Heidegger's Thinking on the "Same" of Science and Technology

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Abstract

In this article, we trace and elucidate Heidegger's radical re-thinking on the relation between science and technology from about 1940 until 1976. A range of passages from the *Gesamtausgabe* seem to articulate a reversal of the primacy of science and technology in claiming that "Science is applied technology." After delving into Heidegger's reflection on the *being* of science and technology and their "coordination," we show that such a claim is essentially grounded in Heidegger's idea that "Science and technology are the Same [*das Selbe*]." In addition, we argue that, although different ontic epochs can be distinguished in the evolvment of science and/or technology, for Heidegger there is only one unique ontological Epoch of modernity that encompasses various ontic epochs. Therefore, such suggestions as we have now gone from an "epoch of objectivity" to an "epoch of orderability [*Bestellbarkeit*]" cannot be considered to be an ontological shift. Furthermore, it is not right to ascribe to Heidegger the view that the development of quantum physics signals the beginning of a new ontological Epoch.

key words

Heidegger, technology, science, uncertainty relation, epoch, *das Selbe*, relation of science and technology, premodern, modern, and postmodern technology

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Introduction

Two weeks before Heidegger's death on May 26, 1976, the tenth annual meeting of the "Heidegger Conference" of the North American Heidegger Society was held at DePaul University in Chicago. Heidegger's letter of greetings to this conference has been reported as the last philosophical text by his hand. In this letter, he requested that the participants take up the following question as "stimulation" [*Anregung*] for their discussion:¹

Is modern natural science the foundation [*Grundlage*] of modern technology - as assumed - or is it, for its part, already the basic form [*Grundform*] of technological thinking, the determining fore-conception [*Vorgriff*] and incessant incursion [*Eingriff*] of technological representation into the realized and arranged [*ausführende und einrichtende*] machinations of modern technology?

Here, carefully formulating in terms of a question, Heidegger made the crucial point that, instead of the common-sense idea that science lays the foundation for technology, the technological essence may well be the source from which science receives its form and on behalf of which science functions.

What is perhaps most perplexing is the fact that Heidegger singled out this question, from among many other questions, as an indispensable inquiry relative to "the asking of the question of Being."² Toward the end of his 1976 letter, Heidegger suggests that fruitful reflection upon the relation between science and technology could help prepare a transformation of man's dwelling in this world, which he claims to be what the question of Being *is* "in truth."³ At the 11th "Heidegger Conference" in 1977 as well as the 35th "Heidegger Conference" in 2001, the question of the being of science and technology was made a central theme of both meetings. However, the

¹ Heidegger (1977, p. 747/3). Page numbers of English translations if available follow the page numbers of the original.

² Ibid., p. 748/4.

³ Ibid., p. 748/4. Forman (2007, p. 9) cites exactly the same passage from Heidegger's 1976 letter, and takes it to be "perhaps his last public act" to try to convey his neglected message concerning the primacy of technology over science. Later in this article we provide a different reading of Heidegger's message. For the moment, suffice it to say that Forman completely ignores Heidegger's relating this issue to "the question of Being" in his letter. The connection with the question of Being is precisely the demarcation line between Heidegger's concern in apparently speaking of the subsumption of science under technology in an emphatic manner and the postmodernists' straightforward elevation of technology in relation to science. We are grateful to one of the anonymous reviewers for informing us of Forman's particularly lengthy article. Consulting this contribution, nevertheless, makes us see more clearly where Heidegger's philosophy parts from most supposedly *postmodernist* theorists who are still following a unilinear *modernist* route of reasoning, which thus often leads to one-faceted pronouncements.

contributions to these conferences have hardly addressed Heidegger's question directly.

In this paper, we attempt to shed light upon this enigmatic aspect of Heidegger's thinking, which shares an essential bond with "the mystery of what *is* today in truth in the technologically determined world."⁴ When it comes to Heidegger's thinking on modern science and technology, the prejudice that Heidegger "deeply contested" science and technology remains prevalent.⁵ We would like to emphasize, in the introduction of this paper, that this is only one facet of the profile. It is true that Heidegger often express worries about such things as "the possible self-destruction of the human being," but such remarks are usually followed by a disclaimer: "it is not a matter of hostility toward science as such."⁶ In many places, Heidegger reiterates that "the sciences are in themselves something positively essential,"⁷ and stresses that our comportment toward technology should be "yes" and "no" at the same time: "We can use technical devices, and yet, with proper use, can also keep ourselves so free of them that we may let go of them at any time."⁸

Such authors as Forman, while noticing Heidegger's denial of a denigratory stance regarding modern technology, insist that the later Heidegger shares the Romantics' antipathy against it and we cannot take Heidegger's denial at his word. One needs to bear in mind that for Heidegger the way out of the *Ge-stell* certainly does not reside in a simplistic turn to Romanticism, which embraces an idea of nature as mysterious, and as opposed to human artificiality, or to what Heidegger once called "calculable nature." This occurs in a discussion of 1955 about one of his favorite poets, J. P. Hebel. Here Heidegger argues that science and technology can well co-exist with "*simple naturalness*."⁹ Referring to Hebel as a "friend to the house which the world is,"¹⁰ Heidegger suggests that his poetry exemplifies this ideal of co-existence. After citing Goethe's review of Hebel's *Allemanic Poems* in which he says that Hebel "thoroughly countrifies the universe," Heidegger adds that Hebel *also* shows nature in its scientific calculability. The current problem, as Heidegger points out, is precisely that "calculable nature" and "natural nature" have been separated into

⁴ Heidegger (1998, p. 20/138). Unless otherwise noted, the emphases in the citations are all original.

⁵ Ihde (2010, p. 110).

⁶ Heidegger (2001, p. 124/94).

⁷ Heidegger (1968, p. 16/14).

⁸ Heidegger (1966, p. 526f/46).

⁹ Heidegger (1983, p. 145/97).

¹⁰ Ibid., p. 139/93

“two alien realms,” the latter being degraded and the former being “offered as the sole key to the mystery of the world.”¹¹ Heidegger’s criticism of Romantics is manifest in the last remark.

In the following, we provide an outline of the present paper. First, we trace the genesis of Heidegger’s radical re-thinking on the relation between science and technology since about 1940, and expound relevant materials that disclose his major concerns in ruminating upon it (section 2). In this section, quite a number of substantial citations come from *Leitgedanken zur Entstehung der Metaphysik, der Neuzeitlichen Wissenschaft und der modernen Technik*, published in 2009, where one finds an abundance of preparatory notes in preparation for public lectures on the essence of science and/or technology.¹² We argue that it is around the year 1940 that Heidegger developed some of the *Wegmarken* for a response to this question, and he continued to ponder upon it until his death. Next, using a text from the Winter of 1945/46 as an initiating clue, we lay out a three-fold structure of Heidegger’s formulation of his questioning (section 3), from which evolves the crucial thesis that modern science and technology are the “Same” (*das Selbe*).

In recent literature, some scholars ascribe to Heidegger a prescience of what is now called “technoscience,”¹³ while some others suggest that Heidegger’s work provides a clue to the idea that the “non-locality” of quantum mechanics points toward a non-totalizing science and another Epoch in the history of Being. We will address the first claim throughout sections 2 and 3 and the second in section 5.

Yet another piece of criticism coming from philosophers of technoscience is that Heidegger did not engage himself in concrete, empirical study of actual technologies.¹⁴ Therefore, his more conclusive statements about science and technology would lack a firm ground. This criticism seems to be far-fetched. It is true that Heidegger has never carried out any prolonged “case study,” which is currently a shared practice among philosophers of technoscience. However, one can see from

¹¹ Ibid., p. 146/98.

¹² Heidegger (2009).

¹³ Most contemporary philosophers of technology, such as Feenberg, Ihde, and Latour, subscribe to the thesis that science and technology cannot be separated anymore and should be studied via detailed case studies. They criticize Heidegger because he is considered to be an essentialist, determinist, and pessimist. Ihde’s *Heidegger’s Technologies: Postphenomenological Perspectives* is a systematic discussion of important differences between Heidegger’s approach and his own “pragmato-phenomenological account” (which “leaves in shamble the metaphysical Heideggerian tale”) (Ihde 2010, p. 113).

