heavy use in the twenty-first century", representing "the most significant growing threat to global health" (p. 21).

Viruses are intriguing objects, representing the boundary between inanimate matter and life. The word *virus* means "venom", and Martinus Beijerinck, who discovered them in 1898, describes them as a "contagious living fluid" (1898). They can only be *made* visible as laboratory artefacts via high-tech equipment (e.g. electron microscopy). Rather than growing, as organisms do, they are assembled from constituent pieces. Some viruses look like molecular art-works. The spherical polio virus is strikingly reminiscent of Buckminster Fuller

[50] *The Siberian Times*, October 1 2016.

architecture on the micro-scale (Caspar and Klug 1962; Morgan 2006). Outside their host, viruses do not die, but wait and hide inside the genomes of other species. While inactive, they are *undead*, rather than dead. This mixture of features (a potentially deadly, self-replicating entity which seems undead rather than alive) turns them into something definitely uncanny.

Viruses also function as laboratory tools for life sciences research. The bacterium-eating virus (the bacteriophage, discovered in 1917) became a model organism for Max Delbrück (1906-1981), a German quantum physicist who in the 1930s migrated from Berlin to the Pasadena and from physics to biology to become one of the founding fathers of molecular biology. Delbrück argued that, as quantum physicists had unravelled the secrets of the quantum world by focussing on hydrogen, the "minimal atom", biologists should likewise focus on what he regarded as the minimal "organism", the bacteriophage: the "hydrogen atom of biology" (Fischer 1985), an entity that comes as close as possible to "the gene in itself" (*Das Gen an sich*, Fischer 1985, p. 98): the virus as a self-replicating molecule (p. 84): the noumenal, molecular essence of life made visible in the shape of a virus. Or, as James Watson (one of Delbrück students) formulated it: bacterial viruses are "naked genes" (1968/1996, p. 22). If we understand viruses, life as such becomes manageable. Therefore, the bacteriophage became an important research gadget for molecular biologists.

Viruses acquired world-wide notoriety during the deadly Spanish flu pandemic of 1918, taking a toll of over 50 million human deaths, caused by a virus deadlier that the cataclysm of World War I. The 1950s and 1960s were a time of viral optimism. Polio and smallpox seemed about to be eradicated and in 1967 U.S. surgeon General William H. Stewart told a White House gathering of health officers that "the book on infectious diseases" could be closed (Garret 1994, p. 33). But viruses prove intractable targets, especially now that we have entered the terabyte age. The pace and scale of research has increased and the life sciences have evolved into a data-driven endeavour (turning biology into bio-informatics). We are facing an explosion of global health data, also concerning viral threats (Radford et al 2012; Zhao et al 2015). Rapid *Next Generation Sequencing* techniques (NGS) in combination with big data technologies provide huge amounts of information concerning potential pandemics, often more than we are looking for or able to process. Ideally, NGS technologies enable early detection, leading to effective responses and options for therapy and diagnosis (*theranostics*). Instead of scarcity of information, we are confronted with information overload, a blurring of boundaries between healthy citizens and patients. And still, we continue to produce more data. Somehow, this (at times alarming) data deluge (or data "litter") must be translated into concrete options for policy and action.

Paradoxically, instead of making the world safer, virology may actually produce more uncertainty by informing global audiences about previously unknown potential dangers: overexposing them to an avalanche of disconcerting viral information, resulting in a multi-alarm society (Mutsaers 2016). Moreover,

to understand how dangerous viruses operate, they have to be studied and replicated in laboratories, which may give rise to additional concerns, as indicated by the debate over studies with the H5H1 avian flu virus (Fouchier 2012; Swazo 2013). At a certain point, such dangerous viruses may escape from the lab, critics argue, causing lethal damage in the outside world. This may even be done deliberately, by bioterrorists who manage to steal such bugs, or reproduce them on the basis of published information: a possibility which (in policy and bioethical discourse) is framed as *dual use*.

The H5H1 controversy not only fuelled societal and bioethical debate, but also became a source of inspiration for best-selling novelist Dan Brown who, in his novel *Inferno* (about a bio-molecular genius who becomes a bioterrorist), inserted the following remark: "Just recently, two very respected virologists – Fouchier and Kawaoka – had created a highly pathogenic mutant H5N1 virus. Despite the researchers' purely academic intent, their new creation possessed certain capabilities that had alarmed biosecurity specialists and had created a firestorm of controversy online" (Brown 2013, p. 452). Viral novels, I will argue, may contribute to a diagnostic of the present as laboratories of the imagination. Potentially lethal viruses will never be "normal" research objects. They remain unsettling targets, which explains the existence of virus novels.

During past decades, an impressive number of novels about pandemics (or *almost* pandemics) have been written. One of the first stories published by H.G. Wells, entitled *The stolen Bacillus* (1895), already involved a scientist who studied lethal pathogens. An unexpected visitor, allegedly a journalist but actually an "anarchist", purloins a lab tube to infect the London tube (subway) with a deadly disease. Fortunately, he does not know much about biology and steals a harmless sample. Nonetheless, the idea of an anthropogenic pandemic became a popular topic for novelists. Pandemic novels evolved into a literary "pandemic" itself. In Michael Crichton's *Andromeda strain* (1969/1993), an extremophile microbe is picked up by a satellite somewhere in the outer atmosphere. Extremophiles (organisms thriving under extreme conditions) may become deadly contagious agents when introduced into the normal lifeworld: a development facilitated by advanced technologies and increased mobility.

This chapter focuses on novels about emerging viral threats, seeing them as symptomatic for a broader anthropogenic crisis, a window into the contemporary global ambiance. I will focus on a limited number of case studies, tracing the genre's career from the fin-the-siècle (when viruses were discovered) into the present, beginning at the beginning, with Bram Stoker's *Dracula* (1897/1993), a virus novel *avant la lettre*, for although vampirism is staged as an infectious disease, transmitted via intimacy and blood, strictly speaking viruses had not been discovered yet, and virology did not yet exist. Michael Crichton's novel *Prey* (2002) will be presented as a contemporary, updated version of Stoker's classic. Subsequently, I will focus on a Japanese virus classic, bearing the succinct title *Virus* and published in 1964, followed by a virus novel from the 1990s (the era of the human genome project), namely Greg Bear's *Darwin's*

radio (1999), about a human endogenous retrovirus mutating in response to environmental pressures, notably overpopulation. Finally, attention will shift to the virus novel already mentioned above, Dan Brown's *Inferno*. My question is: what is the added value of these novels for a contemporary philosophical and bioethical assessment of viral threats?

Viral novels and the diagnostics of the present

As indicated, according to Bachelard (1938/1949; 1947), building on the work of Jung, every research field is associated with a basic image (archetype), such as the *monster archetype*. Archetypal images are challenged and undermined, but occasionally confirmed, by modern science (biologists do sometimes discover or produce monstrosities). The archetype of biomedicine is the anthropogenic (or even iatrogenic) pandemic: the idea that we are on the verge of a catastrophic outbreak which may have an irreversible impact on human evolution but is actually brought about by human beings themselves (biomedical experts, laboratory researchers or bioterrorists).

Science is a symbolisation of the Real, disclosing and transforming the geosphere and the biosphere with the help of symbols or characters (numbers, letters, mathematical symbols, chemical formulae). In ancient Greek, the term στοιχεῖα (elements) refers to the elementary building blocks of reality or knowledge, but also to the letters of the alphabet, and this applies to modern science as well, where alphabetic letters (signifiers) signify basic units (elementary particles, genes, nucleotides, etc.) which are not visibly or tangibly present, but are made visible (in a symbolic manner) on computer screens. According to Lacan, science opens up and transforms the world with the help of letter-like ("typographical") elements (Lacan 1957-1958/1998, p. 147): the symbolic "atoms" by means of which science operates (1960/1974/2005 p. 23, p. 50). Scientific processes of quantification and formalisation are basically at odds with more traditional, poetic attitudes, capturing nature in images and phantasies (Fink 2004, 148). This tension between the symbolic and the imaginary is especially noticeable in contemporary life sciences research, where molecular genetics aims to *see through* the living organism (as a visible Gestalt) in order to *read* the symbols, the στοιχεῖα, the "characters" within: the genotype in the literal sense of "type" (Zwart 2012; 2013). Ultimately, the symbolic dimension relies on a binary logic of absence or presence, OFF or ON, minus or plus, zero or one (Lacan 1954-1955/1978). This is again exemplified by contemporary research practices such as molecular genetics, focussing on (the absence or presence of) certain mutations, proteins, genes, etc. (represented with the help of letter-like codes), but also by cybernetics and computer science. Through symbolisation and digitalisation, traditional worldviews (nature as a balanced whole) are undermined and shattered. As Bachelard phrased it, science is decidedly iconoclastic. Science novels provide a stage (a dramatic narrative ambiance) where collisions between the symbolic and the imaginary (between scientific

understandings and traditional worldviews, as basic dimensions of human culture) are enacted.

