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CRITIQUE OF THE CONCEPT OF ENERGY
IN LIGHT OF BERGSON'S PHILOSOPHY OF DURATION

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1. Introduction

The history of the concept of energy is inextricably bound to the history of western philosophy and science. The dominant energy discourse of the west arises within the context of nineteenth century thermodynamics. Following the paradigm shifts in the history of physics, our understanding of energy has evolved with the development of relativity, quantum mechanics, and non-equilibrium thermodynamics. However, despite the drastic improvement in scientists' understanding of energetic processes, we still have «no knowledge of what energy is» [Feynman 1966].¹ This is odd, considering that, ever since Lord Kelvin gave cosmic significance to thermodynamics by extending «the canvas of the Second Law [of thermodynamics] to... all of nature» [Coopersmith 2015, 286], energy and its transformations have been viewed by physicists as the stuff of reality itself. Nevertheless, energy still remains but a quantity for scientists to calculate; a concept for which it seems close to nothing ontologically positive can be said, outside of its employment for the quantification of physical processes.

The thesis of this paper is that, by taking a broader view of the history of the concept of energy and with the help of Bergson's analysis of the cinematographical mechanism of thought in *Creative Evolution*, we can indeed come to understand what is expressed by this concept.

¹ Section 4-1 "What is energy?"

Inspired by Nietzsche, Stephen J. Gould noted that a genealogical approach distinguishes «current utility [from] sources of historical origin» [Gould 2002, 1258], which is what I pursue here in my analysis of the concept of energy. That is, I want to draw a distinction between the way we currently employ the concept of energy in physics with the historical, philosophical, and psychological motivations that inspired its development in the first place. It should be noted that this is not a criticism made by Bergson being restored by the author, but a criticism on the author's part to develop a genealogical critique of energy with the help of Bergsonian concepts. I will argue that the thread that runs through the genealogy of energy is, following Henri Bergson, the tendency to «think the unstable through the intermediary of the stable, or the moving through the immobile» [Bergson 2023, 240]. In particular, I will show how Bergson's analysis of the cinematographical mechanism of thought in the fourth chapter of *Creative Evolution* can help us see that the essence of energy is the tendency to privilege immobility over the mobile in metaphysical accounts of change. I will then look to Bergson's analyses of intuition and intelligence in *Creative Evolution* and *Introduction to Metaphysics* to show how Bergson's method of intuition overcomes the cinematographical mechanism of thought, opening the door for a more robust conceptualization of energy beyond spatialized notions of time that ignore qualitative and vital differences in nature by reducing physical process to differences in degree, thereby leveling differences in kind.

2. *Overcoming the Cinematographical Mechanism of Thought*

Let us first provide a brief explanation of Bergson's concept of 'duration,' without which this analysis is impossible. Bergson introduces the concept of duration in his first work, *Time and Free Will*, where he distinguishes between duration – how we experience time as a continuous and uninterrupted flow – versus empirical time, which is divided into separate moments measured by clocks. Bergson posed the question of whether time was the kind of phenomenon that could be counted like a discreet set of numbers, indivisible and external to each other in their own right much like a series of self-contained presents in

linear succession [Bergson 1995, 78-79]. Whereas clock-time partitions the continuity of events, which is characteristic of becoming, duration refers to the passage of time viewed from within consciousness, rather than outside of it. When viewed from within, time is not a series of instants that combine individually to form a unified sequence. What we find is that the passage of time involves a qualitative and indivisible movement where the past continuously swells into the present in novel forms. As Pete A.Y. Gunter notes, «[duration] is not at all like our traditional measurable time... All [clock-time] segments (for example, minutes or seconds) are the same in character as are all other time segments. But experienced time is not like this. No two moments of experienced time are identical» [Gunter 2023, 1]. For Bergson, clock-time represents the spatialization of time because the fact that all its segments are identical and mutually exclusive to other segments allows us to treat time as if it were a geometric line that can be quantitatively measured and indefinitely partitioned; as if moments in time could be counted like numbers. The ahistorical nature of clock-time leads to the interpretation of time as a succession of mutually exclusive segments, where every moment is virtually annihilated and reconstructed in the passage from one segment to the next.