¹⁴ Ihde (2010, pp. 2-5). Latour paints Heidegger as a thoroughly pessimistic technological determinist. For a relevant discussion see Kochan (2010). According to Feenberg (1999, pp. vii, 15-17, 29), Heidegger is an essentialist on three counts: a-historical, substantivist, and one-dimensional. For a relevant discussion of such claims see Thomson (2000).

Heidegger's working notes, conversations, and lectures that he has always kept himself well-informed of traditional as well as new types of technology.¹⁵ Furthermore, Heidegger's more primary concern is involved with the "climate" in which technologies are used and experienced.

After a discussion of Heidegger's use of the word *Epoche* (epoch) and related terms (section 4) and the (alleged) essential difference between pre-modern and modern technology (section 6), we propose in section 7 a more conclusive interpretation of Heidegger's concern with the relation between science and technology, and suggest that the saying "Science and Technology are the Same" serves as a more apposite summary of his view than "Science is applied Technology,"¹⁶ which has been taken as not more than a precocious reversal of the primacy of the two.

2. Reversing the "modernist" order of modern science and technology?

On the basis of relevant materials, we suggest that it is in the year 1940 that the question concerning the relation of science and technology emerged, as one of the essential questions with which Heidegger was seriously preoccupied until his death in 1976.¹⁷

In a note taken after delivering the lecture „Besinnung auf die Wissenschaft" in Freiburg in June 1938, Heidegger writes,¹⁸ "modern science as 'technology' – This step in the lecture of 1938 was not yet completed although everything was ready."¹⁹ This "step" was soon taken, and taken resolutely.

In his notes of 1940 with the heading *〈Philosophie〉 und 〈Wissenschaft〉*,²⁰ Heidegger directly identified modern science with technology, and technology with the completion of metaphysics: "What modern science is: 'technology'. What

¹⁵ See for example two pages of insightful notes on the steam engine (Heidegger 2009, pp. 367-8), including "the politics of artifact." Examples regarding more recent technologies are given in sections 4 and 5.

¹⁶ Heidegger (2010, p. 10/15).

¹⁷ According to Ihde (2010, p. 93), Heidegger's interest in science and technology can be found only in a few brief periods, that is: the period of *Being and Time*, the mid 1930s, the mid 1950s, and, after "a gap," his last statement of 1976. This statement is unconvincing in view of Heidegger's own writings, as the citations in this section show.

¹⁸ In Heidegger (2000b, p. 349), one finds a summary of this lecture, the last sentence of which reads, "modern science [is] a way of technology." The same lecture is sometimes referred to as "Die Begründung des neuzeitlichen Weltbildes durch die Metaphysik" of 9 June 1938 (Ibid., p. 802). It resulted in the published text of „Die Zeit des Weltbildes" (Heidegger 2002).

¹⁹ The German original of this remark is: "Die neuzeitliche Wissenschaft als ‚Technik' – Dieser Schritt im Vortrag 1938 noch nicht vollzogen, obzwar alles bereit" (Heidegger, 2009, p. 126).

²⁰ The editors of the *Gesamtausgabe* do not give a date for this bundle of notes, except for indicating that it is from the period 1936-46 (Heidegger 1993c). The years giving for various texts at Heidegger (2009, p. 126f) suggest 1940 as the best guess.

‘technology’ is – completion of metaphysics.”²¹ By way of clarification, he adds such statements and phrases as: “Inserting modern science into the essence of modern technology. The latter appears later, but from early on already rules in the essence [*im Wesen*].” “Pure natural science is an essential completion [*Wesensvollzug*] of technology.” “The *unity* of modern science as technology.”²²

In various writings after 1940, Heidegger often ascribes a technological essence to science. For instance:

“The more plainly the sciences are carried along by their predetermined technological essence.” This comes from „Nietzsche’s Wort Gott ist tot” of 1943.²³

“Modern science stems from the essence of technology.” This is cited from „Der Lehrer trifft den Türmer an der Tür zum Turmaufgang” (Winter 1944/45).²⁴

“Modern science is application of the essence of technology.”²⁵ This comes from the *Bremer Vorträge* of 1949.

“Modern science is grounded in the nature of technology.”²⁶ And: “We still seem to be afraid of facing the exciting fact that today’s sciences belong in the realm of the essence of modern technology and nowhere else.”²⁷ These claims are made in *Was heißt Denken* of 1951.

“Today, that which modern science moves in its innermost essence, ... we can only incompletely characterize ... by giving it the name ‘technology’.”²⁸ This comes from a marginal note to „Wissenschaft und Besinnung” of 1953.

“Modern technology is the supporting grounding feature [*tragende Grundzug*] of modern natural science.”²⁹ This is cited from the lecture „Technische und Überlieferte Sprache“ of 1962.

²¹ Heidegger (2009, p. 126): „Was die neuzeitliche Wissenschaft ist: >Technik<. Was >Technik< ist – Vollendung der Metaphysik.“ For a discussion of the relation of technology and metaphysics see §1 in Ma and van Brakel (2014).

²² „die Einfügung der neuzeitlichen Wissenschaft in das Wesen der neuzeitlichen Technik, das später als sie erscheint, aber früher im Wesen waltet“ (2009, p. 127); „reine Naturwissenschaft [ist] ein Wesensvollzug der Technik“ (125). „Die *Einheit* der neuzeitlichen Wissenschaft als >Technik<“ (128).

²³ Heidegger (2002b, p. 211/159).

²⁴ Heidegger (2010, p. 179/116).

²⁵ „Die moderne Technik ist nicht angewandte Naturwissenschaft, vielmehr ist die neuzeitliche Wissenschaft Anwendung des Wesens der Technik“ (Heidegger 2012, p. 43/40).

²⁶ Heidegger (1968, p. 140/135).

²⁷ Ibid., p. 16/14.

²⁸ Marginal note to Heidegger (1993d), only in Heidegger (2000a, p. 62). „Das, was die moderne Wissenschaft in ihrem innersten Wesen bewegt, das, wodurch sich der gezeigte unscheinbare Sachverhalt ereignet, können wir heute nur erst ganz unzureichend und überdies leicht mißdeutbar kennzeichnen, wenn wir dafür den Namen »Technik« nennen.“

²⁹ Heidegger (1998d, p. 18/137).

“The fundamental character of [the] scientific attitude is its cybernetic, that is technological character.” This comes from „Das Ende der Philosophie und die Aufgabe des Denkens “ of 1966.³⁰

„The essence (*das Eigene*) of modern technology and in it the already grounding sciences: *die Gestellnis*.“³¹ This is found among his numerous notes made in the early 1970s, published in *Gedachtes*.

We can see that, during the long stretch of time from 1938 to 1976, his mind has been fixated on this issue. What is most prominent among these remarks seems to be a reversal of the standing of science and technology. Since modernity, it has been a received view that technology owes its birth to science. Modern technology emerged only when science let itself avail in a specific area. Against this assumption, Heidegger again and again stresses that we should consider science from its technological essence. But what does this imply?

Forman shows convincingly that, until the 1980s, nobody was able “to grasp what it was that Heidegger was shouting out and about,”³² namely, the idea “of technology as prior to science, possessing primacy over science.” He attributes this impotence to the fact that, up to the 1980s, modernist conceptions that regarded science as subsuming technology had been the dominating thinking frame, such that even Heidegger specialists were incapable to hear Heidegger’s message. Forman takes the view that it was the onset of postmodernity’s thinking frame and in particular its “epochal elevation of the cultural standing” of technology that caused the sudden reversal in primacy of science and technology circa 1980.³³

It seems that Forman has too easily assimilated Heidegger’s ideas to the postmodernist paradigm of thinking. He fails to explore what is at stake in Heidegger’s ascription of a technological essence to science. It is of primal importance that we grasp Heidegger’s thinking from the vantage point of the history of Being. He famously traces the word “technology” back to the Greek τέχνη (*techne*), and attributes a *seinsgeschichtliche* significance to it. This word, Heidegger explains, means “a bringing forth of beings . . . out of concealment specifically into the

³⁰ Heidegger (1972, p. 72/58). Cf. Heidegger (2002, p. 85/64): “From an inner compulsion, the researcher presses forward into the sphere occupied by the figure of, in the essential sense, the technologist.”