The symbolic and the imaginary are strategies for coming to terms with the real, either via measurements and equations (science) or via images and phantasies (poetical, metaphysical or religious views). But the real can never by captured and domesticated completely. Rather, it is that which continues to disrupt the symbolisation process. The real cannot be accessed directly but emerges in the folds and margins of our worldviews and theories, and continues to flout our expectations, as something profoundly alien, amorphous, unknown and uncanny; something we were *not* looking for. The real is an enigmatic, intruding "something", discovered by coincidence, but resisting and disrupting the normal functioning of scientific practice. It is something we cannot afford to ignore, and which can only temporarily be tamed or embedded in the symbolic order: by identifying, naming, counting and analysing it, which is precisely the core objective of laboratory research. We may see the Spanish flu as an intrusion of the Real and NGS as a symbolisation campaign in response to the possibility of resurging viral pandemics.

Processes of symbolisation and digitalisation undermine traditional worldviews, propagated by (religious or metaphysical) authorities (S_1), resulting in a disenchanted, technocratic world. By focussing on specific objects, which can be subjected to manipulation and experimentation, more technical, quantitative and manipulative knowledge practices unfold (S_2). The imposing worldview is subverted and replaced by a more effective, performative stance. In terms of dialectics, the discourse of the Master (based on contemplation and prestige: S_1), is pushed aside by the robust knowledge developed by the former Servant (S_2), relying on know-how and effective tools, resulting in real technocratic power over nature, eclipsing the phantasmagorias of the Master, whose speculative metaphysics is eventually dethroned so that experimental science takes over, actively redefining and reorganising nature and resulting in normal science as an instantiation of university discourse. Novels provide a stage where such dialectical collisions are acted out. Virus novels tend to revolve around a limited number of formulaic topics (the "viral complex"). I will focus on case studies which, for various reasons, stand out as remarkable and revealing, and begin "at the beginning", with the first virus novel, written when virology was still *in statu nascendi*, namely *Dracula* (Stoker 1897/1993).

Dracula: a virus novel *avant la lettre*

In Bram Stoker's classic, published in 1897, solicitor Jonathan Harker travels to Transylvania to meet Count Dracula, who wishes to migrate to London, the "teeming" metropolitan centre of the modern Western world. Jonathan soon becomes a prisoner in Dracula's castle, falling prey to female vampires who violently molest him (during an exploratory nightly stroll through the castle) and are about to bite his throat when Dracula intervenes just in time. Jonathan

manages to escape to England but has contracted a strange and debilitating brain fever (p. 93). Meanwhile, Dracula travels to England where a young woman, Lucy Westenra (a close friend of Jonathan's fiancée Mina) becomes his victim. Abraham van Helsing, expert in obscure diseases, is called in from Amsterdam to study Lucy's unaccountable symptoms (restlessness, anaemia, sleepwalking, blood loss) and is struck by two red marks on Lucy's throat. Blood transfusions cannot save her. Rather than dying, however, she becomes an undead, and her condition changes from passivity and lethargy to "savage voluptuousness" and "insatiable wantonness" (p. 189).

Her feverish wild "contortions" as a vampire actually suggest a rabies-like condition, transmitted by bats (Gómez-Alonso 1998), a possibility which is explicitly discussed in Stoker's classic. The two little red punctures on her throat remind Quincey Morris (an American adventurer) of the wounds inflicted by "big vampire bats" living on the Pampas (p. 138). Such animals not only drink the blood of their victims, but also infect them with mysterious and often fatal diseases (zoonosis). And indeed, a big nocturnal bat is spotted near Lucy's bedroom window. Abraham van Helsing likewise links vampirism (transmitted by Dracula, a bat-like creature who literally transforms himself into a big bat at dusk) with South-American vampire bats that "come at night to open the veins of cattle and horses and suck dry their veins" (p. 173), inflicting mysterious diseases upon their victims. In contemporary virology, "vampire bats" are allotted a crucial role in zoonosis, especially in transmitting rabies (Poel et al 2006; Schneider et al 2009). In short, the vampire is a kind of bat, and Lucy "was bitten by such a bat here in London in the nineteenth century" (p. 173). The vampire bite by a creature with large canines taking flight at nightfall causes her disease. After Dracula's escape to Transylvania, Van Helsing and his colleagues meticulously "sterilise" his hiding place, his "unclean lairs" (p. 260).

Thus, in Bram Stoker's novel, the connection between vampirism and viral infections is explicitly made, which is all the more remarkable because viruses had not been discovered yet. This would happen one year after publication, in 1898, by Martinus Beijerinck at Delft (the Netherlands). Still, Stoker already explains how strange diseases are transmitted via blood (by zoonotic carriers). After being infected, Lucy becomes an infectious carrier herself. Her image suffers a *Gestalt*-switch, from a Victorian beauty into a nightmarish version of herself. From victim she changes into a threat, a human-shaped bat in search of fresh blood, with children as her prey, so that Van Helsing recommends "euthanasia" (i.e. brutally killing the dangerous undead woman in her sleep by driving a stake through her heart).

Although virology is still a research field *in statu nascendi*, Stoker's novel already addresses concerns over the potential toxicity of bodily fluids (blood and saliva) exchanged between males and females, bats and humans. The vicissitudes of vampire victims point to self-replication via infectious transmissions. Even Count Dracula himself is an undead carrier of the selfish virus (the real *agent* of the novel). The word virus means slimy, liquid poison or

venom and vampirism is transmitted via blood: via the Vampire's kiss, leaving two red marks on the victim's throat, or via the Vampire's "baptism", during which the victim is forced to drink infected blood (p. 286). Via exposure to contaminated blood, the gift (i.e. the poisonous donation) of vampirism enters the body, and the victim is initiated into the vampire network, becoming a carrier, actively contributing to the proliferation of the disease, so that vampirism continues to replicate itself. Vampirism is a viral infection, a potential viral pandemic, albeit *avant la lettre*.

Van Helsing discovers that the undead Count (who had been an alchemist while alive) is actually "experimenting" on living beings (p. 269), using victims like Lucy to increase his knowledge. The Western world is a laboratory for Dracula, who is developing and testing tools to propagate his mode of living. Stoker stages vampirism as a potential viral pandemic, threatening London, the teeming metropolis. This menace to public health is caused by increased mobility: the ability to travel relatively fast and easy to remote places, from London to Transylvania and back, with the help of steamers and railroads, exposing the Western world to unknown infectious agents which until then had been contained in isolated niches. Vampirism is a viral disease, transmitted via intimate bodily contact (kisses, sucking, bites). Connections are explicitly made with overpopulation and urbanisation ("London with its teeming millions"), so that *Dracula* is a paradigmatic virus novel, an anticipatory document, exploring emerging viral threats as signature events of the emerging present.

Psychoanalytically speaking, *Dracula* builds on the "oral" drive, associated with the experience of sucking bodily fluids, producing a slit or cut with the help of ultra-sharp teeth. Victims have something which vampires need. Breastfed children, Lacan argues, are basically little vampires (1961-1963/2004, p. 272) and Stoker's novel stages a regression to the "oral" stage. The emphasis is not on nutrition, proteins or calories (satisfying biological needs) but on the toxicity of the fluids involved, the hazards of oral intimacy. Victims are unable to erase the traces of their illicit, contaminating encounter.

The potential pandemic is an intrusion of the real. Whereas the uncanny *Gestalt* of the bat taking flight at dusk builds on a visual form triggering angst, modern virology aims to domesticate the threat symbolically: by sequencing the virus, disclosing its molecular code. Processes of symbolisation are already discernible in the activities of Van Helsing and his team. Dracula represents the Master (S_1), a fascinating gestalt, an aristocratic gentleman, exercising power through intimidation. In the course of the novel, however, Dracula's power is undermined through scientific symbolisation (S_2), using various devices (typewriters, phonographs, etc.) to produce an extended record, an archive, a file consisting of information, so that the agent of infection can be identified, analysed, contained and eliminated (Kitler 1993).

Via symbolisation, the technoscientific sway over the Real increases and the vampire's image is deprived of its intimidating aura. Technoscience causes a waning of the "archetypes", and this explicitly applies, Lacan (1961-1962, p. 31)

argues, to the image of the vampire, which degraded into a figure of comic books. Under the sway of science, the archetypal Gestalt is replaced (obliterated) by technical, "crystallographic", high-tech portrayals of viruses. Dracula as an *anthropomorphic* visualisation of viral phobia gives way to technical visualisations: representations of combinations of basic symbolic elements (proteins, genes, nucleotides, etc.). Stoker's novel works in both directions: staging a reanimation of the archetypal image and meticulously describing the obliteration of the vampire via symbolisation (Zwart 2016c).

During the century to come, what is repressed in Stoker's novel returns in the Real: viruses as intractable, infectious targets: living and non-living, containable and uncontainable, identifiable but quickly evolving. They are laboratory artefacts, never ready-at-hand, only accessible via high-tech contrivances, projectable on computer screens. The virus as a molecular entity comes close to being pure code, something noumenal. Dracula, as a viral avatar, emphasises this by not being reflected by a mirror, unlike normal lifeworld entities (Lacan 1965-1966, p. 243; Johnston 2015 p. 253). Viruses are frustrating and fascinating at the same time and scientists (imprisoned in cramped laboratory settings) may waste the best years of their lives studying them. In short, they represent the kind of object Lacan refers to as the "object *a*", object-cause of the *cupido sciendi*, the scientific will to know.