The difference between spatialized time and duration is well illustrated by Bergson's criticism of Zeno's paradox of motion [Bergson 1995, 113-114]. Bergson's first analysis of Zeno's paradox in *Time and Free Will* was meant to distinguish the empirical experience of motion in terms of a divisible trajectory in space and the subjective experience of duration where motion is a single, indivisible act. Referring to the paradox of Achilles and the tortoise, this paradox was supposed to lend credence to Parmenides' and the Pythagoreans' claims that reality is one and that change is an illusion. The paradox is that, to get from point A to point B, one must first traverse half that distance from point A to point B, then half that distance again, which would be a fourth of the length, then another half, which would be an eighth, and so on. Thus, it would seem that getting from any point A to any point B would be a logical impossibility, because no matter how close you get to point B, you can never actually arrive; since a line can be divided in half an infinite number of times, you would have to traverse half the distance

an infinite number of times. These thought experiments were supposed to prove that movement is a logical impossibility, meaning that change must be a sort of illusion resulting from sense experience. However, Zeno confuses the empirical experience – the interpretation of motion as the interval of simultaneities between conscious states and homogenous points between an initial and final point of motion – with the indivisible/qualitative motion perceived in duration. Bergson tried to reconcile these two experiences without reducing motion to spatiality by distinguishing between the «simultaneous positions of... moving bodies, which are in fact in space, and their movements, which cannot occupy space, being duration rather than extent, quality and not quantity» [*ibid.*, 114]. Thus, Bergson argued that Zeno's paradox is merely an illusion; it «consists in making time and movement coincide with the line which underlies them, in attributing to them the same subdivisions as to the line, in short in treating them like that line» [Bergson 1988, 191]. In other words, this only seems like a paradox because Zeno identified time with the geometric line that can be infinitely partitioned and drawn under the trajectory of any movement. If we identify the movement of Achilles and the tortoise with their trajectory in space, then we run into the paradox pointed out by Zeno of how it might be possible to traverse an infinite number of points in space. Of course, it is always possible, retrospectively, to trace the trajectories of the movements we observe. However, when we look at the actual movement from point A to point B, say, the movement of my hand between two points in the air, the act of waving my hand constitutes a single intentionality, extended in time, and an indivisible movement which is, indeed, real. Such is the qualitative nature of duration which, by definition, cannot be divided into homogenous, mutually exclusive frames.

Bergson explained that spatialized time and duration constitute two kinds of multiplicities, the former referring to a quantitative or numerical multiplicity, and the latter to something qualitative and continuous: “there are two kinds of multiplicity: that of material objects, to which the conception of number is immediately applicable; and the multiplicity of states of consciousness, which cannot be regarded as numerical without the help of symbolical representation [in space],” [Bergson 1995, 87]. States of consciousness do not exist as discrete entities and in

fact intermingle and flow into each other without any artificial schisms. We can only “count” states of consciousness by spatializing them, i.e., artificially making them self-contained and discreet, thus introducing spatiality into a sequence which is temporal and qualitative by nature. Numerical multiplicities fall under the category of phenomena that we would traditionally call “objective,” which «denotes not only what is divided, but what, in dividing, does not change in kind. It is thus what divides by differences in degree. The object is characterized by the perfect equivalence of the divided and divisions, of number and unit» [Deleuze 1988, 41]. Bergson offers the example of a flock of sheep. When reduced to what all the sheep have in common – the fact that they take up space as discrete entities – we ignore what makes each sheep qualitatively unique in order to count them according to a common standard of measurement [Bergson 1995, 77]. Another example would be dividing a timeline into multiple segments, since one can then join those segments back together to restore the original phenomenon. To think of time as a geometric line moving from past to present is to think of time as a numerical multiplicity, and it is this mistaken view of time that is assumed by Zeno’s paradox.

