Distributing Potentiality. Post-capitalist Economies and the Generative Time Regime

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Bionote

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1. Introduction. Deep Futurology: Post-capitalism in Cultural Evolution

Institutionally, economically, normatively and metaphysically, humanity is imprisoned by the assumption of unlimited growth, the notion in which the cultural hallmarks of Modernity progress, technologization, capitalism and the linear time regime are converging. How could a civilizational time leap into a society in which growth is redefined, a leap into a post-capitalistic economy and a post-linear time regime, a leap into a new structure of the "societal metabolism"[1] connecting culture and nature be undertaken? Deciding about the direction of such a leap demands to answer two related questions. Is there a way to know what type of economy could emerge out of capitalism? Is there a way to know what form of time could emerge out of linearity? This article[2] seeks to answer these questions through an extrapolation of the developmental trajectory of cultural evolution and civilizational history.[3] It will be shown that the contemporary knowledge about human, cultural and social evolution allows for an embedding of capitalism into macro-evolutionary processes and trajectories. Thus,

[1] Karl Marx, *Capital*, Vol. III, trans. by Ben Fowkes and David Fernbach (New York: Vintage, 1981), 949.

[2] The article is based on chapters from the author's doctoral dissertation which will be published under the title *Generative Realitäten. Zur Zeitform und Metaphysik der Technologischen Zivilisation* (English title: *Generative Realities. On the Temporality and Metaphysics of the Technological Civilization*), forthcoming in 2018. The author thanks Nathan Clendenin, Jacob Vangeest and Stanimir Panayotov for the valuable comments and corrections of his own translation.

[3] In the following pages, *cultural evolution* designates the period between 3 Ma until approximately 50 ka, while the term *civilizational history* designates the time onwards up to today.

this article offers the first posthumanist[4] and cultural evolutionary conceptualization of Modernity and capitalism. It develops a *deep futurology* which allows to extrapolate the currently observable developments based on general cultural evolutionary tendencies,[5] enabling to derive potential future civilizational states emerging out of Modernity. This approach provides insights into the chances for and constraints on a general system transition.

The argument comprises three steps. In the first part (para. 2-5) the cultural evolutionary framework is laid out. It is shown that stages of cultural evolution and civilizational history can be discerned by the depths of operational chains of technologies, starting with the first use of stone tools three million years ago leading up to information technology. Furthermore, it is argued that the depths of operational chains are directly correlated to types of economies and ontologies of time. In the second part (para. 6-7) the hallmarks of three successive stages of history leading up to globalization and the "world-society"[6] are briefly sketched out based on Arno Bammé's theory of axial caesura. After the Axial Age in Greece, in which the coin was introduced, Modernity follows as another axial shift in which capital emerges, leading to the Technological Civilization, a transition which we are currently witnessing. In this part the axial stages are interpreted with the cultural evolutionary framework which shows that the principles and patterns of early cultural evolution can be applied to the axial caesura and that

[4] "Posthumanism," as Philbeck defines it, "asserts that the missing ingredient in Enlightenment humanism's recipe for the 'human' is technology itself. The claim is that the 'human' is not separable from technology. […] the constitution of the human is a technological constitution. A clear example of this constitution is the archeological classification of human history through the presence of artifacts. It is only through the presence of such technological engagement with the world that we recognize ourselves, or our ancient ancestors. […] posthumanism attempts to critique the concept of the 'human' and it's taken-for-granted constitution. For posthumanism, technology must become part of the first principles that constitute the 'human,' meaning that the immaterial subject and material world can no longer be fundamentally distinct." Thomas D. Philbeck, "Ontology," in *Post- and Transhumanism. An Introduction*, ed. by Robert Ranisch and Stefan Lorenz Sorgner (Frankfurt a.M.: Peter Lang, 2014), 173-84, 178.

[5] The history of the paradigms in social evolution theory shows an oscillatory pattern of conjunctures of universalism/progressivism and contingency/relativism. Cf. Stephen Sanderson, "Evolutionism and its Critics," *Journal of World-Systems Research*, No. 3 (1997), 94-114, 105-6. Currently there is another paradigm shift away from relativism to a "neo-synthetical" progressivism that takes particularism into account but also provides a measure for vertical differences of societies or developmental stages. This development is synchronous and analogous to the replacement of postmodernity's relativisms by new realisms.

[6] For an overview of the theories of the "world-society," see Jens Greve and Bettina Heintz, "Die 'Entdeckung' der Weltgesellschaft. Entstehung und Grenzen der Weltgesellschaftstheorie," in *Weltgesellschaft. Theoretische Zugänge und empirische Problemlagen. Sonderband der* Zeitschrift für Soziologie, ed. by Bettina Heintz, Richard Münch and Hartmann Tyrell (Stuttgart: Lucius und Lucius, 2005), 89-119.

each axial shift brings forth a new ontology of time. In the third part (para. 8-11) the emergence of types of economy and temporal ontologies is correlated with the structure of the technologies characterizing each of the axial shifts. This allows for an extrapolation of a post-capitalist economy and a post-linear time concept emerging out of the technological structure characteristic of the Technological Civilization. It is argued that information technology represents a qualitative deepening of operational chains which will lead to the erosion of Modernity's institutions and the capitalist class structure, since they cannot reduce the complexities of interdependencies and map the temporal relations growing out of these technologies.

2. Cultural Evolution, Operational Chains and Economy

Cultural and social evolution can be characterized as the increase of technological complexity and the increase of the interdependency of cooperation and coupled actions. Therefore, it can be described as a continuous extension of "operational chains."[7] Early humans were limited to the production and use of stone tools, while early civilizations such as the "hydraulic empires"[8] already mastered watering systems, demonstrating the increase of the depths of operational chains mediated by the increase in the complexity of technology and social organization. Today, the operational chains extend not only to extraplanetary space, notably in Mars explorations, but also down to the microcosm, as in biogenetics and quantum devices, or into intrapsychic dimensions, as in psychotherapy and cognitive enhancement.

The extension of operational chains and of the integration of cultural units into higher-ordered action sequences is a classical *topos* in sociology. Economy received special emphasis since it naturally plays a central role for coupling of actions. Georg Simmel considers money as the "means of means" which enables the flexible connection of "practical, purpose, or teleological sequences";[9] for Emil Durkheim moral values and the form of division of labor as the organization of operational chains are intrinsically linked;[10] Norbert Elias conceives the "civilizing process" as an extension of "chains of interdependency;"[11] Anthony Giddens

[7] André Leroi-Gourhan, *Gesture and Speech*, trans. by Anna Bostock Berger, intro. by Randal White (Cambridge, MA/ London: The MIT Press, 1993).

[8] Karl Wittfogel, *Oriental Despotism. A Comparative Study of Total Power* (New York: Random House, 1951).

[9] Georg Simmel, *The Philosophy of Money*, trans. by Tom Bottomore and David Frisby from a first draft by Kaethe Mengellberg (London and New York: Routledge, 2004).

[10] Emile Durkheim, *The Division of Labor in Society*, trans. by W.D. Halls, intro. by Lewis A. Coser (New York: Free Press, 1997).

[11] Norbert Elias, *The Civilizing Process* (originally in two volumes: Vol. 1, *The History of*

observes a historical tendency of the expansion of space-time bindings in means of action and interaction which, with the rise of European Modernity, extends across the globe.[12] While these sociological approaches provide general theories about the relation of the types of economies to the social order and the cooperative interdependencies, they do not offer a formal or non-empirical account of the shifts from one type of economy or organizational structure to another, or even a formal pattern of these shifts. This correlation will be elaborated in the following chapters.

3. Stages of Noo- and Technogenesis: Cultural Capacities

The paleoanthropological "Model of the Expansion of Cultural Capacities"[13] developed by the cognitive archeologist Miriam Haidle allows to identify discrete stages in cognitive and cultural evolution. In this model the "problem-solution-distances"[14] or depths of "operational chains"[15] derived from archeological artefacts, such as stone tools or needles, are analyzed and compared, showing that the evolution of hominin species spreads over four general evolutionary stages. The axiomatic assumption is that tools, cognition and culture co-evolve, thus rendering this model a posthuman approach.[16]

The four distinct cultural evolutionary stages identified by Haidle et al. are termed "cultural capacities." Each grade of cultural capacity is marked by new types of technologies that display a discrete extension of the depths of the involved operational chains. Each evolutionary level also marks the emergence of distinct cognitive and organizational capacities.[17]

Modular Cultural Capacity (<2.6 Ma)

The first distinctly hominin stage is characterized by the appearance of secondary tool use, in which one tool is produced and used to produce another tool. Tools of this stage such as knapped stone hammers or scrapers comprise a set of independent, cultural, learned units as behavioral modules, which are combined in different ways and form different operational chains. The term "modular" denotes that these

Manners; Vol. 2, *State Formation and Civilization*), trans. by Edmund Jephcott (Oxford: Blackwell, 1994).

[12] Anthony Giddens, *The Consequences of Modernity* (Cambridge: Blackwell, 1990).

[13] Miriam N. Haidle, Michael Bolus, Mark Collard et al., "The Nature of Culture: An Eight-Grade Model for the Evolution and Expansion of Cultural Capacities in Hominins and other Animals," *Journal of Anthropological Sciences*, No. 93 (2015), 43-70.

[14] Wolfgang Köhler, *The Mentality of Apes*, trans. by Ella Winter (New York: Harcourt Brace, 1925).

[15] For the history of this concept in cognitive archeology, see Miriam N. Haidle, "Archaeological Approaches to Cognitive Evolution," in *A Companion to Cognitive Anthropology*, ed. by David B. Kronenfeld, Giovanni Bennardo, Victor C. de Munck and Michael D. Fischer (Malden, MA: Blackwell Publishing, 2011), 450-67.

[16] Cf. Philbeck, "Ontology," 138.

[17] Cf. Haidle et al., "The Nature of Culture," 56-60.

tools are acting on or modifying each other and, furthermore, that they are applicable in various contexts.

Composite Cultural Capacity (<500 ka)

Building up on the modular stage, in the composite stage of development tools appear which consist of several modules fused into a composite unit, such as a spear with a hafted tip or a hammer stone with a grip, attached with a compound adhesive. In these tools new materials and qualities are produced and operationalized (for example glue), while their elements are gathered from spatiotemporally separated locations.

Complementary Cultural Capacity (<100 ka)

The following step in the cumulative cultural evolution is marked by the emergence of complementary tools, such as bow-and-arrow, needle-and-thread, or ornamental devices such as necklaces. Complementary tools consist of a module that serves as an acting entity (for example bow or needle) and takes effect on an interdependent exchangeable part (arrow or thread).