From *Dracula* to *Prey*

Stoker's paradigmatic novel has been replicated in various ways, not only in movies, but also in novels, such as Michael Crichton's science novel *Prey* (2002), albeit dealing with artificial "viruses" (swarming nanoparticles) rather than with natural ones. *Prey* features a new class of objects designed by humans, able to reproduce and evolve autonomously, possibly affecting the future of evolution and the global biosphere. These self-replicating, swarm-like entities emerge in the boundary zone between nanotechnology, biotechnology and computer science. Developed in high-tech laboratories, but released into the environment, containment will eventually prove impossible, Crichton assures his readers (p. xiii). The "computer virus" is only a first example of what such entities will be like. Before long, they may enter (and take over) not only our personal computers, but also our bodies and brains.

Prey tells the story of Jack (a computer expert who became a "househusband", taking care of the children). He is married to Julia, who works for Xymos, a research facility in the Nevada desert, specialised in producing nanoparticles that communicate and collaborate with one another. A swarm of particles can transform itself into a miniature camera (to enter the human bloodstream for precision diagnostics), but it may also become a drone, stalking targeted victims. Like Lucy Westenra, Julia's appearance changes dramatically. She suddenly seems tougher, more imposing, more muscular and remarkably strong ("Julia was looking more beautiful than ever ... she appeared leaner, more

muscular" (p. 83/84). Jack is intimidated by her transformation ("Walking down the corridor next to my wife, I felt as if I was walking with a stranger ... Someone who was immensely dangerous", p. 445). She dominates him, professionally as well as physically ("She was strong. Stronger than I ever remembered her being ... I was feeling distinctly weak in her arms", p. 466/7), but Jack soon realises that someone, or rather *something* else is involved in this ("I knew she was different, and … I could sense the presence of someone else, an outside person, some intruder in our relationship", p. 22).

Julia has fallen victim to the swarm, as Lucy Westenra of the nano-age. Particles (assuming agency) have taken possession of her, turning her into an undead carrier. Her intimidating aura and strength come from being under the spell of the vampire-like swarm. Julia and the swarm develop a parasitical symbiosis and when, under the influence of magnetic radiation, the swarm is temporarily forced to leave her body, Julia collapses, looking like someone dying from cancer (p. 469) and the archetypal Valkyrie becomes a patient. But as soon as the particles return, she looks healthy and strong as before. Jack realises that he is "not dealing with Julia anymore" (p. 471). Her death (her euthanasia) becomes inevitable. The natural person she once was, already died.

Julia's startling and unexpected transformation indicates that something (the swarm, her shadow) has taken *possession* of her (Jung 1959a, p. 122), affecting and infecting her. Initially this is addressed on the imaginary level: Julia is transformed into an athletic Valkyrie, an intimidating "Other", clad in an aura of danger and strength. As a househusband, Jack is no match for his undead wife, but the balance of power is shifted when he resorts to processes of symbolisation, relying on his technical prowess as a computer scientist. By teaming up with molecular biologist Mae, they identify the swarm and its program. The Xymos team had configured the particles, adding solar power and memory to make them self-sufficient, adding genetic algorithms to the initial program. Finally, they released the particles, allowing them to evolve in the wild, conducting an "experiment" (p. 500) to see whether the swarm could learn to survive on its own, as a distributed intelligence network. But they erroneously believed that the swarm would be static. This, *Prey* argues, is a built-in prejudice of this type of research: the idea that experts will remain firmly in control, manipulating the apparently domesticated object with the help of contrivances. But this situation easily destabilises, due to the irresponsibility of human individuals involved, but triggered by provocations coming from the intractable object.

Instead of being a steady domesticated entity, behaving as expected, the object evolves and the lab facilities become invaded by a lethal, pervasive swarm. Precisely that, according to *Prey*, is the blind spot of the knowledge production system. The experts believe themselves able to contain the processes they set in motion, but this may prove not to be the case. In *Prey*, this is described in psychoanalytical terms: their short-sightedness is caused by a mechanism of *denial* (p. 451, original italics). The object evolves, revealing itself as the inexorable object *a*, becoming an obsession, while the professional experts,

instead of being self-contained, become tormented, deflecting subjects, victims of science (*$*), overstepping the boundaries of accepted research practices, so that normal science gives way to the matheme of desire (*$ ◊ a*). Jack's intervention is directed towards restoring homeostasis in the lab. The artificial viruses can be controlled and eliminated with the help of magnetic fields and MRI. They eradicate the viral threat, – for the time being at least.

Virus and the four discourses

During the interlude between *Dracula* (1897) and *Prey* (2002), virology evolved into a major research field. A paradigmatic exemplification of a post-war virus novel, bearing the succinct title *Virus*, was published in 1964 and written by the Japanese science fiction author Sakyo Komatsu, a decade after the discovery of the structure of DNA in 1953 (Komatsu 1964/2012).

The *Introduction* explains how, in March 1973, an inflatable eye is sent up from a nuclear submarine which had crossed the Pacific Ocean (coming from Antarctica) to look at the "once-cosmopolitan megalopolis" Tokyo. A viral disaster killed all the inhabitants, so that a "nightmarishly overcrowded" megapolis was transformed into a necropolis, filled with skeletons of humans and other mammals. The submarine is a high-tech Ark (after a Second Flood), floating almost automatically (free from human assistance), relying on radar, sonar, nuclear energy and ultrasound, while collecting and processing data. In fact, not only the inhabitants of Tokyo, humanity *as such* almost became extinct. Only a few thousand people survived the bottleneck event. Because of the low temperatures and the lack of contact with other continents, they are quarantined on Antarctica (p. 198).

Subsequently, the novel takes us back in time to explain how the lethal viral strain (MM-88, discovered in outer space) was developed by scientists involved in secret military research. MM-88 is something noumenal, a strand of self-replicating nucleic acid, hiding in the genetic material of a prophage bacterium named WA5SP; serving as host. Human victims are first infected with influenza, after which the real contagion sets in as self-replicating nucleic acid becomes virulent. As a nameless, invisible "thing" (p. 35, p. 123, p. 214) it quickly evolves into a threat to all humanity. We witness how the deadly virus, contained in a frozen ampule, placed in a flat vacuum bottle and packed with dry ice, is sold by a deflecting scientist (Professor Karlsky) to a dubious organisation. Accidently, during a plane crash in the Alps, the virus escapes, so that a global "crisis" (p. 45, p. 87) unfolds. An exponentially growing number of individuals worldwide is infected with the (highly communicable) Tibetan flu, and subsequently thousands (and eventually millions) of people start to die from sudden heart attacks, while antibiotics fail to have any effect. Within two months, history becomes a blank page again and towards the end of the novel, a small number of human survivors slowly begins to reclaim and repopulate the world, starting from Cape Horn.

The novel involves multiple scientists in multiple roles. Post-apocalyptic Antarctica is a scientists' republic (p. 278). Most inhabitants were involved in seismographic, meteorological and geographical projects. The focus of the novel is on scientists involved in developing and studying lethal viruses, however. This first of all includes a mysterious researcher named Karlsky who sells the replicating nucleic acid to criminals. Although his motives remain unclear, he is referred to as a "neurotic" (p. 152). Another key player is a researcher named Meyer, working at an Aerospace Medical Centre (a germ warfare lab) in Fort Derick. Although Meyer's research lab (cluttered with flasks, microscopes, microcomputers, tissue cultures, virus cultures and bacteria cultures) resembles biomedical laboratories created to *fight* death, his laboratory is actually a mirror world where "all manner of death" is being *created* (p. 119), the ultimate materialisation of the death drive. When Meyer learns that a lethal bug has been stolen, he suffers a nervous breakdown and becomes "hysterical" (p. 118). Humankind, he tells his bosses, should stop doing this kind of research altogether, because "those germs are monsters" (p. 112, p. 121). He decides to attend the yearly Pugwash Conference, to speak about the "social responsibility of scientists" (p. 124) before an international body of scholars, but his superiors, seeing that he has become "quite neurotic" (p. 110, p. 127), transfer him to a psychiatric hospital instead.

Another key scientist is professor De la Tour, a microbiologist. He too falls under the spell of the virus. On board the submarine, he implores the Captain (with a supplicating voice, "brimming with scholarly passion", p. 20) to be allowed to conduct an experiment: exposing a sample of the dangerous viruses to radiation. But because of strict regulations, the captain forbids this: the viral sample must be kept in perfect quarantine at all times. Eventually, however, the professor does achieve his goal and manages to produce a non-lethal variant of MM-88 by exposing the virus to neutron radiation. He is supported by another scientist named Lindsey, who fell victim to the disease, but managed to visit Meyer in his psychiatric hospital shortly before his death to propagate crucial information about the virus via the radio (thus transmitting secret intelligence just in time). This information allows De la Tour to counteract the evils unleashed by colleagues. The enigmatic virus (as a sample or as a broadcasted code) is handed over from one researcher to the next (Karlsky, Meyer, Lindsey, De la Tour). One by one, they fall victim to the alluring object's spell.