³¹ „das Eigene der neuzeitlichen Technologie und der in ihm schon gründenden Wissenschaften: die Gestellnis“ (Heidegger 2007, p. 349). On *Gestellnis* (in relation to *das Ge-stell*) see Ma and van Brakel (2014).

³² Forman (2007, p. 9).

³³ Forman (2007, p. 6).

unconcealment of its appearance.”³⁴ Why technology receives a primordial status is that it signifies the unconcealment of beings. Modern science arises as the consequence of the application of the essence of technology. Insofar as *techne* is connected with practice, it can be said that Heidegger shares a common ground with postmodernists who advocate the primacy of practice. However, Heidegger’s case is more than a simplistic reversal of classical orders in which science and theory assume primacy over technology and practice. This point will be further explained in section 7.

Among sciences, Heidegger pays particular attention to physics, i.e. mathematical, theoretical physics, because it is assumed to be the foundation and origin of all (natural) sciences. In a letter to Takehiko Kojima of 18 August 1963, Heidegger states: “The grounding feature of modern mathematical science is the technological, which appears first in its new and essential Gestalt through modern physics.”³⁵ That the essence of science is the technological, Heidegger presumes, finds a first reflection in physics. In “Die Frage nach der Technik” of 1953, Heidegger says: “modern physics is the herald of Enframing [*Gestell*], a herald whose origin is still unknown.”³⁶ In „A Triadic Conversation“ (Winter 1944/45), Heidegger even claims: “Physics must be technology, because theoretical physics is *the* proper, pure technology.”³⁷ In the next section, we will see how Heidegger comes to this point.

3. Laying out an argument with a tripartite structure

Heidegger’s earliest and perhaps the most important presentation of a detailed argument regarding the relation between science and technology can be found in “A Triadic Conversation between a Guide, a Scientist, and a Scholar” from the *Country Path Conversations* composed in the Winter of 1944/45, just before the end of the Second World War. The argument can be summarized in terms of the following steps.

First step: Experimental physics makes use of technology. The example Heidegger gives is “the machine that splits the atom.”³⁸ Hence, experimental physics

³⁴ Heidegger (1993c, p. 46/35).

³⁵ „Die Natur wird daraufhin herausgefordert, d. h. gestellt, sich in einer berechenbaren Gegenständlichkeit zu zeigen. ... Dieses Her-Stellen, d. h. das Eigentümliche der Technik, vollzieht sich auf eine einzigartige Weise innerhalb der Geschichte des europäischen Abendlandes durch die Entfaltung der neuzeitlichen mathematischen Naturwissenschaft. Deren Grundzug ist das Technische, das zuerst durch die moderne Physik in seiner neuen und eigentlichen Gestalt zum Vorschein kommt“ (Heidegger 2006, p. 156).

³⁶ „Die neuzeitliche Physik ist der in seiner Herkunft noch unbekannte Vorbote des Ge-stells“ (Heidegger 1993a, p. 23/303).

³⁷ Heidegger (2010, p. 8/5).

³⁸ Ibid., p. 6/3.

in itself might be considered to be technology being applied, instead of technology coming into being through the application of experimental physics. On the basis of this observation (which is repeated in 1962 – see below), one may intend to describe Heidegger as prescient of technoscience. That Heidegger was prescient of what is now called “technoscience” was already apparent in *Contributions to Philosophy* of 1936-38 (proposition 19 on science), where he speaks of:³⁹

... growing consolidation of the machinational-technical essence of all science. ... Natural sciences will become a part of machine technology and its operations.⁴⁰

However, the first step is only a preliminary remark, and Heidegger has yet much more to say.

Second step: Theoretical physics, which is “the foundation of ‘fundamental research’ in all the natural sciences,”⁴¹ does not employ instruments or machines. Hence, it is of course *not* applied technology in the sense in which experimental physics is applied technology. However, theoretical physics *is* (applied) technology in a different sense. Heidegger claims: “Physics must be technology, because theoretical physics is *the* proper, pure technology,”⁴² “the technological essence of physics lies precisely in that it is theoretical physics.”⁴³ Why?

Third step: The technological and the theoretical are the selfsame (*das Selbe*).⁴⁴ Why?

Thinking [in theoretical physics and elsewhere in the sciences] sets nature toward itself as the spatiotemporally-ordered manifold of moving points of mass. ... Natural processes are re-presented [*vor-gestellt*]. In this fashion, nature is what is pro-duced [*her-gestellt*]... Nature is as that which stands over against the human. ... [This] producing is the basic trait of the objectification of nature ... something objective for mathematical representation.”⁴⁵

This important step is further discussed in section 7.

Heidegger’s discussion of the essence of science in lectures and writings from the period 1935-1938 can help illuminate the idea embodied in the third step,⁴⁶ in

³⁹ To this could be added Heidegger’s early awareness of the “knowledge economy”: what counts is not anymore which country has the richest natural resources (minerals etc.), but the country which is most successful in technological innovation (Heidegger 1991, p. 9).

⁴⁰ Heidegger (1999, p. 155/107). In the revised list of propositions on science in his notes of 1940 he is more explicit (proposition 22, Heidegger 2009, p. 124f): “Modern science is research because it has its essential foundation (*Wesensgrund*) in technology.”

⁴¹ Heidegger (2010, p. 8f/4).

⁴² Ibid., p. 8/5.

⁴³ Ibid., p. 11/6.

⁴⁴ Ibid., p. 11/6.

⁴⁵ Ibid., p. 11/7.

⁴⁶ Kockelmans has given a still useful and insightful overview of Heidegger’s view of science, drawing on Heidegger (1966, 1968, 1993a, 1993b, 1993d, 2002). See in particular his (1985), Chapter 5 “Toward an

particular his discussion of the notion *ta mathemata* and the impact of Descartes's metaphysics,⁴⁷ which reverses the meaning of *obiectum* and *subiectum*.⁴⁸ According to Heidegger, in such statements as modern science is factual, experimental, and measuring, we miss its fundamental characteristics, which consists in two things. One is the way of working with the things, that is, setting things on their proper foundation *in advance* by using axioms and by "precalculability."⁴⁹ The other is the metaphysical projection of the thingness of the things. This way of projection, in opening up a domain in which only things of a certain kind can show themselves, "sketches out in advance a blueprint of the structure of every natural body as well as of its relation, to every other body."⁵⁰ Thus the task of science is to specify what can be accepted as scientific facts.⁵¹

As a consequence, those most commonly assumed features of science, including experiments & instruments, exactness & law, calculation & mathematics, and more recent ones: research enterprise, specialization, institutionalization, take on a broader meaning.⁵² For example, calculation now means: Taking something into account by setting it up as an object of expectation.

Heidegger argues that modern science is completely different from medieval and ancient (Western) science,⁵³ and that the experience of nature entailed therein is also completely different. Therefore it makes no sense to say that modern science is more exact or that Newton's theory is true and Aristotle's view false. What is essential of modern science is its method of precalculability and the metaphysical projection of the thingness of things.

Ontology of the Modern Natural Sciences." Of course at that time Kockelmans did not have access to sources which have become available from the many volumes of the *Gesamtausgabe* published up to now.

⁴⁷ For Heidegger's broad notion of "the mathematical," see Heidegger (1993b, p. 69-77/249-255; 2002, p. 78/58), Kockelmans (1985, pp. 142f, 150-1), and Dea (2009). *Ta mathemata* means for the Greeks that which man knows in advance in observing entities and dealing with things. Carson (2010) characterizes it as a view of mathematization as prescription that things make their appearance as objects predictable, calculable, and governable in a technological sense.

