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Research article

The Affinity between Feedback Mechanism and Hermeneutical Circle

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Abstract

Hermeneutics traditionally revolves around human experiences and sense-making, often considered distinct from the scientific and technological realms of non-human experimentation and tool-making. This contrast between the humane and the artifactual or the natural, associated with understanding and interpretation on the side of the former and control and experimentation on the other, creates what might be termed a Diltheyan wound. This paper aims to find a remedy for this wound by revealing the affinity between two pivotal concepts in engineering and the humanities: the feedback mechanism and the hermeneutical circle. Investigating their relationship at historical and conceptual levels, we find that both concepts trace back to ancient times but they both flourish in early 19th-century modern Europe. While historical synchronicity doesn't inherently imply direct influence or constitutive interaction, conceptual analysis unveils their shared abstract theme of "circular causality," making them affinitive to each other. Both incorporate errors and misunderstandings within closed loops of cause-and-effect relationships, seeking equilibrium in an open-ended process. Despite their stability, they dynamically adapt to new conditions, accommodating multi-stable configurations. With these historical and conceptual similarities in mind, the question of priority arises: did the feedback mechanism precede the hermeneutical circle, or vice versa? Can we make a meaningful argument for their historical or cognitive precedence over each other? At the very least, an "elective affinity" is discernible – a term borrowed from Weber's seminal exploration of the relationship between Protestantism and Capitalism. We can substitute this chemical metaphor with a cybernetic one, envisioning both concepts entangled in a "closed sequence of cause-and-effect relationships."

Keywords: Feedback mechanism; Hermeneutical circle; Circular causality; Cybernetics; Governor

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Научная статья

Связь между механизмом обратной связи и герменевтическим кругом

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Аннотация
Герменевтика традиционно вращается вокруг человеческого опыта и осмысления, которые часто считаются отличными от научной и технологической сферы экспериментов и изготовления инструментов. Этот контраст между человеческим и искусственным или естественным, связанный с пониманием и интерпретацией с одной стороны и контролем и экспериментированием с другой, создает то, что можно было бы назвать разрывом Дильтея. Целью данной статьи является нахождение средства преодоления этого разрыва с помощью раскрытия родства между двумя ключевыми концепциями в инженерии и гуманитарных науках: механизмом обратной связи и герменевтическим кругом. Исследуя их взаимосвязь на историческом и концептуальном уровнях, мы обнаруживаем, что обе концепции восходят к древним временам, но обе они процветают в современной Европе начала XIX века. Хотя историческая синхронность по своей сути не подразумевает прямого влияния или конститутивного взаимодействия, концептуальный анализ раскрывает их общую абстрактную тему “круговой причинности”, делая их родственными друг другу. Оба включают ошибки и недопонимания в замкнутые петли причинно-следственных связей, стремясь к равновесию в открытом процессе. Несмотря на свою стабильность, они динамично адаптируются к новым условиям, приспосабливаясь к мультистабильным конфигурациям. Учитывая эти исторические и концептуальные сходства, возникает вопрос о приоритете: предшествовал ли механизм обратной связи герменевтическому кругу или наоборот? Можем ли мы привести значимые аргументы в пользу их исторического или когнитивного превосходства друг над другом? По крайней мере, различима “избирательное сродство” – термин, заимствованный из плодотворного исследования Вебером отношений между протестантизмом и капитализмом. Мы можем заменить эту химическую метафору кибернетической, представляя обе концепции запутанными в “замкнутой последовательности причинно-следственных связей”.

Ключевые слова: Механизм обратной связи; Герменевтический круг; Круговая причинность; Кибернетика; Регулятор

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INTRODUCTION

The essence of humanity lies in the quest for meaning, a pursuit that takes various forms. As humans, we achieve understanding through *interpretation* – whether it be comprehending texts, attributing intentions to ourselves and others when interacting with fellow humans, or assigning meaning to the world and its objects, which inherently lack intrinsic significance. This process of sense-making distinguishes the humane from both the natural and the artificial, giving rise to the Diltheyan dichotomy of understanding (*Verstehen*) and explanation (*Erklären*), separating human sciences from natural sciences, as elucidated by Ihde (2010) in what he terms the "Diltheyan divide." This division echoes the Cartesian dichotomy of mind and body, where they are conceived so distant from each other that their very interaction turns into a formidable problem, termed by Deacon (2011) as the "Cartesian wound." Inspired by Ihde's and Deacon's terminology, we might diagnose a "Diltheyan wound" and pose the question: how can human sciences and natural sciences interact peacefully? Is there any actual interaction between them? My affirmative response focuses on exploring their commonalities. In the realm of natural and engineering sciences, we encounter the concept of "feedback mechanism," while in the humanities, the concept of the "hermeneutical circle" prevails. Through historical and conceptual analysis, we can reveal a shared theme: both concepts grapple with the intricate interdependence of entities that serve as both causes and effects *simultaneously*.