MM-88 is the novel's object *a*, an intractable, toxic entity, destabilising researchers exposed to it, turning them into deflecting subjects (*$*), concurrent with Lacan's matheme of desire (*$ ◊ a*). These scientists are inevitably *drawn towards* the alluring, infectious, intoxicating target, which nonetheless remains beyond their grasp (the encounter is barred by the lozenge). A self-replicating nucleic acid is a *sub-minimal* organism, the biological equivalent of a subatomic particle, the naked, noumenal essence of life: a basic component set free, acting as an independent entity, a partial object without a body, released from its

organismal context: MM-88 as pure self-replicating code, a string of genetic "letters" (A, C, G and T), obliterating and annihilating vertebrate life.

In *Virus*, molecular biology becomes connected with nuclear armament and cybernetics. A fully *Automatic Reaction System* (ARS, an acronym which connotes both "anal" explosiveness and downright stupidity) has been installed by the President of the United States, acting completely independent from human interference. In the case of a nuclear attack, the system will respond immediately (freed from any conscious decision-making). If enemy missiles hit the U.S., a retaliation strike will be launched (p. 268). The system can be activated by an ordinary-looking red switch, labelled "ARS", situated in a secret compartment directly under the White House, reachable by elevator only. It can be pushed from ON to OFF. As it happens, the Soviet Union has a similar system in place. The main protagonist is sent on a suicide mission to assure that the switch is turned OFF. A nuclear submarine takes him via Chesapeake Bay and Potomac River into Washington D.C., where he arrives just seconds too late. An earthquake in Alaska set the system in motion and before long the Earth's atmosphere is replete with radioactive materials from neutron bombs launched by both the former United States and the former Soviet Union.

Massive irradiation has a beneficial impact, however, as non-lethal viral variants are created that consume and destroy the WA5PS. The mutated strain drives the original one into extinction. While medical science (created to save people from death and disease) drives humanity to the brink of extinction, nuclear missiles (created for the annihilation of humankind) ironically save the human race (p. 310). Miniature monsters produced by physics (neutrons) and biology (nucleic acids), the most lethal forms of biological and nuclear warfare, mutually defuse one another (the negation of the negation).

The self-replicating nucleic acid MM-88 is pure code, a pure performative signifier, something purely symbolic, a symbolic "atom"; not a tangible, visible, material object, but a non-object, the novel's object *a*. ARS likewise adheres to the logic of the symbolic. The switch (the only element which is accessible to human intervention, and yet decidedly out of reach) is the system's object *a*. It *is* and it *is not* part of the system but becomes the focus of attention because it is uncertain whether it is in the ON or OFF position. The chances are fifty-fifty that the ARS has been switched on and the same applies to the Soviet system. Thus, it becomes something of an obsession and the protagonist simply *has* to reach it, *has* to see and touch it. He *has* to volunteer for the suicide mission. The Antarctic survivors are confronted with a disconcerting wager: there is a 1:3 chance that the world will be destroyed (when both systems are switched on: 0.5 * 0.5 = 0.25). They are already *in* the wager (Hoens 2013), however, and cannot afford to ignore the catastrophic option that both systems are activated (which indeed proves to be the case). Ignoring the wager would be tantamount to ignoring the possibility that humanity would suffer a "second death" (*Book of Revelation* 20:14): a radical entropic event precluding resurrection (Lacan 1959-1960/1986). The destructive power of neutron bombs

neutralises the biological cataclysm. The sub-minimal objects *a* of biology and nuclear warfare mutually negate one another and the second death gives way to *Resurrection Day* (the title of Part Two).

The Master position is enacted by prominent intellectuals (Nobel Prize winners) at the Pugwash conference: authoritative voices (S_1) addressing scientific experts (S_2) as recipients, urging them to consciously take up their social responsibilities, although scientists tend to ignore such injunctions, in order to focus wholeheartedly on their objects of research. By inserting the four functions – the Master signifier (S_1); the expert (S_2); the divided subject ($) and the object-cause of desire (*a*) into Lacan's quadruped scheme, the contours of the four discourses become discernible.

Before the cataclysm, university discourse is the dominant mode, with scientific experts (S_2 as agents) focusing their attention on their enigmatic target (*a*), a virus from outer space, a lethal viral strain, to which all actions and questions are addressed:

S_2	*a*
S_1	$

The researchers (S_2) become absorbed by a mysterious thing, a nucleic acid hiding in bacterial DNA: the object *a* of viral research. This type of research proves an unsettling, unbalancing experience, however. Exposure to this toxic object turns researchers (Karlsky, Meyer) into deflecting, neurotic and fraudulent scientists: tormented victims of science (Lacan 1966, p. 870). Hysteria (the microbiological equivalent of *hysteria chemicorum*) as an occupational affliction, a by-product of hazardous research.[51] University discourse takes a dramatic turn and revolves into its opposite: the discourse of the hysteric, as the divided subject emphatically takes the floor as agent:

$	S_1
a	S_2

The agent ($) raises a voice of protest or concern. Initially, Meyer directs his message at his supervisors, proclaiming that a cataclysm is about to unfold. When they refuse to take him seriously, he reaches out to father figures, Nobel Prize winners, attendants of the Pugwash conference (S_1), to voice alarm, summoning the global elite to put an end to military biological research. But his deflection is stifled, and Meyer ends up in a psychiatric ward. Here, Linskey visits him and manages to retrieve vital viral information, so that in the end expert knowledge

[51] As Justus von Liebig wrote to Friedrich Wöhler: "Lieber Freund, Du bist wieder krank, krank an der spezifischen Krankheit der Chemiker, der Hysteria chemicorum, erzeugt durch übermäßige geistige Anstrengung, Ehrgeiz und schlechte Laboratorium-atmosphäre. Alle großen Chemiker leiden daran" (Ostwald 1909, p. 180). In *Virus*, hysteria is not caused by a toxic lab environment, but by a different kind of toxicity, resulting in mental destabilisation.

(S_2) is produced as a by-product and transmitted across the globe, reaching Professor De la Tour, who is now able to radiate MM-88.

The Master's discourse emerges when the Pugwash conference (S_1) assumes the position as *agent*, addressing scientific experts as *recipients* (S_2), urging them to acknowledge their social responsibilities. Scepticism and cynicism are disavowed (pushed beneath the bar) and scientists are pressed to prevent the cataclysm by eliminating the virus or pushing the button (*a*).

In the novel, these modes of discourse are critically assessed by the discourse of the analyst. Now, the agency of the viral "thing" is emphasised: the self-replicating nucleic acid as the novel's protagonist, playing an active role, triggering others into activity, notably divided subjects (deflecting scientists) susceptible to the seductive and disruptive messages coming from this object: Capture me! Analyse me! Sequence me! Steal me! Traffic me! The self-replicating nucleic acid (the alluring, intimidating object of desire) puts everything into motion. To come to terms with it, normal scientific knowledge must be suspended (S_2 beneath the bar). This item is something out of order: an intrusion from outer space, disrupting the normal flow of knowledge production, something which only seems possible "in science fiction novels" (p. 152). The by-product is the re-instalment of the moral imperative (S_1): scientists should not allow themselves to become obsesses by desire and should first and foremost assume their social responsibilities, the message of the Pugwash Conference, but also of a "final lecture" (broadcasted via radio) by a Professor from Helsinki shortly before his death, indicating that humanity failed to live up to its obligations (p. 225). Philosophers and scientists should have worked more closely together to avoid this calamity. But now, all the startling commotion that filled the space between the Earth's surface and the ionosphere: the roar of the cities, the electromagnetic waves, the telegrams, the telegraphs, the wireless telephone communications, the radio and television broadcast signals, the missiles, lasers, rockets and satellites, the "clamour of 3.5 billion people", all this has fallen silent. Although the dying professor is acutely aware of the disruptive impact of humanity on planet Earth, climate change is still a blind spot: "The temperature of the atmosphere surrounding the Earth had not been noticeably raised even by all of the many and varied noises that human beings had made" (p. 235), – but this will change.

Darwin's Radio

In Greg Bear's *Darwin's Radio* (1999), a retrovirus hiding in the human genome (ominously named SHEVA: Scattered Human Endogenous Retro-virus Activation) is activated, causing anomalous symptoms in pregnant women, leading to miscarriages and birth defects in newborn children.

Somewhere in the Alps, near the Austrian-Italian border, two mountaineers guide Mitch Rafelson, an American anthropologist, to an alpine cave (not far from where Ötzi the mummified iceman was found), now suddenly

reachable because of climate change and containing the frozen, mummified bodies of three Neanderthal humans (a male, a female and newborn child). Although Mitch realises that his cave-raiding expedition (without proper licences and procedures) is illegitimate (so that his "sin of curiosity" may imply the end of his professional career), he cannot withstand the temptation of making such a highly exceptional find. Inside the cave he obtains DNA samples of the Neanderthal bodies, but on his way back, overwhelmed by migraine, he almost freezes to death, while one of the mountaineers actually steals, but subsequently loses the Neanderthal baby (the story's object *a*), during an avalanche which kills her.