Notional Cultural Capacity (<70 ka)

The phylogenetic period of early cultural evolution ends with the stage of the notional cultural capacity, in which the human organism ideal-typically has reached "behavioral modernity."[18] This phase has also been called the "creative revolution"[19] and marks the beginning of civilizational history. It is defined by the emergence of notional tools such as music instruments, figurines, cave paintings and traps. These are tools for cognitive engineering, in which the psyche of the observers is affected. In this phase, sets of symbols, aesthetical codes and semantical rules are developed.

[18] Behavioral modernity is an ideal measure which asserts that a hominin species displays all the features and capacities that are contemporarily present in humans. It is closely related to the notion of "human universals," which are human features such as music, core family, humor, communication through conventional signs or abstract social organization that are found in every culture. See April Nowell, "Defining Behavioral Modernity in the Context of Neandertal and Anatomically Modern Human Populations," *Annual Review of Anthropology*, Vol. 39 (2010), 437-52; Donald Brown, *Human Universals* (New York: McGraw Hill, 1991).

[19] Steven Mithen, "A Creative Explosion? Theory of Mind, Language and the Disembodiment of the Upper Paleolithic," in *Creativity in Human Evolution and Prehistory,* ed. by Steven Mithen (London and New York: Routledge, 1998), 165-91.

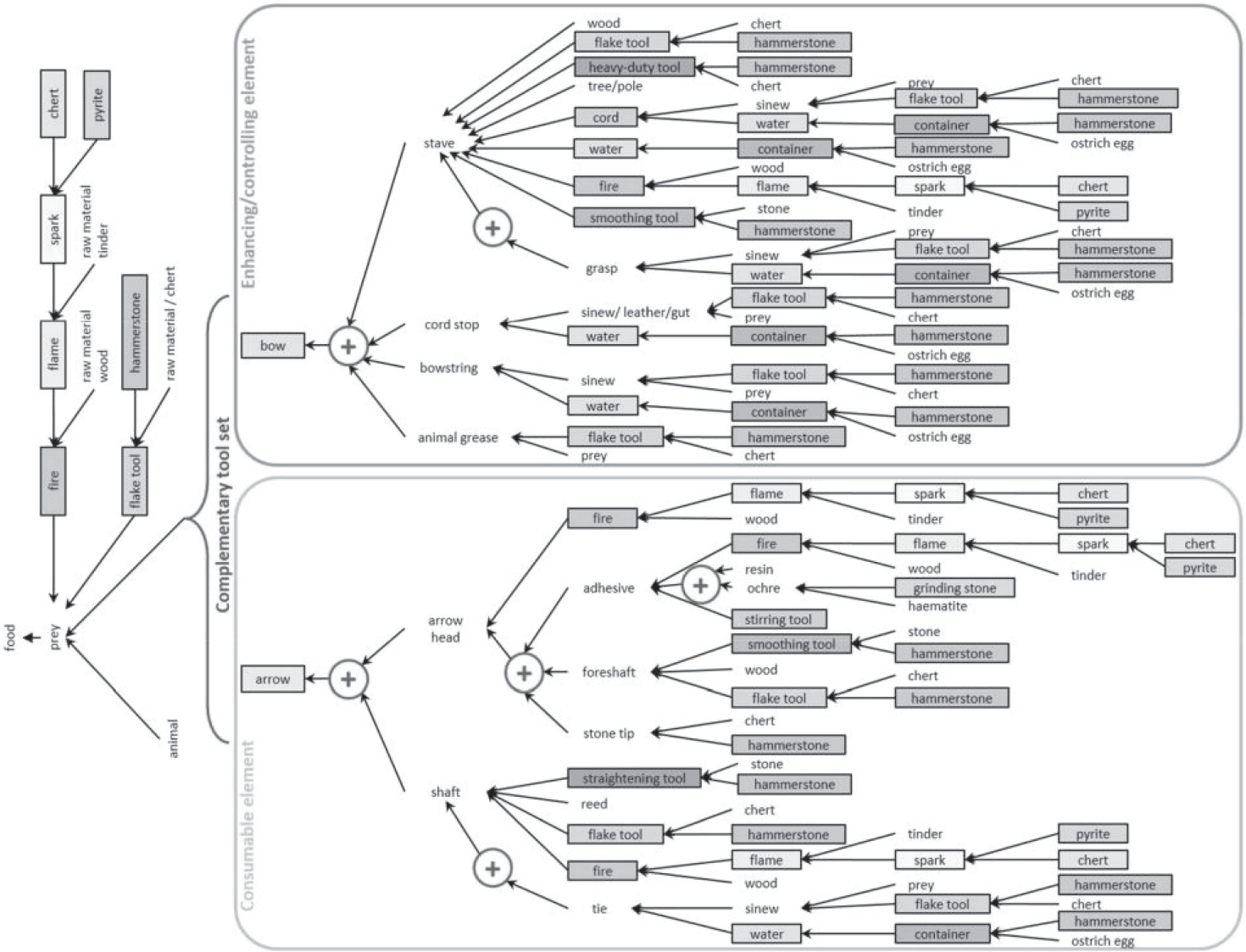

Figure 1. Effective chain of production and hunting with a bow and arrow.

Source: Marlize Lombard and Miriam N. Haidle, "Thinking a Bow-and-Arrow Set: Cognitive Implications of Middle Stone Age Bow and Stone-Tipped Arrow Technology," *Cambridge Archaeological Journal*, No. 22 (2012), 237-264, 257.

The axiomatic assumption of this approach is that the sequence of capacities follows the principle of cumulative cultural evolution or the "ratchet-effect," which Tennie et al. defined as a process "in which modifications and improvements stay in a population fairly readily (with relatively little loss or backward slippage) until further changes ratchet things up again."[20] Every new capacity grade is cumulatively built upon the previous capacity.[21]

Evidently, the cultural evolutionary tendency of the cumulative increase of operational chains and problem-solution-distances continues in and *as* civilizational history. A formalization of the general principles and patterns of the expansion of cultural capacities thus could enable to identify later stages of social evolution as such discrete capacity shifts, allowing to determine whether humanity is currently facing such a transition, preparing it for its consequences.

4. Formalizing Noo- and Technogenesis

At least eighteen formal developmental principles and patterns can be isolated in the stages of the expansion of cultural capacities.[22] To prepare the reframing of the history of economies in terms of cultural evolution theory, the argumentation of this article is restricted to the explication of only three essential principles: the correlation between the range of domesticated space, agency externalization and agency emulation; the principle of the deepening of temporal horizons as modulation of temporal ontology; and the pattern of recursion and hierarchical integration.

Expansion of spacetime domestication

Leroi-Gourhan stated that the earliest technologies are characterized by the emulation of mechanical actions which as a principle propels the history of technology up to the late industrial production.[23] But a close examination of the cumulative sequence of the instruments defining cultural capacities shows a somewhat different principle of progress. Each new capacity level is based on the successive *externalization of agency*.

The performances of the modular capacity as the first stage of cultural development such as knapped stone tools resemble mechanical action patterns by simulating and enhancing the possible interactions of a phenotype with

[20] Claudio Tennie, Josep Call and Michael Tomasello, "Ratcheting Up the Ratchet: On the Evolution of Cumulative Culture," *Philosophical Transactions of the Royal Society B*, Vol. 364, No. 1528 (2009), 2405-15, 2405.

[21] For a formal definition, see Alexander Riegler, "The Cognitive Ratchet: The Ratchet Effect as a Fundamental Principle in Evolution and Cognition," *Cybernetics and Systems*, Vol. 32, No. 3-4 (2001), 411-27.

[22] For a detailed analysis, see Chapters 4 and 5 and, for a summary, see Chapter 8.3 in Löffler, *Generative Realitäten*.

[23] Cf. Leroi-Gourhan, *Gesture and Speech*, 237-56.

its environment, for example "[c]utting, molding, scraping, and digging."[24] While in the first stage the events and processes that claws or teeth can realize are materially emulated and externalized into the instrumental object, the tools of the next technological stage do not refer any longer to the mere organic capabilities and functional interactions, but to the capabilities that the *whole previous technological assemblage* displayed. They extend the range of actions based on the previously established range: a thrown spear or a hammer stone with a grip attached realize events located *beyond the organic spatiotemporal radius of action*, and simultaneously realize events that are *beyond any phenotype-related concept of action*. The events produced by a spear or a hammer are unprecedented in the history of life, for they are *artificial* or *noospherical* events, unfolding within the relational strata of technology or *noos* itself.

The principle of agency externalization is evidently also present in the bow-and-arrow-assemblage (complementary cultural performance), which represents a second order externalization, in which the acting arm is externalized into the bow and the spear into the arrow. The emulation of the action and concept scheme of spear throwing (composite cultural performance), which itself was already distanced from the organic range of actions by one grade, is externalized into the materiality of the bow-and-arrow. The trap (notional cultural capacity) is the most evident example of the principle of externalization of agency, since it instrumentally emulates the presence of a hunting group.

In every new cultural capacity, the point of action is shifted further away from the body. The successive externalization of agency through instrumental mediation results in the expansion of the domesticated space or niche: every new range of externalization establishes a wider continuum of resource retrieval, ordered states and secured spaces. Each capacity grade as a qualitative increase of the depths of operational chains therefore results in an expansion of the "specific functional environment"[25] or the "membrane"[26] between culture and nature. Since economies are mediating the organization of operational chains, the historical sequence of economies can be conceptualized as an expression of the constant cumulative expansion of domesticated spaces starting in early cultural evolution up to today.

[24] Ibid., 242.

[25] Haidle et al., "The Nature of Culture," 51.

[26] André Leroi-Gourhan, *Milieu et Techniques* (Paris: Albin Michel, 1945).

Extension of operational temporality and modification of temporal ontology

Each grade of externalization as grade of cultural capacity also entails a deepening of the operational temporality, regarding the depth of planning time and the expansion of the temporal continua of possible addressable or instantiable events.

There are three types of *quantifiable* temporal expansions:

- The problem-solution-distances in the use and production of instruments are increasing, resulting in a deepening of planning time and the increase and differentiation of modularized sequences of causality (*internal temporal scaffold*).

- The externalization of agency extends the temporal depth by compressing spacetime[27] by technologically extending the continuum of causally linked events and ordered states further into the future (*external temporal scaffold*).

- Domesticated spacetime is expanding, since new technologies such as clothes or weapons allow for securing resources, minimizing threats and stressors, reducing contingencies, normalizing eventualities, mitigating risk and formatting the unforeseen, establishing what can be called "zones of preemption" (*potential temporal scaffold*).