In presenting my argument, I begin by providing an exposition of the concept of the feedback mechanism and its historical development. Subsequently, I articulate the notion of the hermeneutical circle and trace its historical evolution. Through a comparative analysis of their histories, I highlight their simultaneous flourishing during the early 19th century. In the conceptual comparison, I contend that circular causality serves as the overarching abstraction, acting as a unifying theme, or *tertium comparationis*, for both. I conclude by posing a pivotal question: within their relationship, which one takes precedence? Is there a meaningful basis for prioritizing one over the other, be it through historical precedence or cognitive significance?

FEEDBACK MECHANISMS: CONCEPT AND HISTORY

Feedback mechanisms have a long history, yet the conceptual framework is relatively recent. Currently, it has seamlessly integrated into our everyday language, functioning as a loanword across numerous languages. The commonplace act of seeking "feedback" and offering it to others might seem trivial, but it has not been always so natural. This technical term has originated from within the field of engineering. Wiener, a key figure in popularizing the term, defines feedback as "a method of controlling a system by reinserting into it the results of its past performance" (Wiener, 1959/1990, p. 61). The feedback mechanism harnesses a loop between input and output to steer or regulate a system. The design need not be intricate. As Wiener notes, "Feedback may be as simple as that of the common reflex, or it may be a higher order feedback, in which past experience is used not only to regulate specific movements but also whole policies of behavior" (p. 33). While circularity is fundamental, not all circular processes qualify as feedback in the technical meaning. Feedback mechanisms are inherently goal-oriented

and serve the purpose of controlling a system. A classic illustration is the thermostat, which controls the temperature of a room.

For humanists, the concept of control is a red flag and may raise concerns, potentially highlighting a strained relationship and reopening what I referred to as the Diltheyan wound. However, in the context of the feedback mechanism, the notion of control does not and should not carry negative connotations. Feedback mechanisms are goal-oriented, but these goals are interpreted by humans and are susceptible to change.

Whether in the form of tangible artifacts or conceptual models, simple or complex, feedback mechanisms can serve as valuable tools for modeling, studying, or constructing systems, ranging from living organisms and human societies to brains, minds, and robots. The systematic exploration and application of them reached its pinnacle in the 20th century under the terms of Control Engineering and "Cybernetics" – coined by Wiener[1] to mean the art of navigation toward a goal or the art of taking control

> We have decided to call the entire field of control and communication theory, whether in the machine or in the animal, by the name *Cybernetics*, which we form from the Greek *χυβερνήτης* or *steersman*. In choosing this term, we wish to recognize that the first significant paper on feedback mechanisms is an article on governors, which was published by Clerk Maxwell in 1868, and that *governor* is derived from a Latin corruption of *χυβερνήτης*. We also wish to refer to the fact that the steering engines of a ship are indeed one of the earliest and best-developed forms of feedback mechanisms." (Wiener, 1948/2019, p. 23)

Cybernetic ideas have notably affected various scientific and technological fields – such as engineering, physiology, psychology, artificial intelligence, and alike – their influence also extends into the realm of humans – most notably the postmodern and countercultural movements. Nevertheless, like many profound concepts, the roots of cybernetic ideas trace back to ancient times.

The task of identifying and individuating historical instances of feedback mechanisms from the past is a serious challenge. This challenge is common in historical research due to the discrepancies in conceptual repertoire across different ages. To avoid anachronistic errors, a viable approach involves narrating a developmental story that reconstructs the past in light of the present, pinpointing pivotal moments of inception. While microbes existed in the world, it was Pasteur who elevated them to human awareness, establishing them as indispensable actors in our modern world. Evolutionary concepts predated Darwin, yet it was he who wove together a network of people, evidence, analogies, and narratives to articulate a compelling theory of evolution. Similarly, although feedback loops were inherent in various natural and artificial processes, their acknowledgment in the consciousness of humans only materialized in the

[1] This is not a totally new term, not at least in French. As Latil (1957) writes, "Strange as it may seem, this word appears in the Littre dictionary: Cybernetics–Name given by Ampere to the branch of politics which is concerned with the means of government." (p. 15) Even Ampere did not coin the term in 1834. He borrowed it from Greek: "The word is even employed as a substantive, with the meaning "science of piloting", by Plato, who puts it in the mouth of Socrates: "Cybernetics saves souls, bodies and material possessions from the gravest dangers (*Gorgias*, 511)" (p. 16).