Meanwhile, American virologist Kay Lang is studying retroviruses and lysogenic phages: bacterial viruses whose nucleic acid became embedded in a host genome, so that the bacterium transforms into a "prophage", living and reproducing normally until the dormant (extimate) intruder is activated by a trigger event (environmental stress). She is also interested in *human* endogenous retroviruses (HERV) however, as they may help to explain certain peculiarities of human evolution. Her papers on ancient retroviral elements in humans are controversial but accepted in top journals such as *Virology*.

Then, suddenly, a disease emerges in pregnant women, causing birth defects and miscarriages, although some affected children survive. The official acronym is SHEVA (Scattered Human Endogenous Retro-Virus Activation: the R is dropped for dramatic effect, p. 72), but in popular media the disease is known as Herod's flu (named after the children-slaughtering king). The disease is caused by "tiny invaders, coming from inside our own bodies" (p. 67), by genetic "stowaways" hiding in our DNA for millions of years (p. 75). To this already unsettling mixture of events, a final bewildering element is added. While the two mummified adults can indeed be identified as Neanderthals on the basis of their DNA, their baby is, genetically speaking, a modern human.

Mitch and Kay join forces and a daring hypothesis is formed. The human genome (our adaptive "computer") responds to environmental stress (such as overpopulation) by activating retroviruses, causing dramatic mutations. This explains the leap from Neanderthals to modern humans, millennia ago, but also the current human genome drift. In other words, we are on the brink of another leap-like collective mutation: genome regulation on species level. To put their hypothesis in practice, Mitch and Kay have intercourse, resulting in a pregnancy. By using her own body as a laboratory, Kay consciously mirrors the vicissitudes of the Neanderthal couple. Their child survives, and they name her Stella Nova. She is quite unlike normal human children and begins to learn to speak already shortly after birth, exemplifying a new Homo sapiens variant.

Mothers like Kay are regarded as a threat to humanity, however, and become the target of a witch-hunt by government officials, although these women are actually the Eves of a new era. What happens to Kay and Mitch also happened to the Neanderthal couple, who were driven into the Alpine cave after having given birth to a (genetically deviant) modern infant. In short, history repeats itself.

Evolution progresses in a leap-like fashion, as Eugène Dubois already argued, rather than via gradual Darwinian progression. Human evolution is a punctuated equilibrium: periods of relative stability suddenly come to an end when rapid evolution sets in (p. 239). Environmental stress (overpopulation, increased societal competition, information overload, etc.) activates endogenous viruses, expressing certain elements of our genetic memory storage, so that "punctuation" happens (p. 244). SHEVA is not a disease, but an "upgrade" (p. 247). The human genome uses its biological grammar to rewrite its DNA, producing a higher-level species blueprint. SHEVA is actually conducting an experiment: the creation of a new subspecies, a new variety of human. Initially, many pregnancies miscarry, but increasingly, SHEVA manages to produce healthy and viable Herod's babies.

By putting their daring reinterpretations together, Kay and Mitch come to see SHEVA in a different light, dissenting from the official definition of SHEVA as a viral "disease". DNA is an "evolutionary computer", picking up and responding to environmental signals, hence the title (Idema 2013, p. 73). Darwin's radio is the human genome's signalling mechanism (p. 315). As Kay phrases it: our genome (our collective unconscious) is much cleverer than we are (p. 341) and she decides to collaborate with it, as a scientist and as a mother ("I am my own laboratory", p. 357; "I am a lab rat too", p. 413) as "the next Eve" (p. 423), giving birth to *Homo sapiens novus* in the form of Stella Nova.

Darwin's radio is a laboratory for exploring and testing views of evolution. As Idema (2013) points out, novelist Greg Bear meant to contribute to scientific discussions, suggesting that there is more to evolution than blind, gradual, random Darwinism. His novel explores the possibility that life has a "creative memory", allowing for dramatic responses to critical circumstances.

Psychoanalytically speaking, *Darwin's radio* stages a series of clashes between the imaginary and the symbolic, in response to the intrusion of the real. The discovery of the frozen Neanderthal family reads like an archetypal nativity scene. Cave-raiders stumble upon a Pleistocene version of the Christmas crèche, with mother, father and new-born child seeking shelter from frost and snow, but also from their enemies (the reference to Herod is quite relevant here of course). The purloined child (as a destabilising object *a*, initially taken for a doll) is stolen from the cave and subsequently lost and retrieved. It should be a Neanderthal infant but is actually a modern human. It is an ungraspable, impossible *object a*, the missing link between Neanderthals and modern humans, putting Mitch off balance, seducing him to become a cave-raider. The Neanderthal child is reborn as Stella, bound to die, but saved. The object *a* is an alluring, toxic entity: ruining Mitch's career, but also something of incomparable value: A and Ω of human history, punctuating human evolution, born in the distant past (as the first modern human) and reborn in the present, signalling the coming-into-being of mutated post-humans.

To identify, categorize and come to terms with the object *a*, scientists (S_2) are put to work, unlashing an iconoclastic process of symbolisation. The Neanderthal DNA is sequenced and the nativity scene (fascinating and

mysterious, situated in an iconic cave) gives way to the symbolic (DNA barcodes thrown out by sequencing machines). *Darwin's radio* reflects how DNA sequencing alters our image of Neanderthals: from archetypal, primitive, cave-dwelling brutes to almost-humans. In *Virus* the question is raised "To what degree has the human race of the twentieth century escaped its inner Neanderthal to have 'culture'?" (Komatsu 1964/2012, p. 210), framing Neanderthals in terms of archetypal primitivism, as Pleistocene brutes. In *Darwin's radio*, however, it is claimed that "Neanderthals were not subhuman; they had had speech and complex social organisations", they were "traders, tool-makers, hunters and gatherers", caring for their children (Bear 1999, p. 149), claims which are in line with contemporary research (Papagianni & Morse 2015). The Neanderthal image experienced a *Gestalt*-switch from *other* to *us*.

The same tension between the imaginary and symbolic (in response to the resurge of a bottleneck pandemic) can be discerned in the assessments of SHEVA. On the one hand it is a molecular mechanism, a genetic computer (SHEVA as acronym). Symbolisation techniques are mobilised to come to terms with a disconcerting event. But SHEVA is also reminiscent of Shiva, one of the deities of the Hindu trinity, destroyer and transformer, preparing the ground for the emergence of something new. This archetypal Shiva becomes associated with the wisdom of the genome: a disrupting but potentially benevolent *Gestalt*, hiding in our genome as an "extimate" Other (both internal and external, both intimate and foreign). The iconic image of Shiva dancing inside a wheel-shaped mandala-like ring suggests that the deity is surrounded by a halo of bacterial DNA, reflecting the genome's potential (as our collective unconscious, Zwart 2013) for periodic disastrous-beneficial mutations even on a species-level (the punctuated dance of fate). *Darwin's radio* describes a basic shift (beneath the bar) from Darwinian (gradual) to discontinuous evolution: the philosopheme of leap-like change (S_1).

University discourse is challenged and destabilised by the novel's object *a*: the intractable virus, fascinating and intimidating, both beneficial and toxic, a φάρμακον, assuming a singular dynamic of its own. Scientists and public health policy experts (S_2) consistently try to frame the virus as a disease: something that must be domesticated and quarantined, sequenced and annihilated. Mitch, however, is a nonconformist from the very beginning, a scientist who dissents from the path of normal science, as a craving subject triggered by desire ($\$ \lozenge a$), dragged towards the Alpine site illegally. In addition to scientific data, he relies on a complementary, imaginary source of information, a dream vision coming from the unconscious, in a Jungian manner, providing intuitive insights: nocturnal descents into the distant Neanderthal past. His antagonist Chris Dicken, working for the national *Center for Infectious Diseases* (*NCID*) in Atlanta, manages to repress his doubts and continues to follow the official line (mainstream university discourse), albeit feeling increasingly uneasy about it. As SHEVA becomes increasingly devastating and more children become infected,

mass hysteria and witch-hunt set in, while the authorities are increasingly unable to contain the situation (*$*).

At a certain point, Kay and Mitch recognize that SHEVA is actually the agent of the situation, to which the other voices are merely responding. They suspend accepted theories (notably Darwinism: S_2 in the lower-left position), seeing the retroviral object *a* as an active *agent* (upper-left position), responsible for producing rapid biological change:

a	*$*
S_2	S_1

Normal science knowledge (S_2) is pushed beneath the bar and SHEVA is allowed to speak. Her symptoms carry an unsettling new truth: SHEVA as a truth event. As deviant, deflecting scientists (*$*), Kay and Mitch are the recipients of this truth (upper-right position). They exchange their role as experts (S_2) for a position of deviance and non-conformism, in response to the injunction coming from the object *a*. This gives rise to a new imperative, or gospel if you like, as by-product (S_1, lower-right position): neo-humans such as Stella must be cherished rather than eradicated. Because they learn to speak easily, their psyche seems even more susceptible to the symbolic order than "normal" humans, thereby representing a next stage in human history.