This *quantifiable* expansion of operational temporal horizons is accompanied by a *qualitative* alteration of the *temporal ontology*. The "content" of time, that which provides the temporal continuum with consistency such as forces, relations, causalities, qualities or intentionalities, is changing with each layer of extension.[28] When, for example, in the composite cultural capacity adhesives are manufactured, the continuum of relations compared to the previous modular capacity is lined with new qualities, agencies and processes, resulting in a new type of consistency or ontology of time. The complementary tool needle-and-thread already displays a complex or recursive "object grammar," which implies the abstraction of time sequences as nested layers of operationality and the structuration of instrumental spatio-

[27] For later stages of social evolution this has been elaborated, for example, by McLuhan as media transgressing space, by Giddens as binding of spacetime, by Virilio in the notion of acceleration and by Luhmann as expansion of medial experience space. See Marshall McLuhan, *Understanding Media. The Extensions of Man* (New York: McGraw-Hill, 1964); Giddens, *The Consequences of Modernity*; Paul Virilio, *Speed and Politics: An Essay on Dromology*, trans. by Mark Polizzotti (New York: Semiotext(e), 1977); Niklas Luhmann, *The Reality of Mass Media*, trans. by Kathleen Cross (Cambridge: Polity, 2000).

[28] The current state of knowledge about the general co-evolutionary relation between cognition, cooperation, tool use and temporality, particularly with regards to the human feature of "mental time travel," is summarized in Michael C. Corballis, *The Recursive Mind. The Origins of Human Language, Thought, and Civilization* (Princeton and Oxford: Princeton University Press, 2013), 81-127.

temporal part-whole relations.[29] The function of a trap as a performance of the notional cultural capacity is based on the capability to anticipate the attention, intention, processing and decision time *within* the mind of prey organisms; it operates with stochastic probabilities.

Each capacity stage in early cultural and the following social evolution is characterized and therefore *formally identifiable* by a new ontology of temporality. Inversely, every type of temporal ontology must be correlated with a capacity stage. Stages in civilizational history as defined by discrete increases of the operation chains therefore can be identified and distinguished by *differences in the culturally dominant conception of time* which again must be correlated with the type of economy.

Levels of hierarchical integration and the pattern of recursion

The sequence of expansions of cultural capacities reveals a universal developmental pattern in human and cultural evolution, which - as will be shown in the following sections - is also seen in social evolution up to the current civilizational shift. It comprises two functional mechanisms: the cumulative hierarchical integration of complexities and the recursion of abstractified performances.

The increase in the depths of operational chains in a new cultural capacity is based on the operational implementation of previously established performances. The former range of operations within a performance or assemblage is objectified as a single unit and transferred into a higher order effective chain as a *modular element*. The production of the hammer stone with a hafted grip, within the composite cultural capacity, requires the production of the stone tool as in the previous modular capacity and *in addition to that* the crafting of the grip and adhesive material. In this way, every new cultural capacity can be formally defined as an *emergent layer of integration* for previously established modules. The expansions of cultural capacities are basically increases in the "complexity of hierarchical integration"[30] of processes. This suggests that stages in cultural and social evolution can be formally defined and identified by the number of layers of hierarchical integration of performances.

The second principle, *the pattern of recursion*, shows that the increase of the range of integration is not gradual or continuous,

[29] For the general concept of nested layers of functional integration in technologies, see W. Brian Arthur, *The Nature of Technology. What It Is and How It Evolves* (New York: Simon and Schuster/Free Press, 2009), 39-44.

[30] This notion was elaborated in detail by the developmental psychologist Commons. See Michael Lamport Commons, "Introduction to the Model of Hierarchical Complexity and its Relationship to Postformal Action," *World Future: The Journal of New Paradigm Research*, Vol. 64, No. 5-7 (2008), 305-20.

but discrete and discontinuous. This finding is essential, since it allows to connect the formal measure for development - the level of hierarchical integration - with empirical data.

As mentioned above, the emulation of a cultural performance such as hammering does not mean the externalization of the mere mechanical process into materiality, but the material emulation of the *whole functioning* of the entire assemblage. For example, when a grip is attached to a stone tool, two functional aspects are implemented which firstly emerged in the process of hammering. The grip allows the application of higher forces and better control as a functional enhancement of the existing artificial process, but simultaneously it protects the acting hand and arm from injuries during the practice as a practical enhancement of the artificial process. The grip as a device *recursively* refers to the knowledge derived from previous technological actions. In this way, every new tool contains the abstraction of already instrumentally discretized processes. This process of the abstraction of a previously present functional process and its *re-entry* into operational chains as a single, materialized module can be termed *process-emulative recursion*.[31] For example, in grip tool technology the whole previous tool-agent assemblage including its functional and affordance environment is *recursively* implemented into the grip. Accordingly, the composite cultural capacity represents a recursion of the previously established modular cultural capacity.

The principle of *process-emulative recursion* is also explicated in the following capacity transitions. The bow-and-arrow emulates the entire spear-thrower assemblage. The bow-and-arrow thus, in its material composition, *recursively* contains and addresses the *whole* purpose and context of the previous performance as an abstraction. Most strikingly, the principle of process-emulative recursion is illustrated in the trap as a performance of the latest stage, the notional capacity. Traps are emulating the presence of a whole hunting assemblage, they are recursive materializations of the entire hunting process: the trap contains all the historically accumulated knowledge not only about the technical and strategic aspects of hunting, but also of the limits of the prey's cognition, which have been revealed over time in the experiences of hunting assemblages. Simultaneously, its fully automated

[31] Process-emulative recursion is to be distinguished from other types, such as the linear-iterative recursion in mathematics and computer science, the generative-hierarchical recursion in linguistics, the organizational-syntactical recursion in theories of cognition (cf. Corballis, *The Recursive Mind*) or the operative-functional recursion in theories of technology (cf. Arthur, *The Nature of Technology*, 39-44). For a detailed introduction of this new understanding of recursion, see Chapter 4.2.4 in Löffler, *Generative Realitäten*.

snapping mechanism as a functional principle is a recursive abstraction of the previously developed half-automated snapping mechanism of bows. Each cultural capacity can therefore be formally defined as discrete level of hierarchical integration of the previous extent of operational chains through the *recursive implementation* of its concept as a single module. Thus, grades of cultural capacity can formally be understood as discrete levels of recursion.

Transferred to economies, their types must also be related to the depth of hierarchical integration of operational chains, wherein each of the lower order economic performances are *nested* in higher order economic performances, such as coin exchange is *nested* within capital exchange. In this way, types of economies can be localized within the developmental grading of cultural and social evolution by their depth of recursivity.

5. The Extension of Agent Coupling in and *as* Civilizational History

In the following step of the argument, the model of cultural capacities is sociologically reformatted to enable the application of cultural evolutionary principles and patterns isolated from early capacity expansion to later history. What is needed is an understanding of the mode and means by which operational chains are being continuously extended beyond mere tool use. For a theoretical conceptualization of this process, the notion "civilizational capacity"[32] has been proposed. Civilizational capacities demarcate the ideal ranges of commensurabilization and coupling of abstract agents such as individuals, groups, collectives or any other regular entity. It shows that operational chains are expanding beyond the instrumental and productive aspects of early cultural performances, by the integration of abstract agent units into higher order operational chains.

Performances such as those displayed in the production of figurines, cave paintings or music instruments, which appeared in the notional cultural capacity stage approximately 70.000 years ago, are a type of tool whose purpose was not to create events in physical nature but in the mind. This capacity is evidence of "behavioral modernity" in which the biological evolution of mankind is ideal-typically completed. It marks the beginning of civilizational history.

Haidle et al. define the functional scope of notional performances in the following way:

> Notional concepts are mentally constructed and socially shared entities and relationships that can be represented in a)

[32] For a detailed elaboration of the concept, see Chapter 5 in Löffler, *Generative Realitäten*.

the signification of objects/signs (e.g., cross, crescent and Star of David as symbols of religions); b) systems of ideas (e.g., myths, religious beliefs, philosophical questions, constitutions of states); c) normative definitions (e.g., metric and value systems); or d) virtual beings (e.g., angels) and characters (e.g., protecting capacities of an amulet). The socially transmitted information exceeds that of all former capacities. It is now based on non-physical concepts, which can be manipulated only in the mind or through imagination, and their effects on real or other notional modules.[33]

As devices for "cognitive engineering," notional tools are addressing the minds of others (cave painting) or of the self (music instrument). They contain elements within the production sequence that are purely conceptual, such as certain semantically laden color schemes, affecting tones, or magical materials. In these performances, the mind, psyche or anima is revealed or isolated (*freigestellt*) as an object. The notional stage in which the mind as an invisible unit is revealed and addressed technically marks the beginning of the *operationalization of abstractions of concrete agents*.

[33] Haidle et al., "The Nature of Culture," 59.

Notional performances inherently relate to sociality and to the continuum of the "generalized other."[34] Notional tools allow for the operational formatting of abstracted agents (any agential or seemingly intentional entity such as individuals, groups, collectives, animals, spirits, natural phenomena or technological assemblages) and their implementation into potential action sequences through a symbolic, semantic and informationally commensurating matrix. They enable to convey information horizontally and vertically to any recipient and to extend the operational chains and cooperation beyond the immediate present and locality. In short, the notional cultural capacity is the period in human evolution in which media emerge as the central relays and relational structure of practices. Media are material externalizations of mental contents, or, in Merlin Donald's terms, "external symbolic storages" or "exograms."[35]

The appearance of exograms establishes a new type of evolutionary capacity: the *civilizational capacity*. Civilizational capacities are performances and technologies that enable the coupling of autonomous agents. Exograms or

[34] George Herbert Mead, *Mind, Self, and Society from the Standpoint of a Social Behaviorist* (Chicago: University of Chicago Press, 1934).

[35] Cf. Merlin Donald, *Origins of the Modern Mind. Three Stages in the Evolution of Culture and Cognition* (Cambridge and London: Harvard University Press, 1991), 314-19.

notional tools are the basis of the *cumulation of knowledge, practices* and *social organization*, and thus of history. Just as each grade of cultural capacities can be formally defined and identified by the recursion of a lower grade capacity into a higher level of hierarchical complexity in the new capacity, discrete stages in civilizational history can be identified by the expansion, recursion and integration of civilizational capacities.

As Haidle et al. note, currencies such as money are also a notional tool or external symbolic storage.[36] Their function as a civilizational performance was highlighted early on by Simmel, who states that money as *means for means* significantly expands cooperation and operational chains. Different types of economies therefore must be understood as realizations of different civilizational capacities.

6. Three Caesurae in Civilizational History: Greek Axial Age, Modernity, Technological Civilization

Modernity, as the onset of capitalism, globalization, civil societies, scientification, technologization, the ideology of progress and the linear time regime, is considered a caesura in human history throughout all theories of social evolution. It is rooted in ancient Greek culture, another historical caesura, and it leads to another caesura, the Technological Civilization. These three caesurae are the topic of Arno Bammé's book *Homo Occidentalis*,[37] a detailed reconstruction of the historical development of Western thought and metaphysics. In a synthetic approach, Bammé shows that forms of consciousness and rationality developed in European history are entangled with economic structures as the organization of the metabolism connecting nature and culture.