19th century – a developmental story that I would tell according to Mayr (1970) which remains almost unique in narrating the origins of feedback mechanisms.

In his unique exploration, Mayr outlines criteria for identification of feedback. Firstly, there must exist a command signal and a controlled variable. Secondly, there should be a closed-loop relationship between command and control with negative feedback. Thirdly, it should be possible to identify a sensor for detecting the controlled variable and a comparator for gauging the actual controlled variable against the desired value, and at least one of these two elements should be physically distinct. Applying these criteria, Mayr identifies three ancestral lines in the evolution of feedback: the water clock from the Hellenic period, the 17th-century thermostat in Europe, and the mechanisms of controlling windmills up to the end of 18th century.

According to Mayr, the water clock stands out as the oldest device embodying a feedback mechanism, with a history dating back to ancient times. A notable example is attributed to Ktesibios[2] in third-century BC Greece.[3] At the core of this water clock lies a float valve designed to regulate water flow. In this setup, a cone floats on the water's surface within a small vessel. Water enters from above and exits the vessel through a hole in the wall. The floating cone serves as a sensor,[4] reacting to the water level. If the level is too high, it rises to close the inflow; if too low, it descends to open it. The inflow of water both causes variations in the water level and is influenced by that very level, creating a closed sequence of cause-and-effect. Maintaining a constant water level results in a steady outflow, making it an effective time-measuring device. Beyond timekeeping, feedback mechanisms embedded in water clocks can serve various other purposes, like empowering automata.

Another notable gadget is an oil lamp credited to Philon of Byzantium, an inventor from a generation following Ktesibios. Unlike the water clock, Philon's oil lamp operates based on hydraulic principles, but without a floating element. Instead, it incorporates the dynamics of air pressure and vacuum. This ingenious mechanism has found application throughout history, with inventors such as Heron of Alexandria (first century AD), Banu Musa brothers (9th century), da Vinci (15th century), Leurechon (16th century), and, more recently, in modern agriculture, specifically in drinking troughs for animals (See Mayr, 1970, p. 18).

The final feedback mechanism from the Hellenic period highlighted by Mayr is a wine-dispenser crafted by Heron, an inventor from Alexandria renowned for his treatise named *Pneumatica*. Resembling the float valve of Ketebsios, Heron's device introduces an innovation: "the complete separation of the functions of sensing (float) and that of control action (valve); through this the system has become formally a feedback system in the modern sense" (Mayr, 1970, p. 21). This mechanism has a counterpart in today's toilet flush tanks.

Mayr examines similar feedback mechanisms in the Islamic golden age, notably those described by Banu-musa brothers (9th century), Al-Jazari (12th century), and Al-

[2] His name is also written as Ctesibius.

[3] A great reconstruction of this clock can be visited in the Deutsches Museum in Munich.

[4] Mayr says the bottom of the cone is the sensor and the top of it is the actuator. This distinction is made to meet his criteria for defining a feedback system. I will return to this point.

Khurasani (13th century). Some well-known examples include the tower clock in Gaza, which had vestigial features from the Hellenic period. According to Mayr, despite minor adjustments, these mechanisms in the Islamic world bear no substantial difference from those of the Hellenic era. It was in Europe that new mechanical feedback mechanisms truly thrived.

Mayr (1970) asserts, "The first feedback system to be invented in modern Europe and independently of ancient models is the temperature regulator of Cornelis Drebbel (1572-1633) of Alkmaar, Holland" (p. 55). Drebbel, according to Mayr, comprehended the fundamental principles of feedback and applied them practically. Mayr goes on to claim that, "According to all available evidence Drebbel must be regarded as the inventor of temperature regulation and hence as the inventor of the first feedback mechanism of the West" (p. 55). Drebbel's invention was well-known in 17th century Europe, acknowledged by figures like Boyle and Hooker, and documented in the transactions of the Royal Society. Drebbel's mechanism aligns with Mayr's threefold criteria, as it senses temperature by gauging the pressure of smoke and heat produced by the furnace's fire. It has a recognizable path for negative feedback, utilizing levers to regulate the fuel valve and maintain the desired temperature. This innovative configuration could be applied to control chemical reactions or facilitate chicken hatching. Remaur (17th century), a French physicist who contributed to the development of thermostat, describes Drebbel's mechanism as "making use of these degrees of heat against themselves, so as to cause them to destroy themselves" (as cited in Mayr, 1970, p. 68).