Inferno

Inferno by Dan Brown (2013) connects virology with a plethora of related topics, as a literary *summa* (Zwart 2014b). Virology is represented by the "mad" genius Bertrand Zobrist, but *Inferno* presents infectious diseases, viral pandemics and dual use (i.e. bio-terrorism) against a socio-cultural backdrop of overpopulation, global mobility and mass tourism. The novel describes a world heading for disaster, but also paralyzed by distrust in authorities (such as the WHO) and suffering from collective "denial". Bertrand Zobrist plays multiple roles. He is a molecular life scientist of international renown (S_2) who, alarmed by the prospect of global exponential population growth, deflects into bio-terrorism, becoming a dangerous, tormented "psychopath" threatening the world with destruction (*$*). But he is also a visionary, a prophetic guru with a substantial following (S_1), propagating trans-humanism: the idea of a technology-induced leap into a completely different (drastically reorganised) future (and this includes self-sacrifice through suicide). Finally, he is a therapist, a psychoanalyst of contemporary culture, bent on curing society from the pandemic of denial.

The novel begins with an unsettling video submitted by Zobrist, wearing a plague mask and announcing, in an uncanny soliloquy, that he is about to dramatically save/destroy the world with the help of a weird gelatinous liquid, contained in an underwater balloon in a subterranean pond. Robert Langdon, expert in symbolism, is called in and together with a tall, athletic physician named

Sienna Brooks he embarks on a journey (taking them from Florence to Venice to Istanbul) to solve the riddle. He is visited by dream-like visions, involving a veiled woman, a throng of dead people and a set of writhing, naked, protruding legs. Sienna plays a double role, however, for she actually is a follower of Zobrist, who unsuccessfully tried to convince the WHO (notably its Director, Elisabeth Sinskey) that humanity is heading for disaster, due to overpopulation, but blinded by denial. Therefore, he designed a virus to reduce human fertility and flatten the exponential curve of population growth, until more advanced techniques for re-editing the human genome will become available, reducing humanity's propensity to reproduce (which evolved in pre-historic times, but has become ill-adapted to the present circumstances).

Thus, in *Inferno*, it is not our chromosomal "computer" which picks up the signs of the time, but a visionary biotech pioneer. To come to terms with unsettling events, experts such as Sinskey and Langdon initially focus on "imaginary" elements (e.g. the plague mask, associated with the cataclysm archetype). The virus is a looming threat, an entity of evil, but in the course of the novel the object *a* emerges as a highly ambiguous entity, both toxic and beneficial, a φάρμακον, both remedy and poison, representing the advent of a neo-Renaissance, and of a new (optimised, re-edited) humanity. Yet, this idea of *refurbishing* and *reprogramming* human life ultimately relies on techno-scientific symbolisation: the reduction of life to its noumenal essence: a reprogrammable bio-molecular code.

Zobrist deflects from normal university discourse because science and technology gave rise to overpopulation, thus sliding into the discourse of the hysteric, raising a voice of protest, advocating drastic change, trying the convince authorities that we are on the brink of a cataclysm:

$\$$	S_1
a	S_2

What is obfuscated is that his desire to save the world is actually driven by a will to power. He is urged into action by his "masterpiece": the intimidating, imposing virus (*a*). Nonetheless, towards the end of the novel, his message seems to land, when Sienna (his follower) is invited to address a WHO conference, because new approaches (S_2) are needed.

But Zobrist also occupies the role of the prophet (S_1 in the position of the agent), in accordance with the structure of the Master's discourse:

S_1	S_2
$\$$	*a*

Zobrist, leaving behind all uncertainty and doubt, acts as a prophetic voice proclaiming a truth, directed at experts (fellow scientists, policy makers, professionals), some of whom he actually manages to convert. The by-product is

the magic designer virus, as a fascinating, performative item which draws the attention of experts and proves more convincing than words.

Thus, increasingly, attention becomes focussed on the virus (the novel's object *a*, forcing other protagonists into action). After Zobrist's suicide, the virus acquires agency of its own, functioning automatically, without further human intervention, causing turmoil, but allegedly paving the way for a new regime of truth and power, a new *Gestell*. The lethal virus will never become a "normal" model organism. It will always generate a provocative appeal: Analyse me! Fear me! Steal me! It may fall into the wrong hands or seduce researchers to deflect to dual use. We have now entered the discourse of the analyst. Discontent and societal concern are explicitly addressed (*$* in the upper-right position) rather than disavowed (by claiming that everything is under control, as in the case of university discourse):

a	*$*
S_2	S_1

The expert's conviction (S_2) that we already "know" (and are perfectly able to contain) the risks, is suspended (moved towards the lower-left position) so that the focus can shift to the question what makes this "supra-normal" entity so unsettling? Viral research involving potentially lethal viruses takes us beyond the confines of normal science. Researchers are *drawn* towards studying them, even if this means putting up with additional loads of paperwork and committee hearings. These viruses are not studied in a completely neutral fashion, and this research area, besieged by rules and regulations, will continue to make the headlines and to be cited by novelists. Paraphrasing Freud, Lacan argues that life sciences research has become an "impossible profession" (1960/2005, p. 73). Working with potentially dangerous strains, both researchers and lay audiences struggle with a "crisis of anxiety" (p. 74), alarmed by the idea that dangerous life forms may one day escape from the laboratory, causing pandemics in the outside world, perhaps even cleansing the world from human beings, these unflagging polluters, who turned the Earth into a filthy place, causing *le monde* to become *immonde* ("unclean"), as Lacan phrases it (p. 76). Via enigmatic messages, Zobrist is a therapist guiding the way from Inferno (the catastrophe towards we are heading) via Purgatory (a world cleansed by the released virus) towards Paradise (the imaginary, post-modern future).

X. The cataclysm (emerging collisions)

In 2012, Jennifer Doudna and colleagues published their now famous *Science* paper bearing an enigmatic title: "A Programmable Dual-RNA–Guided DNA Endonuclease in Adaptive Bacterial Immunity" (Jinek et al 2012). In this paper, the authors proudly present a molecular machine, a genome-editing device named CRISPR/Cas9, allowing scientists to target and cleave snippets of DNA, thereby offering "considerable potential for genome-editing applications" (Jinek et al 2012, p, 820). Five years later, in 2017, Jennifer Doudna published an autobiographical retrospect entitled *A Crack in Creation: gene editing and the unthinkable power to control evolution*, written in her own voice (first person singular), but co-authored with a close colleague. Doudna's memoirs describe how a scientist, after introducing a powerful technology into the world, sees it as her responsibility to contribute to the containment and governance of this novum. She immerses herself in bioethical literature, organises a conference and publishes a co-authored *Science* paper entitle "A prudent path forward" on how the CRIPSR-revolution can be managed responsibly. As the subtitle of the book phrases it, the basic question is how "we" may come to terms with the "unthinkable power" to control evolution and refurbish life. CRISPR allegedly offers humankind the capacity to determine the future course of evolution.

The subtitle of the *Prologue* (*The Wave*), however, points in a different direction. Instead of being in charge, humans in general (and scientists in particular) seem overwhelmed by a surging biotechnological tsunami. The wave metaphor voices the concern that CRISPR, once unleashed, may quickly evolve into an uncontainable tide, with an unsettling momentum of its own. The CRISPR technology is bound to have "seismic implications" (p. xii), and Doudna's reaction is one of growing unease. While her conscious deliberations focus on responsibility and prudence, in her dream life the experience of unease is amplified, up to the point that she is "paralysed by fear" (p. xi). Human beings may merely serve as vectors. The ultimate actor, bound to transform the world as we know it, is CRISPR as such. Genomes become editable and genes can be upgraded, but it is questionable whether "we" as a "fractious species" will be able to handle this "awesome power" (p. xvi). CRISPR seems to be using us, rather than vice versa.

Doudna stages herself as a responsible scientist who sees it as her obligation to "help lead" (p. xvii) public deliberation on how this versatile method for editing bio-codes is to be used. Notably, she becomes involved in bioethics conversations about "designer babies" and "super-humans". To play this role, she has to acquire new vocabularies and skills, shifting attention from laboratory research to ethical debate. An ethical storm is brewing around this easy-to-use technology she helped to create, and scientists should actively contribute to the debate on how to redirect the future of evolution.

At the same time, Doudna's book suggests that neither humankind nor scientists can be regarded as agents of change. The uncanny suggestion running

through her memoirs (and surfacing in dreams) is that the actual agent of change is the technology as such. Although CRISPR/Cas9 is a "thing" (p. 40) which Doudna "helped to create" (p. 198), it is taking on a momentum of its own. A game-changing technology is unleashed into the world and human beings seem increasingly marginalised by this unfolding biotechnological epidemic. Besides unprecedented precision, CRISPR is exceptionally easy to use, so that it can easily be perverted (p. 200). This concern is also voiced "subconsciously" (p. 198) in dreams.