Bammé calls these stages of social evolution "axial caesurae," referring to the concept of the "Axial Age" introduced by Karl Jaspers in 1949.[38] Jaspers famously stated that between 800-200 BCE, a shift in the worldviews took place simultaneously in Greece, the Levant, Persia, China and India, which is characterized by the emergence of transcendentalism and individuation, a renunciation of myth and personalized divine forces, and a turn towards abstract metaphysical concepts as in Greek philosophy, the prophetic religions, Zoroastrianism, Confucianism, Buddhism and Hinduism. The question whether the Technological Civilization marks

[36] Haidle et al., "The Nature of Culture," 59.

[37] Arno Bammé, *Homo Occidentalis. Von der Anschauung zur Bemächtigung der Welt. Zäsuren abendländischer Epistemologie* (Weilerswist: Velbrück Wissenschaft, 2011).

[38] Karl Jaspers, *Origin and Goal of History*, trans. by Michael Bullock (New Haven and London: Yale University Press, 1955). For the current state of the "Axial Age Debate," see Robert N. Bellah and Hans Joas (Eds.), *The Axial Age and its Consequences* (Cambridge and London: Harvard University Press, 2012).

another such axial transition is left open by Jaspers.[39]

Exactly this question is the starting point of Bammé's inquiry. He asserts that Modernity and the Technological Civilization display characteristics of an axial shift, since, in these stages, new forms of consciousness and metaphysics, as well as a new type of social synthesis mediated by new structures of economy, occur. For the scope of this article the main hallmarks of the axial caesurae are sketched out in order to lay out the material for the cultural evolutionary interpretation in the following sections.

Greek Axial Age

In the Greek Axial Age culture, a new relationship to transcendence, the absolute truth and the *logos* is established, enabled through the spread of rational reflection or "second order thinking."[40] The relation of individuals to society and world for the first time in history becomes broadly founded on rationality. Bammé explains this metaphysical and cognitive novelty through Sohn-Rethel's materialist epistemology, which states that the use of the coin - which was introduced in the Mediterranean space between 800-650 BCE - leads to "real abstraction,"[41] which grounds an artificial socialization or "social synthesis" that does not rely on synthetizing relations through direct barter or use value, but through the abstraction of use value in the numerical exchange value, causing the institutionalization of abstract and conceptual framings of the concrete.[42] An analogical increase in abstraction can be found in the synchronically developed alphabetical writing system, since the alphabet allows a reflective distancing from language and thinking.[43] The Greek polis structure has proto-democratic institutions, which are bound by the *nomos* as an abstraction and formaliza-

[39] Jaspers in his time could not conceive of a co-evolution between technology and metaphysics. This prevented him from recognizing that new technologies themselves can be and indeed were the cause of axial shifts. As Bammé shows, these shifts are also directly related to changes of the economic structure.

[40] Cf. Yehuda Elkana, "Die Entstehung des Denkens zweiter Ordnung im antiken Griechenland," in *Kulturen der Achsenzeit. Ihre Ursprünge und ihre Vielfalt.* Teil 1: *Griechenland, Israel, Mesopotamien*, ed. by Shmuel N. Eisenstadt (Frankfurt a.M.: Suhrkamp, 1987), 52-8.

[41] Cf. Alfred Sohn-Rethel, *Intellectual and Manual Labor: A Critique of Epistemology*, trans. by Martin Sohn-Rethel (Atlantic Highlands, New Jersey: Humanities Press, 1977), 35-56.

[42] See also Rudolf Wolfgang Müller, *Geld und Geist. Zur Entstehungsgeschichte von Identitätsbewußtsein und Rationalität seit der Antike* (Frankfurt a.M. and New York: Campus, 1981); Richard Seaford, *Money and the Early Greek Mind. Homer, Philosophy, Tragedy* (Cambridge: Cambridge University Press, 2004).

[43] Here Bammé refers, among others, to the two classical works of Havelock and Ong. See Eric A. Havelock, *The Literate Revolution in Greece and its Cultural Consequences* (Princeton, New Jersey: Princeton University Press, 1982); Walter J. Ong, *Orality and Literacy: The Technologizing of the Word* (London and New York: Methuen, 1982).

tion of traditional societal systems.[44] Here early forms of civil societies and bourgeoisie emerge.[45] Since a full market-based society had not developed in Antiquity, production was still based on slaves, and wealth was not reinvested but retained, resulting in a social synthesis that did not become fully artificial and prevented the full development of formal thinking. Therefore, even Greek metaphysics, although within philosophy the relatedness to the universal is institutionalized, remains attached to a realism and to the concrete.

Expressed formulaically, the historical shift in the Greek Axial Age can be characterized as the *transition from myth to logos, from magic to substance, from community to society*.

Modernity

Bammé shows that Modernity can be understood as another axial caesura in which the formal and rational relationship to the world was completely developed. The commercial revolution during the end of the Middle Ages, the formation of the inner market, the commodification of work force, and the conversion of the economy towards surplus production lead to a new type of social synthesis. The entirely formal and abstract equivalent exchange within anonymous markets results in an increased artificiality of social relations. It is characterized, in Sohn-Rethel's term, by "conceptual abstraction," which is the basis of the dualistic, scientific and calculative world-relationship (*Weltverhältnis*) characteristic of Modernity. Nature turns into an operational continuum and becomes rationalized, leading up to the metaphysical concept of the dualism of mind and matter. Natural science is institutionalized and supports the ubiquitization of abstract thought and "formal-operational" cognition in Piaget's term. The formal relation to the world is furthermore supported by urbanization, the empowerment of the merchant class, reformation and secularization, book print, firearms and metallurgy, new sailing technologies, colonization, engineering, and mathematization. It finally becomes institutionalized with Newton's force equations, which enable the transfer of scientific knowledge into the sphere of production, resulting in industrialization. The modern individual and the rational Kantian transcendental subject as social forms are rooted in the reciprocity of equivalence exchange in capitalist markets and the contractual relationships in constitutional states.

This cognitive and social historical period can be characterized as the *transition from logos to ratio, from substance to matter, from society to nature*.

[44] Cf. Christian Meier, *Die Entstehung des Politischen bei den Griechen* (Frankfurt a.M.: Suhrkamp, 1980).
[45] Cf. Shmuel N. Eisenstadt, "Einleitung. Der Durchbruch der Achsenzeit im antiken Griechenland," in *Kulturen der Achsenzeit*, 43-51.

Technological Civilization

Following the sequence of transformations based on changes in economic relations and social synthesis, Bammé identifies the Technological Civilization as another axial caesura. It starts around 1880 with the fusion of science, industry and capital.[46] In the Technological Civilization sociality is not constituted by relations mediated by the anonymous market, but is based on a new type of synthesis: in the "synthesis through technology,"[47] humans are connected by the possibilities of interactions provided by continuously progressing technology. The hybridization of science and production results in the "amalgamation of nature and society"[48] and dissolves Modernity's dualism. The virtualization of currency erodes the equivalence relation as the basis of reciprocity and undermines subject-bound rationality as the basis of social interactions. Cybernetics, as the externalization of ratio into information technologies, leads to a replacement of the Aristotelian two-valued logic by a many-valued, "polycontextural"[49] logic, which results in the formation of yet another form of consciousness, which Gotthard Günther termed the transclassical "consciousness of the machines."[50] Globalization leads to an erosion of territorially defined states, and medialization turns the modern, rational and civil subject into an avatar. Metaphysically, the dualism of mind and matter dissolves and the rendering of the world through the category information leads to the category of the *process* taking up ontological primacy.

Condensed in a formula, the Technological Civilization can be characterized as the *transition from ratio to generativity, from matter to process, from nature to the hybrid*.

While Arno Bammé's historical reconstruction convincingly proves that the Technological Civilization can be understood as another axial shift, it does not provide a detailed description of any associated upcoming institutions, economy, metaphysics or cognitive structure. By applying the formal criteria for capacity shifts as detailed above, the sequence of the axial caesurae can be understood as the continuation of the same developmental principles and patterns that are determining early cultural and human evolution. Each axial caesura represents a level of hierarchical integration in which the civilizational performances of the previous caesura are abstracted, condensed into operational modules, and recursively imple-

[46] Cf. Bammé, *Homo Occidentalis*, 237.
[47] Ibid., 741-52.
[48] Ibid., 817.
[49] Cf. Gotthard Günther, "Life as Polycontexturality," in Gotthard Günther, *Beiträge zu einer operationsfähigen Dialektik*, Band 2 (Hamburg: Meiner, 1979), 283-306.
[50] Gotthard Günther, *Das Bewusstsein der Maschinen. Eine Metaphysik der Kybernetik* (Baden-Baden and Krefeld: Agis, 1963).

mented into higher order operational chains.[51] The Greek Axial Age is the "*human assemblage-integrative civilizational capacity*" in which performances form a new level of hierarchical integration, which allows differently constituted human groups to connect into operational chains. These performances are recursively implemented in the "*machine-integrative civilizational capacity*" of Modernity by a new level of hierarchical integration which connects all kinds of formal units and machines into operational chains. This is followed by another recursion in the "*process-integrative civilizational capacity*," which characterizes the Technological Civilization in which another level of hierarchical integration implements all kinds of informationally rendered systems and processes into operational chains. An extrapolation of the pattern of recursion allows for a *deep futurological* deduction of the constitution of a civilizational stage after Modernity.

7. Stages in Civilizational History as Types of Temporality Domestication

Historians and sociologists of culture have found five historical "time *Gestalts*"[52] or "time regimes"[53] that correlate to different levels of social complexity:[54] "Cyclical" and "oscillatory" time concepts characterize early centralistic cultures such as the Mesopotamian, Egyptian or Maya; an "absolute" time *Gestalt* develops in Axial Age Greece and simultaneously an "eschatological" one appears in the Axial Age monotheistic cultures, followed by the "linear-progressive" time *Gestalt* of Modernity.

Each *Gestalt* of time is characteristic of a certain mode of collective domestication of spacetime since it mediates, binds and commensurabilizes the instrumental and cooperative actions aligned in trans-temporal operational chains.[55] The *Gestalt* of time or culturally dominant time regime therefore can be understood as a fingerprint of the reproductive and genera-

[51] For a detailed elaboration, see Chapters 8.4-8.6 and 10.4 in Löffler, *Generative Realitäten*.

[52] Cf. Karen Gloy, *Zeit. Eine Morphologie* (Freiburg and München: Karl Alber, 2006).

[53] Cf. Aleida Assmann, *Zeit aus den Fugen. Aufstieg und Fall des Zeitregimes der Moderne* (München: Hanser, 2013).