Mayr identifies the third and final ancestral line of feedback in the mechanisms developed for controlling windmills during the 17th and 18th centuries. Windmills presented the challenge of controlling various variables such as the rate of grain input, the speed of the grinders, the distance between grinder stones, the orientation of the mill toward the wind, and the force of the wind on the sails. In response, different mechanisms were devised in Europe to regulate these interconnected variables. Notably, there emerged a speed regulation mechanism anticipating Watt's governor. Mayr (1970) notes, "A new idea was grasped with enthusiasm and imagination, but it was not always cultivated to the stage of maturity. It was only in another field, the steam engine, that the idea of feedback control became historically effective" (p. 108).

Watt's Governor, also known as the centrifugal governor, served as a regulating device for steam engines. It consisted of two interconnected centrifugal pendulums, sometimes referred to as "flying" pendulums. These pendulums rotated in response to the engine's motion, either spreading apart or coming close due to centrifugal force. This movement effectively sensed the speed of the engine. Utilizing levers, through a path for negative feedback, the governor controlled the steam valve, thereby regulating the engine's speed in response to any fluctuations. Beyond its mechanical ingenuity, Watt's governor possessed a visually captivating quality, making it one of the most iconic images in the history of technology. However, interestingly, Watt himself might not have fully grasped the impact of the device that bore his name. As Mayr (1970) points out, "One and a half centuries later, when feedback came to be regarded as a key concept not only in industrial but also in sociological matters, the character of technology had changed far beyond anything Watt could have imagined" (p. 113).

The significance for our current discussion lies not in the technical intricacies of Watt's Governor but in its profound impact on society and culture. By the turn of the 19th century, the widespread use of the centrifugal governor contributed to the integration of the feedback concept into "the consciousness of the engineering world" (Mayr, 1970, p. 109). While Mayr has elsewhere explored the intricate interplay of technology, economics, and politics (see Mayr, 1971 and Mayr, 1989), he does not extend his historical account into the realm of humanities, which constitutes the aspiration of this paper.

Before delving into hermeneutics, it's essential to loosen the tight constraints of Mayr's threefold criteria. Flexibility in our conception would prepare us for the exploration of the conceptual and historical connections between feedback mechanisms and hermeneutics, potentially uncovering shared principles and influences.

Mayr, according to his rigid account, dismisses several mechanisms that others consider as feedback devices. In a footnote, he names inventions like the south-pointing chariot of ancient China, the mill-hopper, the fly-wheel with centrifugal weights, and Huygens' centrifugal pendulum, as "erroneously" labeled by others as feedback devices (see Mayr, 1970, p. 133). Mayr's concerns can be summarized in two main worries. Firstly, he emphasizes that human action should not be part of the feedback loop. He believes that the inclusion of human contribution might result in an overly inclusive definition of feedback, potentially covering a broad spectrum of systems. Secondly, Mayr asserts that for a device to be considered feedback, it should be "designed" or "intended" to function as such.

Considering the Chinese south-pointing chariot, Mayr says that it has been labeled by Joseph Needham as the first homeostatic device.[5] It has two wheels on a single rod connected to a pointing device through a gearing mechanism. The pointing device remains stable in relation to the road, resembling a mechanical compass. While designed to be self-regulatory, Mayr rejects this as feedback due to its reliance on human involvement – the chariot driver consulting the mechanical compass to guide the chariot. An objection to Mayr's stance arises by appreciating two key points. First, Mayr's objection assumes that the desired goal is to steer the chariot. However, one might argue that the goal is to maintain the direction of the pointing device, not necessarily the chariot itself. Second, there's room to interpret human actions in terms of feedback, not only loops within the brain's neural networks but also in the loops of interaction between the body and its surroundings, which blurs the boundaries of humans and machines.[6] Moreover, even the most complex feedback systems involve human factors at some point or level.

[5] Joseph Needham, a renowned biochemist and Sinologist, is indeed widely recognized for his monumental work, "Science and Civilization in China." This multi-volume series, started in 1954, provides an extensive exploration of the history of science and technology in China. In another influential work, Needham, along with Wang Ling and Derek J. de Solla Price, assert that mechanical clocks originated in China rather than Europe. (see Needham et al., 1960). Unfortunately, this cannot be pursued within the scope of this paper.

[6] The coupling between mind, brain, body, artefacts, and the environment is increasingly appreciated in cognitive science (Varela et al., 2017; Clark, 2001; Newen et al., 2018;), Archaeology (Malafouris, 2013), and philosophy of technology (Ihde & Malafouris, 2019), to name but a few trends.

In other words, from the viewpoint of feedback, the human and machine can be seen as symmetrical or in Latour's terminology *actants*.