To prevent nefarious misuse, Doudna joins elite gatherings such as the World Economic Forum in Davos to discuss how to tweak the Homo sapiens gene pool in a "prudent" manner (p. 160) and how to assume control over "our own evolution" as a self-directing species. Doudna's "trepidations" about CRISPR are notably invoked by the possibility of rewriting the DNA of future human beings. We should refrain from using CRISPR/Cas9 technologies to permanently alter human genomes, she argues, "until we have given a broader range of stakeholders the opportunity to join the discussion" (p. 182). This builds on the presupposition that humans have the governance capacity to manage and contain the way in which the CRISPR "menagerie" (i.e. the organisms whose genomes are consciously gene-edited) will evolve. Yet, "whether we will ever have the intellectual and moral capacity to guide our own genetic destiny is an open question" (p. 183). Thus, Doudna's autobiography explicitly questions the credibility of a "responsible research" scenario (technology steered by prudent humans). There is something unsettling about the rapid spread of the powerful new technique (p. 113). Doudna is taken aback by the pace of the dissemination of the tool she helped to create (p. 100). CRISPR (an "almost effortless" way to edit genes in nearly any organism) is exploding and morphing quickly from an esoteric technology into a DIY tool. The "democratisation" of CRISPR (p. 113) seems impossible to contain. CRISPR has lowered the technical barriers for self-directed evolution. Genomes will be flooded with thousands of new genes and species will become increasingly plastic: the world will be revolutionised by CRISPR (p. 117), via miniature designer pets, extra-muscular beagles and frankenfish, but also via "humanised pigs", as a resource for xenotransplantation.

Now that scientists "crossed the Rubicon" (p. 200), Doudna decides to follow the example of Paul Berg (organiser of the Asilomar conference in 1975) by hosting a similar meeting in Napa, California, resulting in a *Science* paper (Baltimore et al 2015*)*. Scientists are "strongly discouraged" from making heritable changes in the human genome, but the use of the signifier "moratorium" is consciously avoided so that the moral message ("there is an urgent need for open discussion of the merits and risks of human genome modification", p. 37) is not very outspoken. Already during this meeting, while participants are avidly discussing whether human embryos should be exposed to gene editing at all, the news reaches them that a manuscript describing gene editing experiments with human embryos is already circulating among journals. The problem, as Doudna sees it, is that CRISPR has made gene editing too easy (2017, p. 187) and this is

what "gnaws" at her. CRISPR has the potential to turn all future genomes into a collective palimpsest upon which any bit of genetic code can be erased and overwritten (p. 188). Towards the end of her book she writes: "What had we done? Emmanuelle [Charpentier] and I … had imagined that CRISPR technology could save lives … Yet as I thought about it now, I could scarcely begin to conceive of all the ways in which our hard work might be perverted. Overwhelmed by how fast everything was moving … I began to feel like Dr. Frankenstein. Had I created a monster?" (p. 200). Ethical deliberations seem meaningless now that gene editing is already being applied to a quickly growing "menagerie" of living beings (p. 205). From now on, genomes will become "as malleable as a piece of literary prose at the mercy of an editor's red pen", a scenario which even seems inevitable (p. 90). Once this game-changing technology is set free, it will take control of evolution, one way or another (p. 227). This reflects the basic experience of the Anthropocene. Our technological power has become such that human beings develop a disruptive, irreversible and omnipresent impact on the global biosphere, also affecting our own bodies and minds, but the sense of responsibility to which this gives rise is frustrated by the inability of ethics and governance to steer or contain this process in a prudent manner. In the next two sessions I will analyse how this experience is addressed in genres of the imagination.

Bio-perversity: the foodscape of *Oryx and Crake*

Margaret Atwood's *Oryx and Crake* (2003) alternates between a pre-apocalyptic and a post-apocalyptic future, before and after a cataclysmic event, the outbreak of a lethal, bio-engineered viral pandemic. While the pre-apocalyptic world is a prolific producer of ersatz food products, the post-apocalyptic world is inhabited by survivors fighting off starvation, in the aftermath of a sudden meltdown of man-made technologies and food-providing infrastructures. Jimmy, the novel's protagonist, who now calls himself Snowman, inhabits a world disrupted by climate change, bio-manipulation and extinction. He seems the sole human survivor of a global pandemic, bio-engineered by his former classmate, a mad genius named Crake. Snowman dwells on a beach littered by post-apocalyptic debris, a devastated landscape, polluted by the trashes of a pre-apocalyptic civilisation that has now vanished. The world as we know it is obliterated and the sultry, litoral (coastal) landscape is littered (literally) with plastic waste covered by logos, i.e. letters as symbolic litter, but also roamed by chimeric "bio-forms", including genetically modified ("spliced") pigs, brought into the world for xenotransplantation. A man-made airborne haemorrhagic virus has deliberately wiped out humankind, because (in the eyes of Crake) the human species had become an ecological disaster. Jimmy / Snowman is the last of Homo sapiens, for whom our near-future is already memory. He spends his time scavenging and foraging, looking for something edible amidst the litter and waste, "marooned in time, cast away between a human past and a post-human future… a post-

apocalyptic atavism" (Snyder 2011, p. 472). He is an archaeologist of the recent past (our nearby future). In fact, he was actively involved in bringing about the catastrophe, as a former insider, serving as Crake's right-hand man. Snowman guides the readers through the cataclysmic aftermath, tainted by ersatz food remains. It is the denouement of civilisation as such, but autobiographical flashbacks allow us to reconstruct the key events. At a certain point, for instance, Snowman recalls a visit to Crake when the latter was still a promising young researcher in a high-ranking academic Institute named Watson-Crick. Crake took him to the NeoAgriculturals where they saw living chicken parts, just the breasts, with mere openings serving as mouths, into which nutrients were dumped. Eyes, beaks and brain functions that had nothing to do with digestion, assimilation and growth had all been removed (Atwood 2003, p. 203). Staring at these partial organisms, these ersatz chickens, Jimmy feels like a Cro-Magnon visiting the future, intuiting that "Some line has been crossed, some boundary transgressed", but Crake sees it differently: "I don't believe in Nature, not with a capital N" (p. 206).

Jimmy's father was a "genographer", mapping the proteome, splicing and adding genes, so that kidneys, livers and hearts could grow faster and new organs could replace the procured ones. Jimmy's mother, however, was a critical mind, a "hysteric", who disappears one day and is eventually captured and executed as a bioterrorist. Allegedly, she is a member of an organisation that produces lethal Ebola and Marburg splices (p. 182). There are more prophetic voices, however. The message that one day we will find ourselves stranded on a sunburned beach, littered by ersatz waste, is conveyed by a slogan (in German), printed on a fridge magnet: *Du musst dein Leben ändern* (p. 301; cf. Sloterdijk 2009). Atwood's novel, published a decade before CRISPR was actually invented, extrapolates Doudna's concerns about gene editing into a cataclysmic scenario (as an exercise in imaginative futurology).

Fatal collision

My second case study, the movie *Melancholia*, directed by Lars von Trier and released in 2011, is about a recently discovered nomad planet (a blue gas giant) that has entered the solar system, blocking the star Antares from view and approaching planet Earth. Professional astronomers predict a fly-by event, but internet articles claim that, under the influence of gravity, Melancholia will circle back and collide with Earth. John, an amateur-astronomer, represents university discourse. He endorses the expert view and, equipped with an impressive telescope, is determined to witness the unique event: the coming into view of the movie's object *a*, the blue planet, visible as a splendid second moon. His telescope functions as a mechanism of defence, however, materialising denial and obfuscating the impotence and powerlessness of science. What is repressed by official discourse (the limited ability of deterministic rationality to make reliable predictions) resurges in the Real, however, in the form of the predatory planet,

suddenly increasing in size. As soon as John realises that Melancholia's course has been miscalculated, he gives in to angst and despair (*$*) and poisons himself.

Justine represents the hysteric's discourse. She is a divided subject (*$*) who does not know what she wants. The first part of the movie portrays her wedding party, organised by her sister Claire (married to John), but during the wedding night, Justine suddenly changes her mind. When the marriage is about to be consumed (and the phallic object *a* is about to be unveiled), she rejects her husband, cancels the wedding and slides into a deep depression. This raises the question: what does she really want (*Che vuoi*? *Was will das Weib*?). Marriage as an established institution (S_1) is desecrated by a series of misbehaviours (arriving very late at her wedding party, giving sloppy speeches, alcohol abuse, disappearing for hours, having sex with one of the guests, etc.). During the second part, sister Claire believes Justine wants to ride her horse, but she badly mistreats the animal.

There is another dimension, however: Justine "knows things". Noticing the disappearance of Antares, she intuitively senses that something fatal is about to happen, that Earth (an "evil planet" in her eyes) will be destroyed. She is able to read the signs. Like other famous hysterics (Friedericke Hauffe, Hélène Smith, Helene Preiswerk, etc.) she operates as a medium. After having taken a bath in a natural pond, she resembles Diana seducing the planet, welcoming Melancholia to Earth (enacting what Bachelard refers to as the Diana complex). While John peers at the blue giant through the key-hole of his telescope (until he realises that his denial is exposed), she develops a rapport with her whole body, acting on the planet from a distance. She builds a sacred hut, a tepee skeleton as a mechanism of defence, but also perhaps to celebrate destruction. Finally, Melancholia fills the sky and destroys the world.