⁴⁸ Heidegger (1993b, p. 106/280).

⁴⁹ In "Wesen der Sprache" Heidegger ascribes to Nietzsche the insight that "method" is more essential than "result." Scientific method is not a mere instrument, "it has pressed science into its own service." This can be contrasted with "thinking," where there is "neither method nor theme" (Heidegger 1971, p. 178/74).

⁵⁰ Kockelmans (1985, p. 150).

⁵¹ Galileo poses conditions in advance to which nature must answer in one way or another. With Newton, nature becomes the closed totality of the motions of the spatio-temporally related point-masses. See for discussion Kockelmans (1985) and Dea (2009).

⁵² Heidegger may also be said to be prescient of the current "research" phase of modern science, with such features as: research in groups, disappearing of the distinction between *Geisteswissenschaften* and *Naturwissenschaften*, institutionalization, intertwinement with industry, becoming an enterprise. See Heidegger (2002) and Kockelmans (1985, pp. 152-162).

⁵³ See Heidegger (1993b). Already in a text of 1912 ("Das Realitätsproblem in der modernen Philosophie"), Heidegger speaks of "the unavoidable epoch-making facts of [modern] natural science" (Heidegger 1978, p. 4).

During one of the Zollikon seminars in 1965, again the essence of science is described in similar terms as in the late 1930s: it is the “connection between *measurability* and *method*,”⁵⁴ where *measurability* is in fact the same as calculability, which “means *precalculability*.” This is the method of science: securing the calculability of nature. The mind is reduced to a “technician of calculations.”⁵⁵

Coming back now to the *Country Path Conversations*, the Scientist summarizes the argument thus far:⁵⁶

Then the name “technology” strictly speaking, refers to a kind of representing, that is, a kind of cognition, and hence to a kind of theoretical comportment. The essence and the dominance of technology consists in the fact that, through it, nature has become an object. Nature is set up by the human, halted by him, so that it may be accountable to him and to his plans for it. Technology is the objectification of nature.

Since “the word itself ... harbor[s] the significance [*Deutung*] of the matter named by it,”⁵⁷ Heidegger, in the role of the Guide, explains how the word ‘technology’ in the modern sense is a particular kind of *techne*: “modern technology is that letting-see and setting-toward in which nature comes to appear as a mathematical object.”⁵⁸ Hence, Heidegger’s idiosyncratic statement that “physics is applied technology” does not necessarily contradict the common assumption that “technology is applied physics.” This is because: “In each of the two statements the words ‘physics,’ ‘technology,’ and ‘application’ signify something different. ... Because physics is applied technology in the sense of *techne*, ‘technology’ in the familiar sense can and must be applied physics.”⁵⁹

In 1949 and 1953 Heidegger repeats twice that according to chronological reckoning, modern technology is later;⁶⁰ nevertheless, from the point of view of the essence holding sway within it, it is earlier historically speaking.⁶¹ At the same time, modern physical theory of nature prepares the way for the essence of modern technology in that the challenging gathering-together into ordering revealing holds

⁵⁴ Heidegger (2001, p. 134/103).

⁵⁵ Ibid., p. 139/107. And this is further interpreted in *Ge-stell* terms (ibid. p. 135/105): “The point is *control* and *domination* of the processes of nature.” This is followed by a citation from the last part of Descartes’s *Discourse on Method*: “We render ourselves the master and possessors of nature” (ibid. p. 136/105). [Descartes, *Philosophical Writings*, vol. 1, p. 119: “Nous rendre comme maîtres et possesseurs de la nature.”]

⁵⁶ Heidegger (2010, p. 12/7).

⁵⁷ Ibid. p. 12/7.

⁵⁸ Ibid., p. 13/8f. Heidegger is well aware that, as expressed by the Scholar in the conversation (Ibid., p. 14/9): “I just can’t rid myself of the suspicion that you are interpreting the Greek word *techne* in terms of your own dogmatically asserted definition of the essence of modern ‘technology’.”

⁵⁹ Ibid. p. 15/10.

⁶⁰ Heidegger (1993a, p. 303-4/21-2; 2012, p. 43/40).

⁶¹ Kockelmans (1985, p. 177) interprets these passages by saying “although science is first ‘in execution,’ technicity was first in a perhaps still unconscious intention.”

sway in modern physics, although it does not at once come expressly to appearance. Similarly, man's ordering attitude and behavior have already displayed themselves in the rise of modern physics as an exact science.⁶²

Heidegger further explains, as pure theory, modern science's way of representing already sets nature up (pursues and entraps nature) to exhibit itself as a coherence of forces calculable in advance. It orders its experiments precisely for the purpose of asking whether and how nature reports itself when set up in this way.⁶³ Physics sets up (orders) nature as what is pre-calculable.

In 1962, Heidegger remarks that, among scientists and technologists, one now hears the view that science and technology are in a relation of "mutual support." For example, in nuclear physics, the technical instruments co-determine which phenomena will be observed, thus co-determining the process of knowing. However, he points out, the further question concerning their common origin is not raised. Such a mutual relation is only possible provided science and technology are co-ordinated (*gleichgeordnet*). What is the thing in which science and technology correspond to one another? Both share the comportment of challenging posing (*herausfordernde Stellen*) toward things. The essence of science and technology does not consist, as one might think, in a means-to-an end structure, but in the fact that a demand (*Anspruch*) is made by a non-human power, which orders humans to challenge nature forth.⁶⁴

4. Two senses of Epoch/epoch

In the secondary literature, Heidegger's allegedly strict separation between premodern and modern technology has been a point of disputation (see section 6). It has also been argued that at present we do not live in Heidegger's "Epoch" of the *Ge-stell* anymore, because since his death there have been revolutionary changes both in science and technology. For example, Ihde claims that "today's technologies evidence a quite different flavor from what was prominent during Heidegger's lifetime"⁶⁵ and suggests that we have entered a new Epoch of Being (that is, the epoch of technoscience and quantum physics). Therefore, he argues, Heidegger's position

⁶² Given the typical Heideggerian view that "That which is primally early shows itself only ultimately to men" (Heidegger 1993a, p. 23/327).

⁶³ That revealing concerns nature, above all, as the chief storehouse of the standing energy reserve. "For physics, nature is the standing reserve [*Bestand*] of energy and matter" (Heidegger, 2012, p. 42/40).

⁶⁴ „Der Mensch selbst ist gestellt, ist daraufhin angesprochen, dem genannten Anspruch zu entsprechen" (Heidegger 1998, p. 20/138). Cf. Heidegger (1993a, p. 21/302): "It remains true, nonetheless, that man in the technological age is, in a particularly striking way, challenged forth into revealing."

⁶⁵ Ihde (2010, p. 5).

regarding technology is outdated. This judgment does not seem to be fair to Heidegger. Certainly, since the 1970s, new types of technologies appear one after the other, of which it had not been possible for Heidegger to have any knowledge. However, Ihde has neglected some of Heidegger's writings that testify to a broad vision concerning the future of technology. Heidegger has stressed many times that the "modern age" is in no way at an end.⁶⁶ Given the "predetermined essence of science," we have to reckon with "a gigantic progress of science in the future."⁶⁷

In addition, several of Ihde's examples of technologies, about which, he claims, Heidegger knew nothing, or which he failed to present in the right way, are not correct. This is in particular the case with respect to quantum physics (see next section) and what Heidegger calls "biophysics." In the seminar at Le Thor in 1969, Heidegger makes such a remark.⁶⁸ "This means that the human being can be produced according to a definite plan just like any other technological object."⁶⁹ Ihde notices this statement and suggests that it is at most reflective of the Nazi legacy of eugenetics.⁷⁰ However, this abjuration is poor-grounded. Heidegger draws on contemporary statements from scientists. In 1955 Heidegger cites Stanley, the American chemist who was the Noble Laureate in Chemistry in 1946, who made the following prediction (cited by Heidegger),⁷¹ "The hour is near when life will be placed in the hands of the chemist who will be able to synthesize, split and change living substance at will." Stanley made this statement at a meeting taking place a few months before Heidegger wrote the relevant text. A decade later, in one of the Zollikon seminars held in March 1966, Heidegger spoke about "present research on the technique of genetic mutation in humans,"⁷² with reference to a book published two years before.⁷³ It is obvious that until late in his lifetime, Heidegger had always kept himself well informed about cutting-edge advances in science and technology.