[54] The following summary is based on Gloy, *Zeit*, 119-43; Rudolf Wendorff, *Zeit und Kultur. Geschichte des Zeitbewußtseins in Europa* (Opladen: Westdeutscher Verlag, 1985); Werner Bergmann, "Das Problem der Zeit in der Soziologie. Ein Literaturüberblick zum Stand der 'zeitsoziologischen' Theorie und Forschung," *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, Vol. 32 (1982), 462-504; Armin Nassehi, *Die Zeit der Gesellschaft. Auf dem Weg zu einer soziologischen Theorie der Zeit* (Opladen: Westdeutscher Verlag, 1993); Assmann, *Zeit aus den Fugen*, 131-207.

[55] An elaboration of the fundamental relation between institutional complexity, metaphysics and temporality can be found in Günter Dux, *Die Zeit in der Geschichte. Ihre Entwicklungslogik vom Mythos zur Weltzeit* (Frankfurt a.M.: Suhrkamp, 1992).

tive capacities of a culture. More precisely, it is the metaphysical expression of the capacity of each civilizational stage *to domesticate events in time*. It can be derived that with the emergence of another civilizational capacity after Modernity, which is based on a new type of technology, a new concept of time will emerge.

8. Simple Machine, Coin, Absolute Time Regime: Horizontal Coupling in the Axial Age

The principle of externalization of agency, of the emergence of a new layer of hierarchical integration and the recursion of abstracted civilizational performances are immediately displayed in the changes of performances that define the Axial Age transition in Greece. Specifically, the institutionalization of coin currency can be interpreted within the cultural evolutionary framework, allowing for a new understanding of its function. In a modification of Sohn-Rethel's notion of the coin enabling a social synthesis based on real abstraction and Simmel's concept of money as a means for other means, coin currencies can be understood as the medium for a specific extension of operational chains. It will be shown that the coin, the technological structure of the "simple machine," and the metaphysical notion of time in Greece are directly correlated. They constitute a *horizonal coupling* of agents.

Money as a notional tool "contains" the abstraction of a concrete good or service. As such, it is not only a retro-oriented memory system[56] or a recording of past debt-relations,[57] but, moreover, it enables a numerical, quality-neutral coupling of actions *extending into the future*. Stated more strongly, it opens the potential for interactions in the future. The centralized ascription of value to coins forms a virtual or open system of infinitely divisible points in which services and goods, as well as actions, are connected. This medial-numerical matrix spans over the whole Mediterranean space. It commensurabilizes and homogenizes the locally dispersed places of production and consumption by their formatting in abstract numerical symbols. Through this medial matrix, qualitatively different actions, events and processes can be coupled into higher order operational chains. This results in the potential for forming human-based assemblages to a new extent, which can furthermore be flexibly and adaptively constituted. It is characteristic of this function of the coin that it was initially spread and institutionalized in Greece to pay mercenaries.[58] The coin allowed this class of

[56] Cf. Niklas Luhmann, *Die Wirtschaft der Gesellschaft* (Frankfurt a.M.: Suhrkamp, 1994), 197.
[57] Cf. David Graeber, *Debt. The First 5000 Years* (Brooklyn, New York: Melville House, 2011).
[58] Cf. Graeber, *Debt*, 226-8; Bammé, *Homo Occidentalis*, 200-11.

agents to take part in any local market despite not producing or offering anything. The virtual matrix of exchange established by the coin enables the flexible allocation of resources and the coupling of operations and agents beyond the limits of locality.

The Ionian colonies were not only the centers of commerce from which the coin and alphabet started to spread but were also the place where philosophy emerged.[59] In contrast to historically grown myths, philosophical reasoning is a *techne*, a thought technology for the systematic search for absolute, universal truths. The assertions and interpretations of the world based on rationality and argumentation are in principle comprehensible to any individual at any place and at any time. As a typical expression of the axial metaphysical shift, philosophy draws a distinction between the concrete world with all its variant phenomena and qualities, and a homogenous world of the absolute beyond. This realm of transcendence contains the good, the true and the beautiful and overarches the concrete reality (analogous to the Kingdom of Heaven in the monotheistic axial cultures). It allows for interpretative homogeneity, the establishment of reciprocity of motives, and the commensurabilization of purposes of individuals and collectives. Philosophy, by revealing intersubjective truth, increases the potential to form operational chains significantly. But the realm of absolute truths remains a *static* realm that is always derived directly from the concrete. As in Plato's cave metaphor, the absolute in Greek philosophy is spread only as one layer of abstraction over the given.

This staticity of the transcendental is also characteristic of the abstract-but-static time concept in Greece. Early cultures display cyclical and oscillatory temporal concepts, which are constituted by regime eras or natural cycles, and are thus defined by concrete phenomena and qualities.[60] In contrast to these quality-bound time concepts an abstract, an "absolute time *Gestalt*"[61] emerges in Greece. One such abstract notion of temporality was developed by Plato in the concept of the Aeon as that which endures infinitely,[62] statically layered over the concrete, while the mythical Golden Age is similarly a static realm of the abstract beyond which it is never to be realized in the real world (again structurally analogous to the eschatological concepts of the monotheistic axial cultures). Even when Heraclitus concludes that everything flows, he throws a static conceptual layer of abstraction over the concrete since the monistic principle of everything flowing in itself does not allow for dynamicity or differentiations. The abstract temporality and

[59] Bammé, *Homo Occidentalis*, 480.

[60] Cf. Wendorff, *Zeit und Kultur*, 54-7.

[61] Cf. Gloy, *Zeit*, 131-41.

[62] Cf. ibid., 141-2.

conceptual transcendence forms a layer of *relational homogeneity*, commensurabilizing concrete phenomena, thus allowing the alignment of interpretations, motives and actions.

While the Greek proto-democratic political structures enable organizational flexibility, they remain oriented towards establishing *isonomia*,[63] the concept of equality in political rights. The Greek culture did neither develop notions of general societal change, reform, or even revolution, nor of social progress or utopia.[64] The social world remains static.

This staticity is also characteristic of the economy: profit is retained, not reinvested, slaves and not workers are still the basis of production, and production is not aimed at an inner market.[65]

The realm of transcendent truth in philosophy, the regulative idea of *isonomia*, the "real abstraction" in the coin, and the abstract absolute time concept form a layer of *formal homogeneity* that spans over the given objective and social elements of the world. Interpreted in cultural evolutionary terms, it allows for a flexible, context sensitive, and smooth coupling of subjects, production units, and collectives.

The key to understand this staticity lies in the structure of technology and the means of production. Work was based on organic power sources - that is, the muscles of animals and slaves, which Aristotle considered as "speaking tools."[66] They filled the *slots in the techno-cultural matrix* of society, which derived from a certain type of technology, the "simple machines." Simple machines comprise the "mighty five of power amplification in Antiquity"[67]: the winch, wedge, pulley, screw and lever.

Simple machines have specific functional principles:

- they have one deflection point;
- they move in unidirectional vectors;
- they are employed in "static," single moving patterns.

The spectrum of operationality thus comprises a limited set of simple functions. Reciprocal to this limit, the simple machine implies a certain ontology:

- they are mainly muscle-powered;
- they involve and unfold around qualities (organisms as energy sources, materials like wood);
- they do not imply a formal measure or abstract concept of force, work or energy.

These functional properties of simple machines result in one essential limitation that correlates to the metaphysical, political and economic structure of the Axial Age: simple

[63] Cf. Meier, *Die Entstehung*, 70-90.
[64] Cf. ibid., 486.
[65] Cf. Bammé, *Homo Occidentalis*, 216.
[66] Cf. ibid., 603; Metz, *Ursprung der Technik*, 28-31.
[67] Ibid., 31 (translation by the author).

machines do not allow for *structural, functional or conceptual innovation*. Since there is nothing to add to the functionality of the winch, wedge, pulley, screw or lever, besides some slight material improvements, they do not imply any potential for *substantial technological progress*. A cultural reality that is built upon atomistic, unchanging simple machines is a *developmentally static reality*. Improvements or quantitative enhancements are only realized by improvements of the organization of the acting agents, but not by improvements of the mechanical elements.[68] The notional performances developed in Greece, such as philosophy, rhetoric, logical arguments, alphabet and the coin, are exactly complementary to this stage of technology: they enable a flexible organization of the sources of forces that drive the simple machines.

Therefore, coin currency can be understood as a means for "*horizontal coupling*" within *a structurally unchanging technocultural state*. Profit is derived either from sheer conquering or from extracting surplus from the differences between *horizontally* related, meaning developmentally and technologically *equally constituted* places of production or markets.

While development is ideal-typically non-existent, and places of production remain in *horizontal* reciprocity in Antiquity, in Modernity technological innovations open a new dimension of relations and events: the *vertical-developmental time*, in which states, processes, agents and events are coupled by capital.

9. Compound Machine, Capital, Linear Time Regime: Vertical Coupling in Modernity

Following the introduction of the coin, various features and forms of capitalism were developed prior to Modernity and outside of Europe in China, the Arab Empire, Italian city states and Hanseatic cities.[69] While profit was retained in Antiquity, later trade capitalism already aimed at surplus production for reinvestment, although fixed capital and the possibilities for investments remained limited. The unique features of *investment* or *production capitalism* characterizing Modernity are the ownership of the means of production, the establishment of the inner market, and the production *for* the production of surplus.[70] The reason why Modernity, capitalism and the linear time regime are entangled can be derived from these features once they are correlated

[68] The innovations of Archimedes occurred after the downfall of Athens and the end of the Classical Period, in which Greece had become a protectorate of the Roman Empire and thus was "frozen" in time.

[69] Cf. Jürgen Kocka, *Geschichte des Kapitalismus* (München: C.H. Beck, 2013), 23-42.

[70] This is the minimal definition of capitalism according to the historian of economy Kocka (see Kocka, *Geschichte des Kapitalismus*, 20-1).

to the shift in the structure of technology and the means of production occurring in Europe during the Middle Ages. It can be shown that capital is a mean for the extension of operational chains into the potential future. It allows the coupling of actions across the *vertical-developmental* or *linear-evolutionary time*. Analogous to the coin, which formed a commensurabilizing matrix across the *horizontally* related, *developmentally equal* places of production, capital forms a matrix that commensurabilizes *vertically layered, consecutive grades of development*.

Neither Marx's "fall of mankind" narrative of the primitive accumulation of capital nor the bourgeois ideological counter-explanation of Schumpeter, who assigned special causal status to the efforts of exceptionally intelligent and entrepreneurial individuals,[71] fully explains the emergence of capitalism. A closer look at the history of technology reveals a somewhat different picture, which suggests a fundamentally new understanding of the economic phase of capitalism and the function of capital.