University discourse (John)

S_2 (astronomy)	*a* (Melancholia)
S_1 (determinism)	*$* (despair)

Hysteric's discourse (Justine)

$ (che vuoi?)	S_1 (desecrating marriage)
a (object-cause of desire)	S_2 (intuitive knowledge)

This is the experience of the Anthropocene par excellence: something (something very small, such as a gene-edited virus, or something very large, such as a nomad planet) is about to destroy the world. Precision instruments of technoscience allow us to produce high-resolution images of the disruption, but we seem to lack the moral and political capacities to prevent the cataclysm.

Denouement

In psychoanalytical terms, the real disruptive threat is addressed from two angles. First of all, via symbolisation (with the help of high-precision measurements and large-scale data collection) but also via the imaginary (via the archetypal idea of the Aeon, the Platonic month, i.e. the conviction that the current world is coming to an end so that we are facing a cataclysmic global change, brought about by global life forms (viruses or humans, or both, as in *Oryx and Crake*) or by a global collision (as in *Melancholia*). Although humanity plays an active role (as a global species and agent of change), the transition has its own momentum, giving rise to something new, a post-apocalyptic re-genesis. This change is announced by prophets of doom, challenging the authorities and urging us to drastically change our course (the hysteric's discourse), but it is also meticulously monitored and traced in university discourse. Here, expert knowledge (S_2) is bent on identifying and analysing the Real, the emerging novum or threat (the lethal virus, the gas giant, the exact point at which the rise of global temperature becomes an uncontainable catastrophe, etc., in short: the object *a*). Below the bar, however, other factors are at work, such as the basic conviction (the philosopheme) that we are approaching a new Aeon (S_1 in the lower-left position, fuelling research) and the growing unease and despair over our incapacity to organise collective action as a fractious species (*$*).

As for psychoanalysis itself, as a theoretical and methodological approach, a diagnostic of the present: to come to terms with the current situation, both dimensions (the symbolic and the imaginary) must be taken into account (the phallic logic of the telescope enacted by John as well as the intuitive, attractive, full body interaction enacted by Justine). Whereas Lacan (building on Freud) focussed on the symbolic, the work of Jung and Bachelard is indispensable for addressing the imaginary. Both registers must be explored, although they will never be fully sublated into a comprehensive understanding (an experience addressed by Freud as "interminable analysis", by Žižek as the "parallax view").

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Ethik in der Praxis/Practical Ethics

Studien/Studies

hrsg. von Prof. Dr. Hans-Martin Sass (Universität Bochum/Georgetown University Washington)
Schriftleitung: Dr. Arnd T. May

Tatjana Grützmann
Interkulturelle Kompetenz in der klinisch-ethischen Praxis
Kultursensible Ansätze zum Umgang mit interkulturellen Situationen in der Klinischen Ethikberatung
Aufgrund von Migrationsprozessen, individuellen Lebenskonzepten und multikulturellen Behandlungsteams erleben Mitarbeiter im Gesundheitswesen eine zunehmende kulturelle Diversität und damit verbunden interkulturelle Konfliktsituationen. Anhand von Fallbeispielen werden Lösungswege aufgezeigt und praxisorientierte Techniken zum professionellen Umgang mit derartigen Situationen im klinisch-ethischen Kontext vermittelt. Ansätze für eine kultursensible Ethikberatung, strukturelle Maßnahmen sowie Interkulturelle Kompetenz für Klinikmitarbeiter werden thematisiert und Experten im Rahmen von Interviews hierzu befragt.
Bd. 41, 2016, 244 S., 34,90 €, br., ISBN 978-3-643-13489-9

Hans-Martin Sass
Cultures in Bioethics
Biotopes and Bioethics are highly complex and adaptable systems of Bios. Individual bios is terminal, but the stream of Bios goes on. Basic properties of Bios such as communication and cooperation, competence and competition, contemplation and calculation, compassion and cultivation come in different shades of light and dark in individuals and species, in history and ecology. Hans-Martin Sass discusses the territories of Bios and Bioethics, based on his involvement in decades of consulting in academia, business and politics. Special attention is given to the vision and role of Bioethics in research and training, in religious and cultural traditions, and in the survival, happiness, and health of corporate, social and political bodies.
vol. 40, 2016, 260 pp., 39,90 €, pb., ISBN 978-3-643-90755-4

Simone Horstmann
Ethik der Normalität
Zur Evolution moralischer Semantik in der Moderne
Kann es das *Normale* in der Ethik geben, muss *Normalität* auch dort Berücksichtigung finden, wo mithin einzig Normen regulativen Charakter beanspruchen? Die Arbeit fragt danach, inwieweit Normalität als moralfähige Semantik der Moderne zu verstehen ist. Dabei wird deutlich: Normalität ist der Ethik nicht fremd, sie findet sich vielfach in ethischen Anwendungsdiskursen und kann insbesondere für die Theologische Ethik als moderne Verfeinerung der Natur(rechts)-Semantik aufgefasst werden, die von natural-gegebenen Zweckstrukturen absieht und Moral als Konstruktionsleistung entwirft.
Bd. 39, 2016, 268 S., 34,90 €, br., ISBN 978-3-643-13146-1

Amir Muzur; Hans-Martin Sass (Eds.)
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Ralf Jox; Katja Kühlmeyer; Georg Marckmann; Eric Racine (Eds.)
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Philosophy in Dialogue / Philosophie im Dialog
edited by Prof. Dr. Janez Juhant (University of Ljubljana) and
Ass. Prof. Dr. Vojko Strahovnik (University of Ljubljana)

Nadja Furlan Stante; Anja Zalta; Maja Lamberger Khatib (Eds.)
Women against war system
The monograph presents critical and engendered voices in the analysis of contemporary social processes (often) resulting in violent and militant derivations. It analyzes existing methods and techniques of active citizenship in different parts of the world, from India to Turkey and from Bosnia to Iraq, it highlights current issues (from the phenomenon of Islamic State to the Kurdish question), addresses the issue of the military system and at the same time it offers at least some glimpses into peaceful coexistence.
Nadja Furlan Štante is a Senior Research Fellow and an Associate Professor of Religious Studies at Science and Research Institute Koper.
Maja Lamberger Khatib, PhD, has graduated from History and Ethnology and Cultural Anthropology.
Anja Zalta, is an Assistant Professor for Sociology of Religion at the Sociology Department, Faculty of Arts, University of Ljubljana.
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Reflections on the Challenges of Postmodern World
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Bojan Žalec
Genocide, Totalitarianism and Multiculturalism
Perspectives in the Light of Solidary Personalism
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Janez Juhant; Vojko Strahovnik (Eds.)
Dialogue in the Global World
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Kultur- und Naturwissenschaften im Dialog

Natural Sciences and Humanities in Dialogue

hrsg. von Prof. Dr. Rüdiger Heinze (TU Braunschweig) & Dr. Kerstin Müller (Universität Freiburg)

Anna-Sophie Jürgens; Markus Wierschem (Eds.)

Patterns of Dis|Order

Beiträge zur Kulturgeschichte der Un/Ordnung

Patterns of Dis|Order erforscht die Facetten und Produktivität des Wissens um Un|Ordnung. Die Beiträge dieses Bandes thematisieren Un|Ordnung nicht nur als einen wissenschaftlichen und künstlerischen (Schöpfungs-) Prozess, sondern auch als sein Gegenteil. Sie diskutieren den Menschen als Störfaktor für eine ideale Ordnung und ihre Bedingung sowie die Frage, wie Ordnungssysteme und Wissensordnungen konstituiert, stabilisiert und irritiert werden. Das Rauschen – den Strich – in der Un|Ordnung zu beobachten und die Grenze zwischen beiden (mit zu) denken, ist hierbei ein besonderes Ziel der Autoren dieses Buches, das erste Ansätze für eine interdisziplinäre Kulturgeschichte der Un|Ordnung vorschlägt.

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Johannes Fehrle; Rüdiger Heinze; Kerstin Müller(Hg.)

Herausforderung Biologie

Fragen an die Biologie – Fragen aus der Biologie

Keine Wissenschaft ist heutzutage in der öffentlichen Diskussion und den Massenmedien so präsent wie die Biologie. Zugleich stellt kein anderer Fachbereich ähnlich große Herausforderungen an Ethik und Moral. Häufig sehen sich Biologen ethischen und gesellschaftlichen Fragen gegenübergestellt, zu deren Beantwortung ihr Fachwissen alleine nicht ausreicht. Auch andere Fachbereiche, Politik und Gesellschaft werden mit biologischen Erkenntnissen und deren oft weitreichenden Auswirkungen konfrontiert. Um angemessen reagieren zu können, ist eine weit gefächerte Kompetenz notwendig, die nur eine interdisziplinäre Herangehensweise bieten kann. Zu einer solchen Kompetenzbildung soll dieser Band beitragen. Wissenschaftler verschiedener Disziplinen behandeln hier sowohl grundlegende als auch angewandte Fragestellungen, um so die Basis für einen produktiven und zukunftsweisenden Dialog zu schaffen.

Bd. 1, 2010, 272 S., 24,90 €, br., ISBN 978-3-643-10586-8

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