Misunderstandings may arise because Heidegger employs the word "epoch" for different purposes, sometimes more on the ontological, sometimes more on the ontic

⁶⁶ Heidegger (1968, p. 57/54).

⁶⁷ Heidegger (1999, p.156/108; cf. 1966, p. 524/45).

⁶⁸ Heidegger (2003, p. 358/55).

⁶⁹ Cf. *WM* 257/197: "Sometimes it seems as if modern humanity is rushing headlong toward this goal of *producing itself technologically*."

⁷⁰ Ihde (2010, p. 111).

⁷¹ Heidegger (1966, p. 525/44).

⁷² Heidegger (2001, p. 177/135).

⁷³ Heidegger referred to "[Friedrich] Wagner, *Die Wissenschaften und die gefährdete Welt. [Eine Wissenschaftssoziologie der Atomphysik]*, München, 1964] pp. 225 ff., 462 ff."

side. This has caused confusions,⁷⁴ such that some scholars assume that there might be different (ontological) Epochs of modern science (on Heidegger's terms). According to our reading, we need to draw a line between a presumably *ontological* Epoch and a range of *ontic* epochs.⁷⁵ Modernity is a unique Epoch in the history of being, whereas there are a plurality of "epochs" *within* the Epoch of modernity. Although, as far as we know, Heidegger himself has never used the expression "Epoch of modernity,"⁷⁶ we suggest using this expression is in line with his thinking. For example, Heidegger often uses the word *Neuzeit*, usually translated as "modern age,"⁷⁷ where we think it is justified to understand this word as a reference to "modernity." For example, Heidegger mentions five essential features of the *Neuzeit*,⁷⁸ including not only modern science and technology, but also "loss of gods" and features related to art and culture; and he states that the fundamental event of the *Neuzeit* is the conquest of the world as picture.⁷⁹ These features are similar to features of modernity proposed by other writers. When Heidegger uses circumlocutions such as: "the current world-historical Epoch," "the Epoch of the *Gestell*," or the *Neuzeit* as the last Epoch of its history up to now," we also assume we may take these expressions as referring to the Epoch/Age of modernity.⁸⁰

Heidegger also uses such words as "era" and "revolution" as alternative phrasing of epochs in the ontic sense.⁸¹ These refer to particular periods or phases *within* modern science or technology that is supposed to have a unilateral history. One has to guard against the tendency of ascribing ontological weight to such epochs. The Epoch of modernity embraces possible breaks between classical physics and quantum physics, industrial technology and postindustrial technology, early modern science and science as an institutionalized research enterprise, and so on. For example, within the history of modern technology, Heidegger distinguishes such developmental stages as: power machinery, electrical technology, and atomic technology.⁸² In regard to atomic technology, Heidegger states: "If the taming of atomic energy is successful,

⁷⁴ This is exacerbated by the fact that in German, the word "Epoche," being a noun, is always capitalized.

⁷⁵ For Heidegger, philosophy, history, metaphysics, and Being have Epochs/epochs.

⁷⁶ Perhaps with one exception when he speaks of "that epoch that we call modernity" (Heidegger 1998, p. 15/135), also cited in section 7.

⁷⁷ The *Neuzeit* is translated in Dutch as "nieuwe, moderne tijd", literally "new, modern times."

⁷⁸ Heidegger (2002, p. 75f/57f).

⁷⁹ "The fact that the world becomes picture at all is what distinguishes the essence of the modern age [*der Neuzeit*]" (Ibid., p. 94/71).

⁸⁰ The citations are from Heidegger (2006, pp. 11, 121, 155).

⁸¹ The word *Epoche* is less common in German than the word "epoch" is in English, because it has more (near) synonyms such as *Zeitalter*.

⁸² Heidegger (1993a, p. 23/303).

and [I know] it will be successful, then a totally new era of technical development will begin.” Such a statement should not be taken to mean that atomic energy signifies the beginning of another Epoch of Being. Similarly, in an undated note, probably from the early 1950s, he speaks of the “second industrial revolution,” which amounts to “entering decision-making into the machine,” and which will constitute “the era of automatization after World War III.”⁸³ Again this should not be taken to be a new *ontological* phase in the history of technology or technoscience.

With respect to developments in science, Heidegger offers the epithet “a revolution that belongs to the greatest in human thought” to Newton’s first law of motion.⁸⁴ This “revolution” is one of the contributions to the inception of the Epoch of modernity.⁸⁵ Within this Epoch, he further identifies several “lower-level” revolutions and changes. In the Le Thor Seminar of 1969, he remarks that today there are no objects as there were for 18/19th century scientists: “The further modern technology unfolds, the more objectivity [*Gegenständlichkeit*] transforms in standing-reservedness [*Beständlichkeit*].”⁸⁶ In the 1973 seminar in Zähringen he reiterated: “Man has gone from an *epoch* of objectivity to an *epoch* of orderability [*Bestellbarkeit*].”⁸⁷ This transition parallels the transformation of science into “research.” According to Heidegger, since the 1930s, science has been under threat (*Bedrohung*). This threat stems not only from science proceeding according to a certain pre-given method, but from science becoming “research,” that is, becoming an externally financed institution and an enterprise, like the industries with whom it collaborates.⁸⁸ We suggest that the genesis and strengthening of the institutional character of academic research since the second half of the 20th century has corroborated Heidegger’s insight. However, Heidegger’s distinction between an

⁸³ „Das automatische Zeitalter nach dem III. Weltkrieg” (Heidegger 2009, p. 368); “Die zweite industrielle Revolution. Die Eingabe des Entscheidens in die Maschine”(Ibid., p. 376). In 1962 he mentions cybernetics as exemplifying the “second industrial revolution” (Heidegger 1998, p. 10/134).

⁸⁴ Heidegger (1993b, p. 89/257).

⁸⁵ Heidegger has provided detailed accounts of the work of Galileo and Newton (Heidegger 1993b, pp. 77-95/255-271). Dea (2009, p. 54) thus puts these accounts into the terms of *Being and Time*: “Before Newton, the fore-understanding the scientist brought to his understanding of nature included an interest in individual entities and, hence, a hermeneutical openness to Being; after Newton, the scientists’ hermeneutical horizon is restricted by the fore-understanding that individual entities are the indifferent manifestations of universal laws.”

⁸⁶ Heidegger (2003, p. 367/61).

⁸⁷ Heidegger (2001, p. 388/74, em. ad.).

⁸⁸ Heidegger asks, without implying that “an other beginning” is occurring: “What understanding of beings and what concept of truth is it that underlies the transformation of science into research?” (Heidegger 2002, p. 86/65).

“epoch of objectivity” and an “epoch of orderability” should not be understood to represent two successive Epochs in the history of Being.

5. Quantum physics

It has often been suggested that the transition from classical physics to modern physics is so fundamental that it heralds a new Epoch of Being; but this view cannot be ascribed to Heidegger.⁸⁹ Kockelmans has rightly stressed this point. With quantum physics, “nature must still set itself in place in advance for the objectifying and securing processes which science, as the theory of what is actually real, accomplishes.”⁹⁰ Quantum physics still aims at writing the “one single fundamental equation from which all the properties of all elementary particles, and therewith the behavior of all material things, follow”.⁹¹ The comportment toward nature embraced by quantum physics remains to be the same with that embraced by classical physics. This is so, even though Heidegger speaks of “epochs in modern physics.”⁹² In a passage in square brackets in Heidegger adds:⁹³

The subject-object-relation thus reaches, for the first time, its pure “relational”-, i.e., ordering, character, in which both the subject and the object are sucked up [*aufgezogen*] as standing-reserves. That does not mean: the subject-object-relation vanishes, but the opposite: it now attains to its most extreme dominance [*Herrschaft*], which is predetermined from out of Enframing [*das Gestell*].