Another mechanism that does not align with Mayr's stringent criteria is the mill-hopper (*baille-ble* in French). Latil (1957), in his influential book aimed at introducing cybernetic ideas to the French public, presents it as the oldest example of a feedback mechanism predating Watt's governor. He writes,

> Here was a governor ante-dating that of Watt by at least two centuries. The grain distributor has always been called a "*baille-ble*" and consists of a wooden chute which guides and delivers the stream of grain. The end of this chute rests directly on the driving shaft of the mill, which at this point is squared or encased in a more or less square box whose edges are strengthened with metal. At every revolution the "baille-ble" received four knocks, each of which makes some grain fall out. In modern mills this principle is termed a "shock distributor." When the wind increases, the mill turns more rapidly and will receive more grain; with less wind, the feed will be diminished. (Latil, 1957, p. 117)

This is an ingenious simple feedback system. However, Mayr excludes the mill-hopper from the category of feedback mechanisms, stating, "The property of self-regulation is inherent to them. It is not the result of deliberate design, as would be the case if the comparator, the feedback path, or the sensing device could be identified as physically distinct elements. All this makes it clear that the mill-hopper has no significant place in the history of feedback control" (Mayr, 1970, p. 93). Mayr's concern revolves around the absence of *deliberate design*, presupposing that deliberate design of feedback mechanism necessitates the use of separate sensors and actuators functioning along a feedback path. However, this demand may be overly stringent, even for the centrifugal governor. Ironically, formalizing the dynamics of the governor into a neat measure-compare-adjust framework proves challenging, if not impossible. Instead, its dynamics find the best expression in differential equations, inspiring the Dynamical System approach (Port & Van Gelder, 1998; Thelen & Smith, 2002) to model human cognition and action within a dynamic framework. As Bermúdez (2020) summarizes, "It is a coupled system that displays a simple version of attractor dynamics, because it contains basins of attraction. Unlike the computational governor, it does not involve any representation, computation, or decomposable subsystems." (p. 156). In a nutshell, even the governor is not *deliberately designed* with separate sensors, comparators, and actuators and cannot pass Mayr's filter.

While Mayr's concern about the vacuity of a concept with too many instances is valid, there's also a risk in overly limiting the scope of the concept. Defining feedback requires a nuanced approach that acknowledges the complexity of systems. However, the identification of feedback should not solely rely on the inherent properties of a system, nor should it be confined to the intentions of its designers or builders. A more flexible account of feedback is needed. In the context of our current discussion, I refer to the definition of feedback as outlined in a contemporary and reputable control engineering textbook: "Feedback exists whenever there is a closed sequence of cause-and-effect relationships." (Golnaraghi & Kuo, 2017, p. 13). Importantly, the authors stress that the

feedback need not be exclusively physical, enabling the modeling of ostensibly non-feedback systems within a feedback framework. This broad and inclusive perspective facilitates the recognition of a wider range of systems as instances of feedback – for example, the hermeneutical circle.

HERMENEUTICAL CIRCLE: CONCEPT AND HISTORY

Hermeneutics, the art or philosophy of interpretation, has a range of meanings and applications. At any rate, a central skill in hermeneutics is navigating the hermeneutical circle. As elucidated by George, "On the one hand, it is necessary to understand a text as a whole in order properly to understand any of its parts. On the other hand, however, it is necessary to understand the text in each of its parts in order to understand it as a whole." (George, 2021) This is a circle not only between the whole and the parts of the text, but also between the reader and the text. The interpreter's mindset, influenced by initial expectations and experiences, shapes the interpretation of the text. This, in turn, alters the interpreter's expectations and experiences, perpetuating an iterative cycle. This process, marked by its open-ended and infinite nature, culminates in what Gadamer famously terms the "fusion of horizons" (Gadamer, 2004).

The circularity inherent in the hermeneutical circle extends beyond the relationship between the whole of a text and its parts or a reader and a text. It extends to the introspective relationship within an individual, leading to a self-referential interpretive task (as spelled out by Heidegger), or the conversations between oneself and others (Rorty, 1979), or the I-Thou relations with objects or loved ones or spiritual connections between humans and the divine (Buber, 1970). Moreover, this circular process might extend to relationships between humans and machines (Grunwald et al., 2023). In each of these applications, the hermeneutical circle not only describes but also prescribes an open-ended and purposeful interplay, emphasizing the ongoing nature of interpretation and understanding.