The idea of time as a numerical multiplicity is closely tied to the idea that time is reversible, since it is of the essence of numerical multiplicities that there be a perfect equivalence between the whole and its parts. In this case, directionality matters not, since reconstructing a numerical multiplicity from front to back or from back to front amounts to the same result. This would imply that an individual’s experience of the passage of time is really an illusion relative to the observer’s experience, and that the passage of time does not actually add anything new to the universe. Duration, however, is a qualitative multiplicity. Whereas numerical multiplicities are spatial, duration is temporal. Whereas spatialized time proceeds by differences of degree in its leveling of time to a common metric and mutually exclusive instants, duration proceeds by differentiating differences in kind. For example, from one moment to the next, I feel sad then happy. This progression consists of the flux of sensations in my body, along with my interactions with my environment, and my recognition of those sensations – none of these qualitative phenomena can be clearly partitioned or quantified like a straight line.

Furthermore, when I move from sadness to happiness, there is also the recollection of my sadness after it is gone, and recollections of similar moments that might be called to mind in the flow of consciousness, which Bergson referred to as *mouvant* as opposed to the “movement” of consciousness associated with the Zenonian paradigm. The memory of my sadness is not divorced from the present but protrudes into it, coloring the light in which I perceive my current happiness. Memory and quality, as opposed to space and number, is the stuff of duration. According to Deleuze, «duration divides up and does so constantly: That is why it is a *multiplicity*. But it does not divide up without changing in kind, it changes in kind in the process of dividing up: This is why it is a nonnumerical multiplicity, where we can speak of “indivisibles” at each stage of the division» [Deleuze 1988, 42]. We can only carve duration into distinct objects and moments in time retrospectively, but to think duration in itself requires the method of intuition (discussed later on) to re-place consciousness within the qualitative movement of duration, rather than artificially reconstructing duration by gathering static moments and spreading them along arbitrary temporal units of length.

It is precisely this fragmentation of duration that is characteristic of the cinematographic mechanism of thought. Whereas the becoming of duration «is infinitely varied» [Bergson 2023, 263-264], the cinematographic mechanism replaces infinitely varied *kinds* of movement by the general and impersonal movement of the cinematograph. Summarizing the cinematographical mechanism, Bergson explains that:

the procedure [of the cinematographical method] consisted in first extracting an impersonal, abstract, and simple movement, *a movement in general*, so to speak, from all of the movements belonging to all of the figures; then, in placing this movement into the projector; finally, in reconstituting the individuality of each particular movement through the composition of this anonymous movement with the individual attitudes [of the actors]... We take quasi-instantaneous views of snapshots of the reality that passes by, and, given that they are characteristic of this reality, we can simply string them together – along a becoming that is abstract,

uniform, invisible, and situated at the foundation of the apparatus of knowledge – in order to imitate what is characteristic in this becoming itself. [*ibid.*, 265].

Bergson argued that there are distinct kinds of movements within becoming. There are qualitative movements (such as changes of color), evolutionary movements (the change from green to blue is not like the transition from larva to nymph), and extensive movements (the spatial movement of extended objects) [*ibid.*, 263-264]. What the cinematographical mechanism does is extract from these different kinds of becoming the concept of becoming *in general*, devoid of the qualitative differences unique to these activities. In place of true becoming, it divides duration into a composition of distinct states strung together by an impersonal becoming, where time is the apparatus that unrolls the film from without, being completely external, and therefore having no bearing, on the content of the snapshots it unwinds. The frames of the film represent the different states of an empty space that serve as the container for the content unfolding from one frame to the next. Here, the inner-life of movement is merely represented, only to be perceived by a mind standing outside that empty space and able to mysteriously generate epiphenomenal representations of that impersonal becoming. Thus, the cinematographical mechanism works by supplementing mobility to what is immobile by nature.