Werner Heisenberg, whom Heidegger first met in 1935 in Todtnauberg, provided him with first-hand information about quantum physics. According to Carson (2010), in Heidegger’s lectures in the fall of 1935, quantum physics was given a partial exemption from his apparently derogatory view of science. But from 1936 onward, Heidegger presented all forms of *Wissenschaften*, including quantum physics and the humanities, as an extension of the technological will. Carson further documents that, in the years 1949-1953, Heidegger had been looking for a public confrontation with Heisenberg, which was finally taking place at the week-long lecture series of 1953 on *Die Künste im technischen Zeitalter*. Heisenberg presented “Das Naturbild der modernen Physik.”⁹⁴ Heidegger, delivered, “Die Frage nach der Technik”.⁹⁵

⁸⁹ According to Ihde (2010, p. 109), it is by the mid-1950s that Heidegger came to recognize that “quantum physics totally resituates the early modern subject-object distinction.” This statement is not correct, as we will see.

⁹⁰ Kockelmans (1985, p. 169).

⁹¹ Heidegger citing Heisenberg in Heidegger (1993d, p. 54/172).

⁹² Ibid., p. 54/172.

⁹³ Ibid., p. 55/173.

⁹⁴ Cf. his *Das Naturbild der heutigen Physik* (Heisenberg 1955).

⁹⁵ Some time before the meeting, Heidegger had distributed a draft of the text that was later to be published

Already in 1937, soon after the Einstein-Bohr debate concerning the interpretation of quantum mechanics, Heidegger writes several pages concerning what he calls “statistical physics” and the uncertainty relation.⁹⁶ “Can we say with N. Bohr, ‘that here [referring to the uncertainty relation] the separation between observed object and observing subject starts to disappear’? No!” This statement is followed by a couple of reasons why Bohr is wrong.⁹⁷ For Heidegger, it is completely mistaken to base a “new epistemology”⁹⁸ on the uncertainty relation.⁹⁹ According to Heidegger “cause” and “rule” are presupposed in every experiment, including quantum physics.

Again he thought about the issue at length when preparing for the “meeting with Heisenberg”. In a letter to Medard Boss (October 28, 1953), Heidegger writes: “I am kept very busy by the lecture in München [“Die Frage nach der Technik”] and with an interrelated correspondence with Heisenberg. At the hut I wrote a wide-reaching sketch and got deep into the question of causality.”¹⁰⁰ The result of Heidegger’s ponderings and exchange of ideas found its way in the printed text as follows.¹⁰¹

If modern physics must resign itself ever increasingly to the fact that its realm of representation remains inscrutable and incapable of being visualized, ... [It is still being] challenged forth by the rule of enframing, which demands that nature be orderable as standing-reserve. Hence physics, in all its retreating from the representation turned only toward objects, which has been the sole standard till recently, will never be able to renounce this one thing: that nature reports itself in some way or other that is identifiable through calculation and that it remains orderable as a system of information.

In addition, there is the technological side of atomic physics: atom bombs and nuclear power stations, which he mentions in several places. In *Gelassenheit* of 1955 there is a critical discussion of several pages on nuclear science, from which we already cited: “If the taming of atomic energy is successful, and it will be successful, then a totally new era of technical development will begin.”

In a marginal note to “Wissenschaft und Besinnung” Heidegger comes close to

with the title “Wissenschaft und Besinnung” (Heidegger 1993d).

⁹⁶ Heidegger (2009, pp. 175-181). In Heidegger’s 1927 paper to which Heidegger explicitly refers, Heisenberg uses the word “Unbestimmtheit” (indeterminacy) throughout. Only in an endnote the word “Unsicherheit” (uncertainty) occurs, which is now the received terminology in English.

⁹⁷ It is debatable whether Bohr held the view Heidegger ascribes to him.

⁹⁸ The phrase “new epistemology” was used as a section title in Eddington’s influential *The Nature of the Physical World* (Eddington 1928, pp. 225-229). Using this phrase Heidegger addresses a much-discussed issue since Eddington, Dewey, and many others started this discussion.

⁹⁹ Heidegger (2009, p. 179).

¹⁰⁰ Heidegger (2001, p. 246f/310). From the letter a month earlier (dated September 30), it is apparent that Heidegger had been working on the preparation of his lecture and public discussion with Heisenberg for a considerable period of time.

¹⁰¹ Heidegger (1993a, p. 231/327-8). Cf. Heidegger (2012, p. 43/41): “To be sure, atomic physics is experimentally and calculably of a different sort than classical physics. Thought in terms of its essence, however, it nevertheless remains the same as physics.” Heidegger (1993b, p. 54/172): “atomic physics admits only of the guaranteeing of an objective coherence that has a statistical character.”

acknowledging the need of a “new epistemology” when he remarks that “through” Heisenberg’s uncertainty relation the human is explicitly included in the artificiality of the instruments, becoming a part of it.¹⁰² However, even in the case of quantum physics and nuclear technology, science and technology are still governed by “the Same” (that is, calculability, orderability, predictability). During one of the Zollikon Seminars in 1966,¹⁰³ Heidegger repeats his view that predictability is not invalidated by the uncertainty relation.¹⁰⁴ Referring to Heisenberg’s 1927 paper, in which he speaks of “acausality” in relation to his uncertainty relation, Heidegger argues that the principles of causality and predictability are not invalidated by the uncertainty relation.¹⁰⁵ If this were the case “any technical construction would be impossible.” The only thing that changes is that unequivocal [*eindeutig*] and completely precise predictability becomes impossible. Making his argument concrete, if the uncertainty relation would invalidate causality and predictability,¹⁰⁶

then the construction of the atomic bomb, indeed any atomic technology, would have been impossible. ... [although] regarding the explosion of an atomic bomb, only an upper and a lower limit of the magnitude of such an explosion is predictable.

This is perhaps not a knock down argument against those who see an epochal change emerging from early twentieth century physics, but still an argument that has to be taken into account.

Since Heidegger pondered about these matters, numerous publications on quantum mechanics have appeared, leading to a range of quite different interpretations.¹⁰⁷ Nevertheless, the foundational questions remain to be the same as those raised in the Bohr-Einstein debate in the 1930s: how to understand “measurement” of parameters in the quantum mechanical formalism. This is what is called “the measurement problem.” However, until now there is no agreement about where to begin in order to have a provisional formulation of the nature of the problem.

¹⁰² “Through Heisenberg’s uncertainty relation the human being is finally and explicitly included in the artificiality of the instruments and has become part of it [*Bestandstück* – literally “part of the stock(s)”. Seeing it this way, among all the objects he can only meet himself-but what is ‘himself’ in this case: the instrumentation!” (Heidegger 2000a, p. 57). And he cites Goethe commenting on the way the new physics in Goethe’s time reduces knowledge of nature to what artificial instruments indicate [*zeigen*].

¹⁰³ Heidegger (2001, p. 177/134f).

¹⁰⁴ Comments on Heisenberg etc. were occasioned after the participants of the seminar had objected to Heidegger using classical physics as a “general” characterization of science.

¹⁰⁵ Heidegger seems to acknowledge that quantum physics has changed the notion of causality “once again”: “It seems as though causality is shrinking into a reporting, ‘a reporting challenged forth’ of standing-reserves that must be guaranteed either simultaneously or in sequence” (Heidegger 1993a, p. 24/304).

¹⁰⁶ Heidegger (2001, p. 177/135).

¹⁰⁷ Including an empirically equivalent alternative to “standard” quantum mechanics, viz. Bohm mechanics, which presupposes a deterministic world and, by present standards, leads to the same predictions as “standard” quantum mechanics.