According to the historian of technology Metz, first capital investment societies were established to finance the construction of dams and weir systems in the twelfth century.[72] The primary purpose of weir systems is to provide a constant and controllable source of energy for mills which power mechanical devices of all kinds.[73] Mills and connected devices, though, are a specific type of machine: "*compound machines*," in which an array of simple machines is linked together into one functional unit. The essential feature of a compound machine is that it consists of various interlocked functional principles and mechanical parts, which are made of different materials such as metal, wood, ropes or leather. Within the machine, they are instrumentally commensurabilized by its functional purpose, which contextualizes each part in the mechanical arrangement of the assemblage. This new complexity of technology has momentous consequences.

The arrangement of simple machines in compound machines leads to the isolation (*Freistellung*) of a new regular, operationally addressable and reproducible object unknown in Antiquity: *force*. The abstract regularity or object force is isometrically effective at all places within the machine. It can be arithmetically described as a function derived from the correlated movements of the mechanically connected simple machines. Force thus emerges and is isolated (*freigestellt*) as an objective,

[71] Cf. Karl Schumpeter, *Capitalism, Socialism, and Democracy* (London and New York: Routledge, 2003), 15-16.
[72] Cf. Metz, *Ursprünge der Zukunft*, 42.
[73] To the mill as the power source various instruments were attached, such as grinding stones, hammers, spindles or saws (cf. ibid., 41-3).

regular and reproducible fact by the appearance of the compound machine.

The principle of power transmission became widespread after the "Agrarian Revolution"[74] in the Middle Ages. The invention of the yoke turned horses or oxen into an abstractified provider of force or energy within the assemblage by filling the slot between the plough and the yoke. In another step of externalization and emulation, the organic power sources of early compound machines were replaced by wind and water. The improvements of gears and the movable placement of the sails of vertical windmills allowed for a homogenization and control of force, turning inorganic forces into the main energy source. The steam engine as the universal machine, the machine that only produces power itself, represents another recursive externalization and emulation of the previously only stationary exploitable energy sources. This first stage of an abstract mobile energy provider is followed by another recursive externalization and emulation in the combustion engine and batteries.

Abstract, inorganic mobile energy providers are at the core of Modernity and its means of production. In the moment the compound machine appears, everything can be related to its mechanical functionality and rendered as a *potential provider of energy*. This is the birth of labor force and the commodification of labor: humans started to be considered as abstract providers of quantifiable energy (paid with the equivalent of costs needed to retain work power) and were being sorted into "slots" fanning out around the functionality of the machine.[75]

The compound machine has several features that differ essentially from the simple machine, proving that Modernity is yet another civilizational shift, another grade of cultural evolution in which another qualitative extension of the operational chains is realized:

- multiple deflection points internal and external to the machine;
- multidirectional vectors internal and external to the machine;
- inorganic or abstract energy sources;
- controllable and reproducible (steady, homogeneous, discrete) energy flow;
- abstract concept of force, work, energy revealed in the structure;
- abstract, discrete synchronization (clock, control devices);

[74] For the main technological innovations that led to Modernity, see Lynn T. White, *Medieval Technology and Social Change* (Oxford: Oxford University Press, 1962).

[75] The spectral differentiation of the societal slot-matrix emerging around technologies was nicely illustrated by Tainter: "Hunter-gatherer societies […] contain no more than a few dozen distinct social personalities, while modern European censuses recognize 10.000 to 20.000 unique occupational roles, and industrial societies may contain overall more than 1.000.000 different kinds of social personalities […]." Joseph A. Tainter, *The Collapse of Complex Societies* (Cambridge: Cambridge University Press, 1988), 23.

- dynamic movements and speeds;
- "movements within movements," moving parts within other moving parts;
- innovation is inherent.

Particularly the last feature marks the essential difference: since every compound machine is an arrangement of exchangeable elements, *it can constantly be improved*. This property of constant incompleteness or improvability of the technological assemblages marks the momentous difference with those of Antiquity. By improvements of the arrangement or any single part, machines can instantly reach greater efficiency in every aspect. Therefore, striving for constant innovation and technological progress is *naturally built into the compound machine*. The maintenance of the machines and the competition with machines at other places of production enforce or catalyze their constant improvement. Shortly after the spread of the compound machine, innovation itself was legally codified and commodified: patent law was invented in order to regulate the ownership of *material arrangements* or *functional syntaxes*.[76] The compound machine is thus the technological foundation and precondition for the *institutionalization of the ownership of the means of production*.

With the emergence of the compound machine, social power could extend over the ownership of *material arrangements* or *technologies* themselves, which, as a *second order power*, governs the *ways of domestication*, *colonization and ordering of space*. The owner of the means of production is the legally authorized disposer of technical arrangements, alignment programs or patterns of operational chains on which the domestication of nature is based. Different to the traditional elite, which governed space in horizontal, developmentally static time, the *investment or production capitalist is governing the virtual space of developmental time realized in new technologies* through the power to assign money as a catalyst for innovation and production projects. The capitalist class embodies the societal institutionalization of the domestication of vertical time and dynamical development. Functionally, this class is the social interface to the developmental or evolutionary temporality of technological progress. In other words, the compound machine brings forth a matrix of slots for the social role of both the capitalist and the worker.

The compound machine has two momentous metaphysical and cultural consequences which determine the history of Modernity up to today.

[76] The first legal patent was issued to two coworkers of Gutenberg in Venice in 1474. It granted them a five-year exclusive right to produce printing machines. This secured the technological advantage, i.e., the advantage in knowledge of material arrangements of Venice against other cities. Cf. Peter Kurz, *Weltgeschichte des Erfindungsschutzes. Erfinder und Patente im Spiegel der Zeiten* (München: Carl Heymanns, 2000), 41-63.

The first is that it emits a geometrical matrix out of its discretely structured and mechanically interlocked arrangement. Every machine is an actualization of mechanistic arrangements which as a Platonic potential can be concretized anywhere in space. This Platonic continuum of causal-mechanistic relations is captured in the exogrammatic technology of the construction space in Euclidian perspective painting, later formalized in the Cartesian coordinate system. It serves as an operational interface for the building of these machines as their concretization in material space.[77] The operationalization of natural laws, the quantification and the modern metaphysical notion of nature, engineering and science emerge out of this state of technological complexity. The demand for a precise description of forces and the demand for the reproduction of these forces with high precision in all kinds of machines (canons, calculations of trajectories of bullets, city walls, ships, clocks, factories) leads to a view of nature as a "grid of absolute laws"[78] (the term "natural law," again, was introduced by Descartes). Finally, with Newton's force equations, the material world is homogenized, resulting in the concept of the clockwork universe in which every action, object and event from the micro- to the macrocosm[79] is commensurabilized. The formal understanding of nature as a homogenous continuum of unchanging laws to which any action can be uplinked or interlocked significantly extends the capacity for planning, resulting in the expansion of operational chains around the globe.[80]

[77] For a detailed analysis of the relation between the compound machine, perspectival painting and the modern scientific concept of nature, see Chapter 8.5.3 in Löffler, *Generative Realitäten*.

[78] Karen Gloy, *Das Verständnis der Natur.* Band 1: *Die Geschichte des wissenschaftlichen Denkens* (München: C.H. Beck, 1995), 225 (translation by the author).

[79] At the same time Spinoza homogenizes the conceptual world by evacuating God into the level of immanence, thus cleaning it from extramundane qualities, Bach homogenizes the space of musical expression, while the early taxonomies homogenize the expressions of the *bios*. These kind of "form-relationships" or "isomorphisms of world-rendering" are displayed throughout Modernity, as the example of the epistemic isomorphisms around 1900 shows, when Hilbert's axiomatization of mathematics, Rutherford's model of the atom, phenomenological atomization of the mind in philosophy and impressionism in art and music appeared simultaneously. It can be explained by a ratchet-effect of abstraction, whereby in every field the new generation differentiates the findings of the previous one and by that cumulatively and *synchronically* increases the abstraction in various fields. This is the cultural evolutionary explanation for the sequentiality of the paradigms in Modernity and for the "multiple discoveries" in which scientific findings or inventions are brought forth independently by different agents at the same time. For the concept and a list of multiple discoveries, see William F. Ogburn and Dorothy Thomas. "Are Inventions Inevitable?," *Political Science Quarterly*, Vol. 37, No. 1 (1922), 83-98.

[80] The global coupling of operational chains started literally after the introduction of the medium "globe" in 1492 by Behaim and after the improvements of mobile clocks in the eighteenth century, which allowed longitude to be determined. Following the development of these media, a grid was projected onto the earth's surface, which enabled the optimal planning of maritime endeavors by the placing of global actions and interactions into

As nature becomes the homogenous continuum of natural laws, it is conceptualized as a storage of *potential arrangements of matter*, and therefore of technology. Each new arrangement means a new grade of development, concretized in the continuous innovations and improvements of compound machines. The formal concept of nature provides continuity between grades of development. Herein the second consequence is rooted: The notion of the universe as a continuum of ontologically commensurabilized grades of improvement results in the *linear concept of time as the continuum of potential change*.

The linear or vertical time not only adheres to technological but also to social change, as simultaneously emerging utopian visions prove. In contrast to the Axial Age Greece, in Modernity, beyond the machine, any formally constituted unit consisting of exchangeable parts like societies is understood as improvable and reformable. Progress, therefore, is a principle that underlies both the compound machine and the post-traditional, formal-legally constituted societies of Modernity. It stands for the discovered possibility for *rearrangements of aligned action units*, be they institutional or technical. The cultural evolutionary new continuum of domestication, emerging from the potential of flexible rearrangements of formally defined objects, entities and operational chains, is the root of the linear time regime.

Therefore, it can be concluded that the inner market is the expression of the potential to gain profits not from horizontal differences, as in Antiquity, but from *vertical differences*, meaning from the *differences between technocultural grades of development consecutively concretized within the same space*. These grades of development are connected by capital. It allows the canalization of labor or energy needed for production and innovation, while simultaneously it also serves as a medium or interface for the potential future advantages of new technologies, numerically expressed in the profit margin. Thus, capital is the medium for establishing potential future differences between technocultural states mediated by the inner market. As such, capital is a medium between present and potential future technocultural states, as it contains potential time in the form of the *potential to realize new relations*.[81] Capital as a recursion of the

mathematical coherence. The grid projection was completed around 1900 when the need for synchronization of the timetables of train companies, where initially every company had its own time, enforced to develop a globally unified time system.

[81] This cultural evolutionary explanation allows for a better understanding of the notion of "differential accumulation" brought forward by Nitzan and Bichler, see Jonathan Nitzan and Shimshon Bichler, *Capital as Power. A Study of Order and Creorder* (London and New York: Routledge, 2009). The differential accumulation does not only concretize in the realm of pure prices but is based on the potentiality (or expectation) to extract differences in efficiency by investing into a

function of the coin, as second order money, or as the quantification of the abstraction of money, allows for a coupling of actions across virtual spaces or states in vertical developmental time.