This epistemological model only works if you assume that the human mind is able to transcend becoming and grasp that which persists *despite* the passage of time. But this is only a confused half-truth. At the beginning of the fourth and final chapter of *Creative Evolution*, Bergson describes how the intellect's natural disposition towards the necessities of action make it so consciousness, in forming itself into intelligence, is drawn along lines that are suited to the potential action of our bodies. Bergson argues that «the essential function of the intellect will be to sort out the means of dealing with any circumstance whatsoever» [*ibid.*, 137]. The activity of intellect is facilitated by perception, whose purpose is to present the world to consciousness in terms of the conscious being's potential action over its environment. Pascal Blanchard explains that in the Bergsonian model of perception, «*nous nous renvoyons à nous-mêmes dans la perception le tableau*

de nos possibilités des actions» [Blanchard 2008, 511].² In this sense, perception is utilitarian and subtractive in its foregrounding of certain environmental features as a function of their utility for the perceptive being. Bergson argues that intelligence proceeds by carving out terminal points of action within the flux of its environment – the finality of its ends necessitates the objectivity of its means. A common mistake that arises is to take the intellect as an absolute, that is, to model truths about reality in general on the needs of human action. Furthermore, «all of the elementary forces of the intellect tend to transform matter into an instrument of action, that is, into an *organ*, in the etymological sense of the word [...]. The intellect is life looking to the outside, going outside of itself, and adopting in principle the procedures of inorganic nature [*nature inorganisée*] so as to in fact direct them» [*ibid.*, 146]. This is why Bergson claims that the cinematographic mechanism of thought is the «mechanism of our ordinary [human] knowledge» [*ibid.*, 265] because it is of the essence of intelligence to carve the continuous flux of materiality into discreet objects. Understanding the relations that guide the interactions between the objects carved out by intelligence allows the intelligent being more control over its environment. Thus, as intelligence pushes the boundaries of its knowledge beyond its immediate environment and into the totality of the universe, it is natural that it absolutizes itself by taking objectivity, which it naturally projects on to the totality, as an inherent quality of the totality itself.

Crucially, however, Bergson maintained that intelligence is only one of the tendencies of consciousness. Bergson proposed that to think duration in-itself requires what he called the method of intuition, which is made possible by the tendency that opposes intelligence in consciousness: instinct. Let us quickly clarify the relationship between intelligence, instinct, and intuition, since we cannot understand intuition without first showing how it is determined by a particular relationship of intelligence to instinct. As the editors of this edition have noted, Vladimir Jankélévitch defined Bergsonism as a «monism of substance and a dualism of tendency» [Jankélévitch 2011, 174]. The substance is duration itself, pure temporality. The dual tendency of duration is

² «We return to ourselves, in perception, the picture of our possibilities for action» (author's translation).

towards 1) materiality/stability, and 2) change/novelty. Reality exists between these two tendencies, which are inseparable, and we never quite reach the limits of one tendency or the other. Intelligence reflects the tendency to materialize duration for consciousness. However, just as the materializing/stabilizing tendency always contains the creative tendency in itself, so does intelligence contain the possibility of its overcoming, that is, the insertion of consciousness back into the flux of duration through the suppression of intelligence by instinct. Bergson argues that

consciousness, establishing itself as intellect, that is, focusing first on matter, seemed in this way to externalize itself in relation to itself; but, precisely because it is adapted to external objects, it is able to circulate among them, to get around the barriers that it encounters, and to increase its domain indefinitely. Moreover, once liberated, it can fold back within itself and reawaken the virtualities of intuition that lie dormant within it [Bergson 2023,164].

Intuition is possible because consciousness is comprised of the dual tendency of instinct to inhere in the creative flux of duration, and intelligence, which grasps duration from without – instinct is the foil of intelligence in the evolutionary movement of life. For Bergson, «the intellect treats all things mechanically, [whereas] instinct proceed organically» [*ibid.*, 149]. Bergson’s premise for making this argument is his claim that all instinctive behaviors, from the cell to the beehive, must be animated by a common vital impetus that drives the evolution of life (the *élan vital*). The beehive and the cell are extreme cases of instinct in that all the organic parts form a whole that behave as if they were a single organism. On the other hand, intelligence implies a capacity to hesitate before a situation and artfully select a solution for moving forward; the kind of instinctual behavior previously mentioned would be more akin to our ‘knowledge’ of breathing than the knowledge of a skilled artisan [Allen 2023, 55]. The extreme form of instinct is characterized by the perfect coincidence of consciousness with action. This is not the case for human beings, whose evolution seems to have followed the path of intelligence to a much greater degree than the honeybee, at the expense