Hence, the question whether quantum mechanics would require a “new epistemology” is still open and Heidegger’s quasi-instrumentalistic view (what counts is predictability) is still an option.¹⁰⁸

6. Premodern and modern technology

One important aspect of Heidegger’s reflection upon technology (and hence upon the essence of science and technology) is a strict distinction between pre-modern and modern technology. For Heidegger, pre-modern means of production is a “natural bringing-forth” that corresponds to *poiesis*. The work of a craftsman is not so much different from the work of an artist in that both attempt to let things come into unconcealment and reveal themselves, which is a matter of *aletheia*. In contrast, with modern means of production, things are challenged and controlled to reveal themselves as standing-reserves; nature becomes a resource to be exploited.

In a recent article in this journal, Riis disputes Heidegger’s view.¹⁰⁹ According to him, there simply does not exist an unbridgeable gap between pre-modern technology and modern technology.¹¹⁰ For sure, Heidegger should be aware that the Greeks employed slaves to build temples and to work in silver mines, and the mode of controlling embodied in these forms of producing does not have essential qualitative difference from that embodied in modern technology. Hence, Riis concludes, as *Dasein*, humans are essentially modern.¹¹¹

We agree with Riis that a sharp distinction between pre-modern and modern technology is far from self-evident. It is certainly not obvious that ancient ways of production are completely exempted from forms of extracting resources such as silver, as if resources are simply out there in nature ready for use. Similar ways of subjecting nature to human force and control already exist in ancient times. Consider the following passage from Heidegger’s 1962 lecture,¹¹² where we substitute the word “silver” for the word “energy:”

The [silver] that is locked in nature is unlocked [when silver ore is mined], what is

¹⁰⁸ It may be noted, as Heidegger knew, that already with respect to classical physics there is no completely exact prediction. This is because in order to make a prediction one needs to know the initial (or current) state of the system under consideration, but this state has to be measured and measurement can *never* be completely precise.

¹⁰⁹ Riis (2011).

¹¹⁰ Heidegger seems to be pointing to a similar direction when he writes: “It is very difficult to grasp historically the emergence of what is machinationally ownmost to beings, because basically it has been effective in operation since the first beginning of Western thinking” (Heidegger 1999, p. 132/92).

¹¹¹ “The rule of *das Gestell* has challenged humans as long as they have existed” (Riis 2010, p. 116).

¹¹² Heidegger (1998, p. 18/137).

disclosed is transformed [that is, with chemical means silver is extracted from the silver salts in the ore], what is transformed is reinforced [i.e. concentrated, purified, refined], what is reinforced is stored, what is stored is distributed [to the silver smiths]. These ways, according to which nature is secured, are controlled [e.g. (dying) slaves in silver mines]. This controlling, in its turn, must secure itself further.

The main idea of subjecting nature to human force and control remains unchanged with the substitution of the word “silver” for “energy.”¹¹³ There is no silver as such in nature, but only silver ore. Controlling nature as well as human beings exists in all periods of time and in all regions of the globe. One can as well be referred to the construction of pyramids and other “gigantic” architecture around the world, and the phenomenon of deforestation that persistently occurs throughout the history of humanity and across the globe.

For sure, certain ancient tools of production, such as a windmill to which Heidegger refers, appear to be far less challenging (*herausforderend*) than other tools, such as the power station “in” the Rhine to which Heidegger also refers. However, we argue that the contrast between controlling and non-controlling modes of obtaining resources or of making products does not exactly correspond to a certain timeline of pre-modern age and modern age. This contrast also exists in ancient times. The following parable from the *Zhuangzi*, a famous Chinese Daoist scripture, very well illustrates this point.

Zigong, a disciple of Kongzi (that is, Confucius), came across an old gardener, who was carrying water to the fields. He used up a great deal of energy but produced very little result. Zigong asked the gardener whether he would like to use a well sweep.¹¹⁴ The gardener flushed at his words with anger and said:¹¹⁵

I have heard my teacher say, where there are machines, there are bound to be machine worries; where there are machine worries, there are bound to be machine hearts. With a machine heart in your breast, you have spoiled what was pure and simple; and without the pure and simple, the life of the spirit knows no rest. Where the life of the spirit knows no rest, the *dao* will cease to buoy you up. It's not that I don't know about your machine—I would be ashamed to use it!

A possible Confucian retort to the gardener might be that, all the same, the old gardener has to use a sort of gadget such as a bucket in order to get water, and most probably he was actually using one. However, a Daoist would reply that the use of the latter forms of tool conform to the *dao* of nature insofar as it does not exert itself upon

¹¹³ Of course, what is different is that “energy” is more central to technology than “silver.”

¹¹⁴ “It's a contraption made by shaping a piece of wood. The back end is heavy and the front end light and it raises the water as though it were pouring it out, so fast that it seems to boil right over!”

¹¹⁵ Watson (1968, p. 134).

water/nature but instead tries to integrate itself with nature in a calm and peaceful way; whereas the use of a well sweep to get water violates the *dao* of nature in exerting unnecessary force and attempting to subject water to its control.

This parable from over two thousand years ago vividly illustrates the contrast between controlling and non-controlling modes of obtaining resources from nature. All epochs in which some sort of technology is involved share the feature of exploitation of humans and natural resources. That all modes of technology share “exploitation” (and that modern science and technology is the completion of metaphysics) is consistent with a demarcation between a plurality of epochs of pre-modern technology and a unique Epoch of modernity, because “exploitation” is not the only defining feature of modernity (see section 4). What we want to point out is that “exploitation,” which Heidegger put in terms of *herausfordern*, *herstellen*, *Bereitstellung*, cannot be invoked anymore as one of the exclusive features of modern technology.

It is on the basis of a distinction between pre-modern (“natural”) technology and modern (“calculative”) technology that some scholars ascribe to Heidegger the idea of a unique “Epoch of modernity.” The latter idea is correct, but the reason given for it is wrong. Heidegger’s notion of a unique “Epoch of modernity” is set in a much broader vision of the history of Being, rather than grounded on a more or less simplistic division between pre-modern and modern technology.

7. Heidegger’s real slogan: science and technology are the “Same”

In the *Feldweg Gespräche* of 1944/45, Heidegger suggests: “The technological and the theoretical are the same [*das Selbe*].”¹¹⁶ In 1959, he begins his notes „Aufzeichnungen aus der Werkstatt“ by saying that science is identical (*identisch*) with the ruling [*walten*] of modern technology.¹¹⁷ Finally, in his technology lecture of 1962, he remarks:¹¹⁸

A reciprocal relation [*Wechselverhältniss*] between natural science and technology can only subsist if both are co-ordinated [*gleichgeordnet*] ... Now, what is that thing in which natural science and technology agree and thus is the Same?

A close reading of this lecture will give some hints how to understand Heidegger’s

¹¹⁶ Heidegger (2010, p. 11/6).

¹¹⁷ „Manche scheinen heute mit der Not zu ringen, für das Walten der modernen Technik und der mit ihr identischen Wissenschaft eine Vorstellung von der Geschichte zu finden, in die sich der durch jenes Walten bestimmte Weltzustand einordnen“ (GA 13, 151).

¹¹⁸ Heidegger (1998, p. 16/136).

claim that science and technology are “the Same.”

In section 2, we presented many of Heidegger’s emphatic statements such as “modern science is application of the essence of technology.”¹¹⁹ On a first reading, these statements seem to suggest, as Forman (2007) takes for granted, that Heidegger precociously articulated a reversal of the standing of science and technology. However, if we take into consideration Heidegger’s relating such issues to the question of Being, and examine the intricacies of these issues from the vantage point of the history of Being, it will become clear that Heidegger’s concern resides not so much in a reversal of science and technology than in an exploration of their shared “common origin.”¹²⁰

This “common origin” is explored by way of a new interpretation of the essence of science and technology. As mentioned, the word “technology” is derived from the Greek word *techne*. In the 1962 text, Heidegger ascribes a knowledge character to this word in explaining it as: “to know one’s way in something and definitely in the producing of something.”¹²¹ With the Greeks, knowing is further connected with “the unlocking of, making manifest, what is present as something present,” which is the same as what the German verb *herstellen* says literally.