Modernity thus fulfills the criteria for a new civilizational capacity. Capital is the recursion and hierarchical integration of the functions of coin currency, while the compound machine extends the operational chains by a new dimension. These changes are accompanied by the emergence of a new temporal ontology. To determine whether the instantiation of a post-capitalist economy is currently possible, or if it is even already emerging, the cultural evolutionary pattern of recursion and the principle of the qualitative extension of operational chains need to be identified in the current changes of the structure of technology. Simultaneously, a time *Gestalt* can be derived from this, which might recursively grow out of linearity.

10. Information Machine, Active Informationalism and the Generative Time Regime

The linear time regime is a social convention whose validity (or at least applicability) was revealed in the technological structure of the compound machine and was further consolidated by its metaphysical and social consequences. Linearity is entangled with the concept of the universe governed by unchanging natural laws as the continuum in which change and progress can occur. The convention of linearity stands for the homogenization of events and relations in spacetime through causality, allowing the commensurabilization of events and actions across time and space. In this stage of civilizational history capital emerges as a matrix made of interface points that link different grades of technological advancement. Capital contains the potential of *potential production* and as such it is the primary means and medium for the expansion of operational chains into vertical time constituted by grades of development. According to the formal criteria for discrete stages of cultural and civilizational capacities, another complexification of the technological structure and the establishment of a higher level of recursive hierarchical integration demands that a new structure of temporality and economy must again emerge. The Technological Civilization

local process of progress. It is not only societal or institutional power as control over people (ibid., 269-73), but the power over potential production, therefore it is a *second order power* conveyed by the power to catalyze technologies that have better features than the existing technologies. It is the power over the potential to generate the *conditions* in which power relations can concretize.

marks such a civilizational shift. At its core, it displays another qualitative extension of operational chains by the recursive hierarchical integration of the previous technological structure.

In Modernity, simple machines were integrated into the arrangements of compound machines, coupled through an immediate mechanical "communication" between the parts. From a cultural evolutionary viewpoint, the Technological Civilization starts with the utilization of electricity[82] which allows for an *immediate communication between compound machines and their coupling into synchronized units*. The need to couple compound machines has at least two roots. Firstly, the speeds, forces and required precision in machines start to exceed human processing or mechanical control capacities. Secondly, new problems of the connection of machines and the communication between them arise which cannot be solved mechanistically. It is exactly within this machinical generative milieu that the category of information emerges.

Formally introduced in 1928 by Hartley in "Transmission of Information"[83] as signal processing between two equally structured receivers, information became a concept diffusing into every field of science after the "multiple discovery" in the independently developed works of Claude Shannon[84] and Norbert Wiener[85] in 1948. Information was formalized as quantification of the decoding probability of differences in a data stream and as the extraction of order out of noise by a system. It is essential to note that the formalization of communication resulting in the category of information was a necessary occurrence within the technological milieu, which had to solve the problem of how to couple or autonomously steer compound machines.[86]

The coupling of machines comprises three levels of regularities: the regularities in the machines or in the states of the machine, the control unit which abstractly maps the states of a machine or a selection of states of a ma-

[82] For Bammé's historical materialist definition, see infra, Section 6, 21-25 in this article.

[83] R.V.L. Hartley, "Transmission of Information," *Bell Systems Technical Journal*, Vol. 7 (1928), 535-63.

[84] Warren Weaver and Claude Elwood Shannon, *A Mathematical Theory of Communication* (Urbana-Champaign, Illinois: University of Illinois Press, 1948).

[85] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Cambridge, Massachusetts and Paris: The MIT Press and Herman and Cie, 1948).

[86] The Bit is not a universal unit but a technical necessity since it is more feasible to use on-/off-switches as the basis of automated computation than memory storages which can take up multiple states. In principle, any non-binary numerical system could serve as a computational framework. Therefore, the basic principles of the computer and information theory were "invented" simultaneously by several engineers and mathematicians independently in the United States, Great Britain, Germany and the Soviet Union during the technological progress enforced by the existential stress in WWI and WWII, accelerated then in the Cold War.

chine, and the regularities that emerge from the connection of the control units, which are a second order abstraction of the regularities and events within the machine. Information is the unit which allows for a rendering of abstractions of abstractions. Informational rendering is an abstraction or second order rendering of an already mechanically-geometrically rendered machinic perception of the world. It unfolds a matrix that integrates various locally and contextually constituted matrices emitted by each single machine. The new regularities or "epistemic objects"[87] that grow out of the coupling of compound machines are already filtered through a machinic detection system or in general through technical or mathematically formal devices. The granularity of informational rendering is therefore an iterative increase of the rendering of Euclidian geometry covering the relations between the objects pre-rendered by machines.[88] As such, it can map all kinds of systems, relations and functions. The logical next step is the development of cybernetics as the science of autonomous control of informatically constituted systems. Ross Ashby put it this way: "Cybernetics […] is a 'theory of machines,' but it treats not things but ways of *behaving*. It does not ask 'what is this thing?' but, *what does it do*."[89] In this process, substantiality and qualities are de-ontologized, the boundary between subject and object erodes and realities are reframed as discretely describable relations of systems. With the emergence of information everything turns into relational processes.[90]

The second half of the twentieth century can be characterized as the phase of *passive informationalism*, in which the basic functioning principles of systems were revealed. Everything discernable as a system can be commensurabilized informatically by applying the concepts of the feedback loop, homeostasis and

[87] Hans-Jörg Rheinberger, "Experimentalsysteme, Epistemische Dinge, Experimentalkulturen. Zu einer Epistemologie des Experiments," *Deutsche Zeitschrift für Philosophie*, Vol. 42, No. 3 (1994), 405-18.

[88] Therefore, it would be a category mistake to conceptualize cybernetic and algorithmic rendering as a consequence of capitalization. Declaring a phenomenon that emerged in a co-evolutionary process to be the primordial cause of this process is simply ideology and, as such, it prevents the addressing of the actual underlying processes. It is even historically wrong, since cybernetics simultaneously and independently appeared in all cultures that were disposed to computers, as, for example, in the Soviet Union, where, in the 1960s, the implementation of cybernetics and early forms of the internet into economic management was prevented, paradoxically, by socialist apparatchiks themselves.

[89] William Ross Ashby, *An Introduction to Cybernetics* (London: Chapman and Hall, 1957), 1.

[90] In this sense, feminism was the expression of the shift from agrarian societies with their characteristically gender-based work division to industrial societies (in the machine's eye all bodies are equal), while the current calls for the acceptance of trans-, non-, para, xeno- or neo-genders are a symptom of the shift to the information society (in the information machine's eye all bodies are virtual, modifiable, reprogrammable information processes).

self-organization. In this phase systems are rendered but not yet operationalized. As ontology and epistemology are fused in the notion of the self-referential construction of the world by a code-driven system, the result is a processual worldview with the hallmarks of contingency and relativism among the systems related in "flat ontologies."[91]

With the beginning of the new century, *active informationalism* emerges. Once the generative conditions and processes of system formation are revealed it becomes possible to influence their genesis. Since every system is unfolding a self-referential world by its specific selection and synthesis of environmental data, to influence the becoming of a system means to generate worlds. This is currently occurring in nearly every field: from self-optimization by *datafication* of the self, to biogenetics, preemptive politics[92] and nudging,[93] predictive policing, automated speculative markets and derivative trading as bets on potential developments,[94] to generative design as the automation of creativity by algorithms. *Active informationalism* marks the beginning of the domestication of "genetic spaces."[95] Processes of becoming themselves are integrated into operational chains.

Exactly here the seeds of a post-linear temporal ontology can be found. The homogenous continuum of the unilinear time *Gestalt* is dispersed into multiple realizable lines of development: the informational rendering of systems allows for an extrapolation of their developments and the conception of various scenarios of their future being. This results in the constitution of a spectrum of possible futures that depend on the factors in the initial con-

[91] The same principle of rendering by code and its ontological consequences and aporias constituted the postmodern thought in the second half of the twentieth century, starting with structuralism, constructivism, poststructuralism, deconstructivism, system theory to actor-network theory or agential realism, from Gilles Deleuze and Jacques Derrida up to the early Nick Land and Bruno Latour.

[92] Brian Massumi, "Potential Politics and the Primacy of Preemption," *Theory and Event*, Vol. 10, No. 2 (2007), DOI:10.1353/tae.2007.0066.

[93] Karen Yeung, "Hypernudge: Big Data as a Mode of Regulation by Design," *Information, Communication and Society*, Vol. 20, No. 1 (2017), 118-36; Richard H. Thaler and Cass R. Sunstein, *Nudge: Improving Decisions about Health, Wealth and Happiness* (New Haven: Yale University Press, 2008).

[94] Derivatives are the commodification or objectification of the traditional idea of concrete processes of growth. As such, the linear time frame is abstracted and recursively implemented into the myriads of single derivatives, which make potential becoming tradeable. For a general description of the involved temporality, see Elena Esposito, *The Future of Futures. The Time of Money in Financing and Society* (Cheltenham: Edward Elgar, 2011); Suhail Malik, "The Ontology of Finance," *Collapse: Philosophical Research and Development*, Vol. VIII (2014), 629-813. For a summary of Malik with discussion, see Ray Brassier et al., "Pricing Time: Outline and Discussion on Suhail Malik's 'The Ontology of Finance,'" *Identities: Journal for Politics, Gender and Culture*, Vol. 14, No. 1 (2017), 84-122.

[95] Karl S. Chu, "Genetic Space: Hourglass of the Demiurge," *Architectural Design*, Vol. 68, No. 11-12 (1998), 68-73.

ditions and their weighting. For example, the projected scenarios of a 2°, 3° or 6° increase of global warming show entirely different future worlds. These scenarios or process continua are not virtual, but objective; they are the recursive abstraction of the linear continuum condensed in single modules as processes of becoming, which can be coupled and exchanged like objects, as the emissions trading proves. Their objectivity is constituted by how much value we are willing to assign to the worlds we want to produce. This is the same principle at work in monetization of the future in derivatives markets. With the possibility to project scenarios informatically, the present takes up a state of uncertainty like Schrödinger's cat because the constitution of the present is substantialized only in relation to its virtual *future anterior* provided by projected potential futures. In *active informationalism* every moment in time is retroactively substantialized as the initial condition for a spectrum of potential realities.

As informationalism allows to commensurabilize systems, now the processes of becoming themselves are being modularized and coupled into operational chains. This level of higher integration brings forth a temporality that integrates all previous temporalities. It can be called *scenario temporality* or *generative time regime*. In the generative temporality the ubiquitously emerging spots of miniaturized, local developmental processes, or "cones of realization,"[96] are put into coherence and arranged in operational chains.