of instinct. The instinct of the bee is relatively unconscious compared to human behavior, since humans possess a greater power of deliberation, that is, to pause before a question or obstacle and ponder a way forward. Bergson explains that «*the consciousness of the living being [is] an arithmetical difference between the virtual activity and the real activity. Consciousness measures the gap between representation and action*» [Bergson 2023, 132]. With instinct, the arithmetical difference between potential and real activity is practically null. It should be noted that Bergson argues that intelligence and instinct can only grow by thwarting one another, such that intelligence appears as a result of the suppression of instinct and vice-versa. To sum it up, «although instinct and intellect both involve knowledge, in the case of instinct, knowledge is *enacted or played* and unconscious, in the case of the intellect, knowledge is *thought* and conscious» [*ibid.*, 133].

Nevertheless, it should be emphasized that the intellect, despite its objectifying tendency which distorts real duration, does touch reality – the ‘absolute’ – in its mingling with matter, lest we devolve into the solipsistic Cartesian mind which perceives nothing but itself. Rather, if «*[intelligence] peut être dite toucher à un absolu sans toutefois atteindre à la réalité essentielle de la matière comme devenir, c’est bien en tant que le plus bas degré de l’image – sa spatialité géométrique – est déjà de l’absolu dans son ordre propre*» [Cornibert 2008, 528].³ What is meant is that the part of the absolute touched by the intellect is the degree of duration which tends to materiality/spatialization, what Cornibert calls the ‘lowest degree of the image’, i.e., the image offered up to consciousness by perception. However, the point being argued here is that intelligence oversteps its bounds when it claims that all knowledge is of the kind amenable to the objectifying tendency of the intellect, i.e., that intelligence touches the absolute *in toto* rather than just a part of it.

With the distinction between intelligence and instinct clarified we can now analyze the concept of intuition in terms of these dual

³ If «*[intelligence] can be said to touch an absolute without, however, arriving at the essential reality of matter as becoming, it is in so far that the lowest degree of the image – its geometric spatiality – is already of the absolute in its own order*» (author’s translation).

tendencies of consciousness: «*intuition* – by which I mean instinct that has become disinterested, self-conscious, and capable of reflecting upon and indefinitely enlarging its object» [Bergson 2023, 159]. Bergson’s method of intuition seeks to re-place the mind into duration, which requires thwarting the tendency of intelligence to reconstruct duration by means of stable concepts and objects. Whereas intelligence understands its objects by reference to premade symbols, thereby developing knowledge of an object with symbols external to the object itself, intuition leads us to «the very inwardness of life» [*ibid.*, 159]. Intuition is thus a result of intelligence refined by instinct. This endeavor is not impossible, as it is the craft of the artist, for example, to follow the intention and inwardness of life. Bergson argued that if there is any difference between positive science and metaphysics, it lies in the distinction between analysis and intuition, respectively. Analysis «is the operation which reduces the object to elements already known, that is, to elements common both to it and other objects» [Bergson 1999, 24]. On the other hand, then, metaphysics grounded in the method of intuition would be «*the science which claims to dispense with symbols*» [*ibid.*, 24], which places one within reality rather than viewing it from the outside in the mode of analysis. Intuition would allow us to think change in-itself, as opposed to change distorted by concepts grounded in a static ontology. Whereas intelligence understands reality by passing from concepts to things, intuition proceeds by passing from things to concepts [*ibid.*, 38]; it is the attempt to know objects from within, rather than forcing them to fit into generic concepts generated by intelligence.