Heidegger now explicitly stresses: “Τέχνη [*techne*] is not a concept of making, but of knowledge.” Since knowing is a decisive character of technology, it is demanded that this kind of knowledge be developed “as soon as a science corresponding to it unfolds and presents itself. This occurred and occurred only once . . . as the beginning of that epoch that we call modernity.” That technology is a kind of knowledge is evidenced by the development of atomic physics. It is precisely because of the knowledge-character of technology that it shows itself to be “a co-determinant in knowing” in laboratory experiments.

On the other hand, Heidegger points out that modern science has become a variety of technology insofar as it embodies a notion of being as what is measurable and thus posits nature into a calculable objectivity, and insofar as the priority is given to method and pre-determined standards. This seems to suggest a reversal of the status of science and technology, but Heidegger immediately disclaims, “Though the reversal comes closer to the matter, it does not reach to its core . . . What is most

¹¹⁹ Heidegger (2012, p. 43/40).

¹²⁰ Heidegger (1998, p. 16/136).

¹²¹ *Ibid.*, p. 15/135 (all citations in this and the next paragraph).

peculiar to both, their common origin, conceals itself in what we called the positing which challenges forth.”¹²² Heidegger further identifies this “common origin” as “the representing.”¹²³

Heidegger discussed the notion of “representing” in numerous places. The following passage from “Die Zeit des Weltbildes” gives a condensed and yet comprehensive characterization:¹²⁴

To represent [*Vorstellen*] means here: of oneself, to set something before one and to make what has been set in place [*das Gestellte*] secure as thus set in place. This placing-in-securedness must be a calculating, since only calculation guarantees being certain, in advance and always, of that which is to be presented. ... The being is no longer that which presences. Rather it is that which, in representation, is first set over and against [*entgegen Gestellte*], with the character of an object [*Gegen-ständige*]. Representation, setting-before, is a making everything stand over and against as object [*Ver-gegen-ständlichung*] which masters and proceeds against. In this way, representation drives everything into the unity of the thus-objectified.

This kind of representation is the identifying feature of the Epoch of modernity. It became manifest in the rise of modern science, as Heidegger’s detailed discussions of the work of Galileo, Newton and Descartes show. With the rise of *das Ge-stell*, with science turning into “research enterprises,” and with the onset of “planetarization” (Heidegger’s word for what is now called globalization), the devastating consequences of representation became rampant.

Modern science and technology share this unique form of representation, of which three most important features can be highlighted as follows:

First, natural processes are re-presented (*vor-gestellt*), objectified, controlled, and dominated. This challenging posing (*herausfordernde Stellen*) turns nature into being orderable as standing-reserve.

Second, things are set on their proper foundation *in advance* and are set up as usable objects. The thingness of the things falls prey to the metaphysical projection, such that only things of a certain kind can henceforth show themselves.

Third, humans are themselves challenged forth and are rendered into “resources.” Humans are also *demande*d to challenge nature forth into calculable and disposable materials.

¹²² Ibid. p. 18/137.

¹²³ It has been said that the burden of science and technology lies not in their calculative style but rather in their insistent and aggressive spirit (Alderman 1978, p. 43). However, we agree with Rojcewicz (2006, p. 114) that “science attack[ing] nature with experiments is not what is impositional, but the prime imposition is the representation of nature.”

¹²⁴ Heidegger (2002, p. 108/82).

What is the Same in which the essence of science and technology is retained and united is to be seen from a broad vision of the history of Being. When the expression “the Same” (*das Selbe*) occurs in Heidegger’s other writings, it is used sometimes as a unique notion, sometimes in its ordinary sense, and sometimes as a pun that denotes both senses.¹²⁵ As a unique notion, the Same speaks of the “*belonging-together*” of being and thinking.¹²⁶ It is that which lets Being and thinking relate and concern one another mutually. To think of the belonging-together is not to assimilate the components into a unity, as a simplistic understanding of the principle of identity (*Gleichheit*) would presume. What is crucial is to *experience* the togetherness in terms of belonging. The Same is the matter of thinking, the task of thinking, and the way of thinking. As Heidegger writes in “Moira:” “What is silently concealed in the enigma-word τὸ αὐτό [the Same] is the revealing bestowal [*entbergende Gewähren*] of the belonging-together of the duality [of Being and beings] and the thinking that comes forward into view within it.”¹²⁷

In this light, Heidegger’s saying that science and technology are the Same entails that, in exploring their relation, one needs to reflect upon their essence; and in reflecting upon their essence, one needs to think back upon their belonging-together as a gathering from out of which both science and technology come into being and sustain themselves. Heidegger defines the primordial Same as the belonging-together of being and thinking; therefore, speaking of the Same of science and technology inevitably directs our thinking back to their essential connectedness with the history of Being. Because of the forgottenness of Being, the “originary” bringing forth in the sense of unconcealment, which is one fold of the originary meaning of *techne*, develops into a pro-ducing and re-presenting of a standing-reserve to be ordered and challenged.

Instead of reading “Science is applied technology” to be no more than a reversal with a disputable postmodern proclivity, we emphasize that a precise characterization of Heidegger’s position with regard to the relation of science and technology is: “The essence of science and technology is the Same.”¹²⁸

¹²⁵ See Ma (2008, pp. 196-202).

¹²⁶ Heidegger (1969, p. 92/29).

¹²⁷ Heidegger (1975, p. 251/95).

¹²⁸ Some scholars may take the discourse of the “Same” to be a throw-back to modernist views. However, this is not the case. We have to pay attention to the fact that Heidegger not only sees through the dark (as revealing concealment) origin of technology, but also touches the right place where modern science and technology are united.

8. Afterthought: questioning is the piety of thinking

As we have shown, on many occasions, Heidegger has already provided a more or less explicit answer to the question regarding the relationship of modern natural science to modern technology. However, he keeps on raising this question again and again, to such an extent that he singles it out for special attention in his letter of 1976.¹²⁹ Why? Probably it is because the very act of questioning itself is more important than the answer, and “we moderns”¹³⁰ can at best prepare ourselves for “the other beginning of thinking.”¹³¹ As Heidegger says in the Zähringen seminar of September 7, 1973, the protocol of which was read and approved by Heidegger:¹³²

The entry into this domain [i.e. “the ultimate decisions that this reality compels us to take up”] is not produced by the thought undertaken by Heidegger. To believe thinking capable of changing the place of man would still conceive of it on the model of production. Therefore? Therefore, let us say cautiously that thinking begins to prepare the conditions of such an entry.

The essential origin of modern science and the essence of modern technology need be traced out through questioning. This can never be a facile matter. In any case, only by thinking through the essence, or the “Same,” of modern science and modern technology, which denotes *prima facie* the sharing of a particular mode of precalculating, representing, challenging, and controlling nature, and by thinking through this “Same” at the elevated level of the history of Being, could humans possibly obtain a “befitting relation to the technological world.”¹³³ However, there can be no rush in achieving this.

¹²⁹ The 1976 letter was not an isolated occurrence. In a letter to Roger Meunier of 1969, Heidegger (2003, p. 416/88) lamented that “a sufficiently grounded insight into the relation of the two [that is, the interlocking of modern technology and modern science] has not yet been gained.”

¹³⁰ Heidegger (1968, p. 140/135). We are citing the English translation of *Was heißt Denken?*. Heidegger himself wrote: “man heute.”

¹³¹ Heidegger (1999, p. 4/3).

¹³² Heidegger (2003, p. 390/75).

¹³³ Heidegger (2010, p. 179/116).

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¹³⁴ We have been forced to use Springer's house style. This means that Heidegger's works are referenced using the year of publication of the English translation if available, or the latest original language edition. We have added the year in which Heidegger wrote the cited text in square brackets after the German title of the work, which is placed before the English translation from which we cite.

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