The hermeneutic circle, like any profound concept, has a historical lineage. In ancient Rhetoric, as expounded by thinkers like Plato and Aristotle, the dynamic interplay between the whole and its parts is acknowledged in the composition and understanding of texts (see Grondin, 2015, p. 300). This circular engagement may be perceived as a necessity primarily for novice readers grappling with complex treatises, necessitating a back-and-forth exploration until a comprehensive understanding of the whole is achieved. In this perspective, the meaning of the text is presumed to be readily available to experienced readers, with the circular process serving as a crutch for beginners. Conversely, others argue that this cyclic engagement is indispensable and influences both novices and experts alike. Grondin, following a historical overview of the hermeneutical circle in ancient rhetoric, claims that this circle is mostly descriptive and turns into a philosophical "problem" in the early nineteenth century. As he writes,

> The first author to speak explicitly of a "hermeneutic circle" was in all likelihood the German classical philologist A. Boeckh (1785–1867): alluding in his lectures of 1809 to the different types of interpretation (*Auslegungsarten*), for instance, the grammatical and the historical, he says that the "hermeneutische Cirkel" between

> them cannot be entirely avoided (Boeckh 1966, 102; Teichert 2004, 1342). He influenced the Protestant theologian Schleiermacher (1768–1834), who spoke extensively of the "circle" of the whole and the parts in understanding (without, however, using the expression h. circle). (Grondin, 2015, pp. 300-301)

In regard to our discussion, the intriguing historical fact lies in the simultaneous emergence of the concept of the hermeneutical circle and feedback in the early 19th century Europe. While my brief historical sketch falls short of establishing a direct relationship between the two, it is noteworthy that the notion of circularity in hermeneutics undergoes a transformation throughout the 19th and 20th centuries. As noted by Grondin, "The point of classical, methodical hermeneutics was indeed to avoid the hermeneutical circle of an interpretation that would be tainted by its presuppositions, premises, or erroneous assumptions about the whole or the intent of a work." (Grondin, 2015, p. 299) Accordingly, two contrasting attitudes toward the hermeneutical circle are distinguishable: conservative and progressive. The conservative perspective views the circle as potentially vicious or, at best, a mere aid, posing a threat to the objectivity of understanding in the humanities, contrasting with the apparent stability enjoyed by exact sciences. Conversely, the progressive perspective sees the hermeneutical circle as virtuous and constructive. As Grodin explains, "the key is not to escape the hermeneutical circle, but, following Heidegger's famous phrase, to enter into it in the right way." (ibid). All inferences involve this kind of circularity. As Goodman (1983) writes, "This looks flagrantly circular…But this circle is a virtuous one…*A rule is amended if it yields an inference we are unwilling to accept; an inference is rejected if it violates a rule we are unwilling to amend*" (p. 64). It is noteworthy that a similar contrast can be observed in the realm of feedback mechanisms. A "conservative" feedback mechanism is any pre-programmed self-regulating device with a fixed goal, such as a thermostat maintaining a constant temperature, or any device acting with a centralized command center. On the other hand, "progressive" feedback allows for adaptability and change in goals and programs, exemplified by a cat dynamically chasing a mouse, or any system capable of self-organization without any central authority. In any case, conservative or progressive, we can discern a common theme. The key insight is in conceptualizing the notions of feedback mechanisms and the hermeneutical circle in more abstract terms, which I term "circular causality."

CIRCULAR CAUSALITY: THE TERTIUM COMPARATIONIS

One of the most enduring challenges in philosophy is the concept of causality. Philosophical perspectives on causality range from complete rejection to rigorous logical formalizations. Questions surrounding causation often delve into issues of necessity, universality, linearity, reversibility, and more. For the present discussion, the emphasis will be on exploring the aspect of linearity.

In Medieval Islamic Philosophy, a well-known philosophical principle was established as "the impossibility of circular causality." It was argued for by many. Avicenna, for instance, argued against circular causality using *reductio ad absurdum*. He invoked another principle stating that "the effect always comes after its cause." If circular

causality were to exist, it would imply effects simultaneously preceding and succeeding their causes, leading to an untenable situation. Similar arguments against circular causality are found in theology, where Aquinas's well-known "argument of the first cause" for the existence of God relies on the assertion that "nothing can be the cause of itself because nothing can exist before itself." Notably, both arguments reject circular causality based on a linear conception that hinges on the temporal sequence of cause and effect, asserting that nothing can be the cause of itself since nothing can precede its own existence. This is akin to the well-known fact that an individual cannot lift oneself out of a swamp by pulling their bootstraps.

This line of reasoning leads to various conclusions: the necessity for a complex system to be preceded by an even more complex one, the necessity for the universe to be created or designed by an intelligent designer, and the necessity of the spirit for being human and the vital force for being alive. The overarching theme is similar to the claim that no machine can exhibit intelligent behavior without "a ghost in the machine." While these assertions were once persuasive, they gradually lost their potency with the emergence of feedback mechanisms, serving as a material *reductio ad absurdum* against the previously entrenched formal principle of the impossibility of circular causality. In other words, the flourishing of feedback mechanisms allowed machines to assert "autonomy" – which is "a fancy word for self-control" (Dennett, 1995, p. 366). This new material model with its manifest autonomous behavior paved the way for the construction of new mental models and new causal principles.