3. *Overview of the Genealogy of Energy*

I will now provide a brief overview of the conceptual genealogy of energy in light of the previous analysis of the cinematographical mechanism of thought. It should be noted, however, that physicists’ idea of energy has drastically changed since the 19th century. Notably, Einstein’s theory of special relativity posited the equivalence of mass and energy, and one of the conclusions of general relativity is that energy, on a cosmological scale, is not conserved. In quantum field theory (QFT), often considered the most successful theory in all of physics, particles are seen as excitations

of quantum fields that are continuous and dynamic, pervading the whole universe. Energy in this context is associated with the excitations and intra-dynamics of these fields. This paper, however, only considers the genealogy of energy up to its birth in 19th century thermodynamics (although I do offer an example of Bergson's influence on contemporary physics through developments in non-equilibrium thermodynamics in the conclusion of this work). The reason being that energy first arose in an intellectual milieu where the Newtonian worldview still held sway. The Newtonian world of discreet objects and absolute space and time is an example of the limit case where the suppression of instinct by intelligence is such that reality is offered up to consciousness in terms of Cartesian space and atomized entities – the limit of duration which tends towards (but never actually reaches) perfect spatiality. Motion in the Newtonian universe is of the kind described by the cinematographic mechanism: a series of static instants strung together by an impersonal becoming. This makes the Newtonian worldview a perfect example of the conception of time Bergson is arguing against, and does well to illustrate what he means by the suppression of instinct by intelligence. Once we move into the 20th century, however, many of the problems that Bergson points out with the Newtonian worldview begin to be addressed. This is not to say, however, that Bergson's views become irrelevant,⁴ only that extending this analysis beyond the scope of 19th century thermodynamics is not necessary to provide a general overview of the problems which Bergson identified with the way time had been conceived of by classical physics. An extension of these ideas beyond the scope of 19th century thermodynamics is the subject of ongoing and future research.

In *Energy: Historical Development of the Concept*, physicist Robert Bruce Lindsay compiled an anthology containing what he believed to be the most significant texts in the development of the concept of energy in western philosophy and physics. Lindsay claims that the idea which has served as the impetus for the development of this concept «is simple: *constancy in the midst of change*» [Lindsay 1975, 5]. The

⁴ P.A.Y. Gunter's *Bergson and the Evolution of Physics* [1969] compiles many essays written by a variety of physicists on the influence of Bergsonism on 20th century physics.

history of energy reflects the faith that, beyond or behind the appearance of sensible change, there is something that remains constant, a timeless ground for the perpetuity of a world of constant flux. This ground is not just timeless, but unifying, in that the history of energy would express the desire to grasp what is constant everywhere and always, despite the passage of time. This notion contains what Nietzsche considered to be the founding intuition of Greek philosophy: «that all things are one» [Nietzsche 2014, 39]. Bergson was of a similar opinion: «[a] perpetuity of mobility is only possible if it is propped up by an eternity of immutability that it unrolls in a chain that is without beginning and without end. Such is the final word of Greek philosophy» [Bergson 2023, 281]. Furthermore, both Nietzsche and Bergson argued that the bias towards the immutable over the eternal also served as an axiomatic presupposition for modern philosophy and science. As we have already seen, Bergson attempted to explain this epistemological bias through the concept of the ‘cinematographical’ mechanism of thought, which presents movement as a series of immobilities strung together by an impersonal becoming, devoid of the qualitative differences in kind and the swelling of the past in the present that we find in real duration. Thus, if the thesis that the key idea in the concept of energy is constancy through change, then it seems that Bergson’s analysis of the cinematographical mechanism lays bare the presuppositions of this key idea.

The etymological origin of energy is Aristotle’s *energeia*, which is often translated as ‘actuality.’ However, as stated above, when we consider the history of ideas leading up to the concept of energy, we must begin with the origin of Greek philosophy itself. Indeed, the oldest text in Lindsay’s anthology is a fragment from Plato’s *Parmenides*. He goes so far as to say that Parmenides is «the ancient patron saint of the concept of energy» [Lindsay 1975, 16]. Lindsay also recognizes Heraclitus for his contributions because he foreshadows in some sense our current understanding of the dynamism of energy through his philosophy of becoming. However, between Heraclitus and Parmenides, Lindsay believes the latter comes closer to the contemporary understanding of energy by positing a more fundamental, unchanging reality – the One – beyond the apparent illusion of change.