The coupling of the control units of compound machines leads to the formation of a new level of hierarchical integration of events, objects and regularities, which grounds the rendering of the world through the category of information. This leads to a reality granulated by projected developments and scenarios on every scale. In this stage of cultural evolution generativity itself is operationalized. The generative time regime emerges in co-evolution. It unfolds orthogonally to the vertical time of developmental linearity through the information-based isolation (*Freistellung*) of its genetic processes. Herein domestication reaches into a new dimension: the processes of becoming themselves are operationally "ready-at-hand."[97] This realm of regularities accessed by information will necessarily bring forth a new structure of economy as a new mode of re-stabilization of the collective niche exploiting generative processes. After the coin coupled spaces in horizontal time, and capital coupled

[96] See Chapter 8.2.3. for the concept of the "cone of realization" in historical processes, Chapter 8.6.2 for a definition and Chapter 8.6.3 for currently observable examples in Löffler, *Generative Realitäten*.
[97] Martin Heidegger, *Being and Time*, trans. by John Macquarrie and Edward Robinson (London: Blackwell Publishing, 2000), 140-1.

spaces in vertical time, another recursion will lead to an economy that couples spaces in potential, fractal-genetic, or generative time.[98]

11. Distributing Potentiality: Economies of Access as Fractal-Genetic Coupling in the Technological Civilization

"Nothing is ever lost,"[99] the historian of religion Robert Bellah stated. Just as we still practice potlach at birthday parties, we are still using hammers or coins (or the principles thereof). Currencies are emerging in the generative milieu of work-dividing societies as a means for trans-spatial and trans-temporal coupling of interactions. Next to the exogrammatic memory system of writing, they are an actualized Platonic form that enables the increase of social complexity and re-stabilizes the extents of the collective domestication of spacetime. The principle cannot cease to exist.[100] But its form can change.

The essential function of economy is to enable flexible coupling. By providing a medial matrix of abstract placeholders for distributable and exchangeable objects, it enables to establish homeostatic states in the individual which are constituted by the access to goods and services brought forth by collective work. The primary function of economy therefore lies in establishing and enabling balanced states, not in the increase of the number of potential homeostatic states in a single individual (as in the notion of profit production for the increase of personal wealth[101]). The function of mediating and balancing states can be realized by different medial structures.

Since the homeostatic states of the individuals are entangled with the structure of

[98] It can be concluded that the transformation of the Weltanschauung during the Axial Age - Christianity, Judaism, Buddhism, Confucianism, Hinduism and Rationalism in Greece - is the expression of the emergence of a new layer of integration, in which the individual mental figuration was modulated as an adaption to the new depths of abstraction and temporality caused by the increase of operational chains through coin usage. Therefore, Reformation in Modernity can as well be understood as a reconfiguration of the psyche reciprocal to the emergence of anonymous social relatedness in the rise of the market, the city, contract- and print media-based states, the machine environment and capitalism. It remains to be seen if another Buddha, Jesus or Luther will appear in the Technological Civilization, unless the spiritual and academic gurus of the avant-garde of every generation, which, due to the speed of progress, is always the manifestation of a new technocultural collective in need for new offerings of metaphysical integration, did not already take up this function.

[99] Robert N. Bellah, *Religion in Human Evolution. From the Paleolithic to the Axial Age* (Cambridge and London: Harvard University Press, 2011), 13.

[100] It could seize to exist if the memory capacity of the human brain or the range of perception and communication could be increased. Until then, the prosthesis of exogrammatic media remains the central relay for the synchronization of cooperation and coupling of agents.

[101] Being wealthy means being able to potentially realize more homeostatic states, i.e., to actualize, widen or differentiate the attractor landscape within the organism. The spectrum of homeostatic states or the attractor landscape that can be concretized by wealth though, unfortunately, does not necessarily also cover all states that feel like happiness, which is why even the richest people can be unhappy sometimes.

distribution of goods and services, the realization of individual homeostatic states will in the future increasingly be dependent on *global* homeostasis: climate change, environmental destruction and problems of global distribution and exploitation force the inclusion of new parameters into the formation of prices that mediate and filter access to commodities. The market, grown as an institution in the eighteenth century, cannot map or reduce the emerging complexities and problems of the hyper-connected "world-society" because the capacities of this prosthetic apparatus to balance the distribution of resources are limited to the translation and mediation of information and decisions made by single subjects based on individual motives and needs in their local contexts. The replacement of a market economy, which mediates individual decisions as the central relay of economy, is inevitable when considering the global consequences of its unregulated processing.

Besides the external pressures for a reform, the market, as well as the capitalist class structure, is also undermined by internal developments. Automation erodes the logic of work-based wages,[102] which de-functionalizes the class distinction in capitalism as the division between workers and owners of means production. Algorithmization erodes the legally institutionalized ownership of technological arrangements in patent law, since neither algorithms, after their multiple iterations and mutations, nor the products they create can be ascribed to an owner. In the Technological Civilization the economic institutions and classes of Modernity become functionally outdated and will inevitably lose their legitimacy.[103]

Although humanity in the twenty-first century is caught in a path dependency which seems to make a system transition impossible, exactly the technologies developed during the fierce competition in late capitalism are the seeds of such a transition. Information technology permits the inclusion of new parameters into exchange and pricing systems, shifting them away from the orientation and governing by surplus production towards the more efficient and sustainable *distribution of potentiality* in *economies of access*.

The coin re-stabilized the domestication of spaces in horizontal time. Recursively built upon the coin, capital re-stabilized the domestication of space in vertical time. After

[102] For a broad analysis of this problem, see for example Paul Mason, *PostCapitalism: A Guide to Our Future*, (London: Allen Lane, 2015).

[103] From a cultural evolutionary perspective, the modern class structure and institutionalized form of ownership will necessarily be disrupted by the technologies of the new civilizational stage, though a systemic re-stabilization in new institutions and formations of subjectivity can only occur after their ubiquitization. For a detailed analysis and discussion of this processes, see Chapters 8.2.4 and 10.4.3 in Löffler, *Generative Realitäten.*

capital, which contained the function of the coin as an abstraction in itself, a new medium will now emerge that contains the function of capital as an abstraction. With the informational rendering of the world into processes, ubiquitous and scale-transgressing projections of scenarios emerge, which, assigned with value, influence the constitution of the present. The continuum of exchangeable goods comprises dematerialized objects that cannot be ascribed to human or physical bodies but only exist as a *potentiality of world-formation*, or as the potential for the establishment of subject-object relations within autonomous or entangled systems that form objects and relations among themselves. In this world of processes exchange does not revolve around consumable objects but around *points of access to potentialities*. The economic medium will couple *processes of becoming in fractal-genetic time*.

In derivatives and futures, this principle of *potentiality distribution* is already concretized. They are bets on developmental schemes that are an *abstraction of classical growth processes* constitutional of investment or industry capitalism. The domestication of vertical time becomes virtualized and localized as the objectification of the abstract potential for fractalized growth processes (the dispersion of the homogenous linear time continuum into a foam of fractal-genetic process times). This establishes a matrix of access points to a spectrum of *potential future states and developments*. By this numerical assignment, the virtual potential for growth and innovation can be valued (*inwertgesetzt*) and exchanged even without having been concretized. The function of the market to establish equivalence relations between subjects is, therefore, already eroded since *potentiality* cannot be put into an equivalence relation with anything already existing.[104] The question that arises is how the *distribution of access to potentiality* can be implemented, institutionally or technologically, for large scale use.

The emerging post-capitalist economic system can be anticipated. It will highly dynamically, flexibly and adaptively implement extra-economic factors into the exchange processes by a mix of universal basic income, citizen score systems, decentralized blockchain infrastructures, and the management technologies developed in platform capitalism. This will be realized by the inversion of the principle of the latter: after companies have adopted technologies that originally were developed for the public, the public will re-adopt and re-socialize the management technologies enhanced in the competition between the companies exploiting the niches in virtual space. Naturally, this

[104] For a detailed analysis and the consequences of the erosion of equivalence-based reciprocity for institutions, metaphysics and cognition, see Bammé, Homo Occidentalis, 686-817.

will lead to another increase of the resolution of control in control societies. The difference is only that it would be a constitutionally, publicly or interactively governed control, which allows the implementation of factors that the processual, functional and motivational structures of private, profit-oriented controlling entities cannot map. This paradigm can be termed "*institutional accelerationism.*"[105]

The consequence is the formation of a (non-)society constituted by fine-grained "leagues of usufruct,"[106] formed by a dynamical algorithmically established matrix of access slots in which the unlocking of access to goods and services is organized. This would not result in a new planned economy, but rather in a passive and invisible algorithmically controlled and as such constantly adaptable structure of distribution and connection. As an interface between all forms of agentive systems (even the earth's biosphere) it correlates,[107] communicates and distributes potentiality in a constantly open recursive link to current extra-economic factors as the conditions of future homeostatic states and potentiality. As an operational interface it links the present with individual, local and global scenarios of potential futures, constantly updating the leeway and guiding constraints of action and decision.

Currently this structure of economy can only be sketched out in broad strokes, since it will appear as an emergent layer *growing out of the abstractions of the currently developed technologies* (the impossibility to conceive it in detail is analogous to the impossibility for a human of the Axial Age to conceive of capital, natural laws, constitutions or progress).[108] From a cultural evolutionary perspective, this is an inevitable development. It is calling for preparation instead of dwelling in dogmas developed in reaction to historically outdated technocultural states, means of production, media, social institutions and figurations of subjectivity. The *deep futurological* perspective,

[105] Cf. Davor Löffler, "Einbruch in die Technosphäre. Skizze eines postanthropischen Technikbegriffs zur weiteren Erkundung der Möglichkeit technogener Nähe," in *"Menschen" formen Menschenformen. Zum technologischen Umbau der conditio humana*, ed. by Bernd Ternes (Berlin: sine causa, 2009), 197-291, 284-7.

[106] Hans Peter Weber, "Wie spät ist es?," in *menschenformen*, ed. by menschenformen (Marburg: Tectum, 2000), 10-59, 23 (translation by the author).

[107] Therefore, the main frontier of societal progress currently lies in the conceptualization and implementation of "matching algorithms" which will connect agents in para- or meta-monetary ways. Cf. Ralph Heidenreich and Stefan Heidenreich, Forderungen (Berlin: Merve, 2014), 115-36.

[108] Civilizational history will continue mainly determined by developments in China, since it has to solve problems on scales that by far exceed those facing the West, leading to the development of complementary technologies. Furthermore, in contrast to western Modernity, Asian cultures are not stuck in the metaphysics of individualism, in which the concept of the individual makes for the relays, center and catalyzer of social institutions. This directly results in a greater leeway for the implementation of technology-based systems for social organization.

seen from a *future anterior* established by the extrapolation of cultural and social evolution, calls us to start the leap in civilizational time before a catastrophe, the typical cause of system transitions, forces us to instantiate it. But, as Hölderlin found, “where the danger is, also grows the saving power.” We all are already working on it; we just have to become aware that we are.