Instead of rejecting the possibility of circular causality on logical grounds, modern people could actually build configurations in which cause and effect were in circular relation. Of course, this kind of configuration was not alien to ancient people. Those who have attempted to construct a survival shelter using just wooden sticks arranged in a pyramid-like structure understand the phenomenon of causations interlocked: Erecting one stick after another seems impossible, but when they engage in a causal relationship in the correct manner, with precise timing, they can lean on each other, remaining stably erected without a single stick being the sole cause or effect.[7] In this configuration, they mutually support each other within closed loops of cause-and-effect relationships. However, this simple configuration was not worthy of being the foundation of causal conceptions. Complex feedback loops changed the scene. They have a similarly simple but miraculous effect, resulting in intertwined coupled systems of "circular causality". In the 19th century, the magical bootstrapping effect of feedback was increasingly appreciated in theory and practice: more complex systems might emerge out of less complex ones, the universe might have been structured without any demiurge, and the organic world might have been designed without any designer.[8] With the rise of feedback

[7] Hofstadter (2008) delves into similar configurations in his intriguing exploration of loops. One example he discusses is the common trick of sealing a cardboard box by folding its four flaps over each other in a sort of "circular fashion."

[8] In 1858, Alfred Russel Wallace likened "natural selection" to the workings of the centrifugal governor. Bateson (1979) claims, "If it had been Wallace instead of Darwin, we would have had a very different theory of evolution today. The whole cybernetics movement might have occurred 100 years earlier as a result of Wallace's comparison between the steam engine with a governor and the process of natural

mechanisms, the practical achievements displaced and re-shaped the entrenched theoretical beliefs – not only in Engineering but also in Humanities.

The linear conception of causality has a counterpart in the realm of interpretation and understanding: Traditional doctrines, such as Plato's theory of recollection, assume that understanding is possible because we already possess the necessary knowledge in hidden forms inherited from our previous lives. Knowledge is viewed as the totality of justified true beliefs. The Socratic method may be seen as not contributing anything inherently new to the knowledge already present in implicit forms; it merely brings it to explicit awareness. In this view, the world of Forms and Ideas is static and fixed, dormant waiting to be known. However, the hermeneutical circle, particularly in its progressive form, challenges this static and linear conception. The process of understanding, according to the hermeneutical circle, starts with ignorance and prejudice but gradually discovers and constructs understanding in an open-ended, infinite manner, always prepared to re-interpret and re-construct previous interpretations. As Schleiermacher puts it, "Our interpretive experience begins in misunderstanding" (quoted in George, 2021). To make it more in line with our current discussion, we might add: not only it begins from misunderstanding, but it also ends in misunderstanding. In other words, from the viewpoint of the hermeneutical circle, interpretations are always re-interpretations, and they should be.

In sum, referring back to the textbook definition of feedback as a "closed sequence of cause-and-effect relationships," the hermeneutical circle has commonalities with the feedback mechanism.[9] They both start with "error" and "misunderstanding." They both re-adjust and re-vise their initial beginnings. They both yield various equilibrium points – *attractors* in the parlance of dynamical systems – without any final absolute resting end. They are both at work in closed loops but, simultaneously, open-ended and infinite.

CONCLUSION

Our conclusion is twofold. First, historically, feedback mechanisms and the hermeneutical circle thrived at the same time in a shared cultural-technological ground, namely 19th-century modern Europe. While this might be dismissed as a mere coincidence lacking any meaningful constitutive connection, a second observation is pertinent on a conceptual level: they both share the abstract concept of "circular causality." Feedback mechanisms challenge the philosophical principle that asserts the impossibility of circular causation. Similarly, the hermeneutical circle challenges the conception that assigns fixed meanings to the texts. Juxtaposing these two, a question

selection" (p. 43). The idea of "being designed without a designer" is the core of Dennett's version of Darwinism (see Dennett, 2018).

[9] The divide between humanities and natural sciences hinges on the very distinction of reason and cause, the former being non-deterministic and the latter deterministic. However, Cyberneticians interpret the causality of feedback mechanisms as "non-deterministic teleology" (see Rosenblueth et al., 1943). Philosophers might object (for example, see Rorty, 1979, p. 240). A middle way is to appreciate that reasons are exclusively humane and different from causes, but nonetheless products of algorithmic evolution (see Dennett, 2013). This paper is a preliminary attempt to find or build this middle way.

arises: Which one has been the source of inspiration for the other? Is there any meaningful way of prioritizing one over the other, in historical or cognitive terms?

One might observe that the same circularities have always been part of the metaphors and material culture in different cultures, in different ages, and in different practices. Cyclic icons abound in ancient India (e. g. Wheel of Life) and China (e.g. Yin-Yang). The idea of eternal recurrence or cyclic nature of the universe is common in ancient cultures. Circularity is valorized by many mystical and alchemy traditions in the iconic image of a snake biting its own tail (named *Ouroboros* in Greek). More generally, the magic of self-reference has been appreciated since the time humans saw themselves in the natural mirrors of ponds (e.g. the myth of Narcissus) or through the metal and glass mirrors, or even in the mirror of lovers – as feedback loops are ubiquitous in the imagery of literature and poetry. While these might seem "just metaphors" without any practical or cognitive value, we have also mathematical and philosophical methods very similar to the feedback mechanism: the *Regula Falsi* method of mathematics in Greek, the calculus of *Double Errors* in Islamic mathematics, and the *Dialectic* in Plato or Hegel. Rehearsing all these historical examples, the similarity between the feedback mechanism and the hermeneutical circle might lose its appeal. Nevertheless, two points should be noted. First, doing a historical survey necessitates posing "ideal types", in Weber's terminology, resulting in acceptable distortion and approximations. Second, despite the long history of similar concepts, it was only in the 19th century, in modern Europe, that complex automatic machinery thrived, and it was in modern Europe that the hermeneutical circle flourished in a disciplined way. In other words, looking back at the relevant historical data, these "ideal types" are mostly recognizable in the 19th century, not before. Latil (1957), at the end of his book on feedback mechanisms, after mentioning the similarities between the Chinese ancient principle of Yin-Yang and cybernetic ideas, writes,

> But if we find ourselves agreeing with the oriental mystics, it is not because of any nebulous views on spiritual existence; we started off solely on the fundamental concepts of the machine. The reader has been present from the beginning of these concepts, for we have wished him to tread along the same path which we took in order to arrive at an understanding. The principles which have been advanced might have been arrived at by metaphysical consideration, had they been founded on thought alone, but, founded as they are *a posteriori* not *a priori,* on consideration of the mechanical functions of machines, they are of absolute authority. (p. 345)

Despite its outdated Eurocentric tone and its innocent claim for the "absolute authority" of mechanical accounts, he hints at a profound insight. While arriving at the same understanding through different paths is possible, it does not imply that we have actually exhausted all possible avenues. Looking at the ancient water clock as a feedback mechanism from our current perspective might seem obvious, but it wasn't so in ancient times. Categorizing various old ideas under the rubric of "feedback" is straightforward for us today, but it was not the case back then. To illustrate, consider "feedback" in comparison to "microbe." It is now easy for us to perceive microbes as if they were always

present in our world, but it was not easy before the age of Pasteur. The same goes for feedback.

If we succeed in establishing a meaningful constitutive relationship between feedback mechanisms and the hermeneutical circle, another question arises. It could be the case that in the 19th century, the importance and power of feedback were so pronounced and experienced in material culture that people began projecting it onto the realm of interpreting and understanding texts. Conversely, it might be the case that the inherent circularity in the interpretation of texts inspired people to incorporate this circularity into artifacts. Our predicament here is not dissimilar to Weber's question regarding Protestantism and Capitalism, and our ambivalence is similar to the choice between what he calls Materialism and Spiritualism. He finishes his thorough historical research with these sentences:

> But it is, of course, not my aim to substitute for a one-sided materialistic an equally one-sided spiritualistic causal interpretation of culture and of history. Each is equally possible, but each, if it does not serve as the preparation, but as the conclusion of an investigation, accomplishes equally little in the interest of historical truth. (Weber, 2001, p. 125)

This paper is a preliminary attempt. There is no way, and there is no need, to readily give absolute priority to one here. Weber, to emphasize the intricate relationship between Protestantism and Capitalism, refers to their connection as an "elective affinity" (*Wahlverwandtschaften* in German). This *elective affinity*, borrowing a chemical metaphor from the 18th century, describes the inclination of substances to react, or the tendency of individuals with "similar chemistry" to fall in love (see McKinnon, 2010). The term "affinity" has been utilized in the title of this paper to imply a similar meaning. Nevertheless, we can replace this chemical metaphor with a cybernetic one, seeing both the feedback mechanism and the hermeneutical circle within "closed sequences of cause-and-effect relationships." I am not in a position to settle down the question of priority here, but I hope it is at least framed now.

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