In coining the concept of *energeia*, Aristotle was attempting to

provide an answer to the problem of being, not-being, and coming-to-be. Although Aristotle was certainly not the first to take up this question, what interests us here is that he was the first to introduce the concept of *energeia* in doing so. Aristotle's conceptual innovation lies in developing terminology to describe the being of the not-being of what-is-potentially, and its coming to be in/through actuality; that is, in exploring the positive ambiguity of what seemed like a categorical abyss between being and not-being. In accounting for these different senses of being with new concepts, Stephen Menn claims that Aristotle becomes the first western thinker to inaugurate a systematic science of change: «[i]ndeed, Aristotle uses the actuality-potentiality distinction to secure the very possibility of a science of physics, by explaining the possibility of coming-to-be, and resolving the contradictions that Plato, following the Eleatics and the Sophists, had detected in changeable things» [Menn 1994, 73]. In contrast to the original meaning of the word, Michael Marder argues that our understanding of energy is basically the opposite of what Aristotle meant by *energeia*. He argues that the modern conception of energy, as «potentiality waiting to be unleashed into a wide spectrum of activities, is the inverse of Aristotle's» [Marder 2017, 7]. *Energeia* for Aristotle denoted completion and fulfillment, not endless potential and activity. Vision is an example of *energeia* in that when one opens her eyes, she is seeing and has already seen; the activity pursues no end outside of itself. This is distinguished from the motion of matter, which is 'energized' by something external to itself, i.e., the *energeia* of immanent form. Aristotle called the kind of movement characteristic of material flux *kinesis*. It is distinct from *energeia* because the movement of matter possesses an end beyond its own activity, but is nevertheless energized by the actuality of immanent form. Motion that manifests the actual working of *energeia* would then be referred to as *entelecheia*, a word also often translated as 'actuality' – the distinction between these two kinds of actuality is well described by Sachs' translation of *energeia* as "being-at-work" and *entelecheia* as «being-at-work-staying-itself».⁵

Actuality thus held precedence over potentiality for Aristotle,

⁵ See Sachs' commentary of Book III of *Aristotle's Physics* [1995].

the former grounding the latter. *Energeia* refers to the actuality of immanent, teleological form, which potentiality is subordinated to, and it is this subordination of motion to already finished and unchanging form that Bergson is critical of, since it is yet another example of grounding mobility in the immobile. There is much to be said about the concept of *energeia*, but I will focus on Aristotle's claim that the essence (*ousia*) of the Prime Mover is *energeia*, since this is an example Bergson uses in *Creative Evolution* to distinguish his view of change from that of Aristotle's. The Prime Mover would be the uncaused cause of motion in the universe – a solution to the infinite regress that the Greeks abhorred. The activity of the Prime Mover could not have been a kind of *kinesis*, because if the original cause of motion possessed any potentiality, that is, the capacity to be changed or acted upon, then we would be led further down the ladder of regress of motion. The activity of the Prime Mover is imparted to the heavenly spheres and trickles down the rest of the cosmos. This original, uncaused activity is an eternal self-contemplation that is unaffected by whatever happens in the world: «[t]his is Aristotle's God – necessarily immutable and outside of what takes place in the world» [Bergson 2023, 278]. Bergson argues, regarding the cosmology of the Prime Mover, that «[s]ince movement is born of the degradation of the immutable, there could be no movement – and consequently no sensible world – if immutability were not realized somewhere» [*ibid.*, 278]. Aristotle and other Greek philosophers posited that there were degrees of reality, descending from the perfection of the Prime Mover through intermediate degrees of reality (with human reality somewhere in the middle), all the way down to nothingness; the degradation of what is immutable by nature would be the cause of universal becoming. Although *energeia* in Aristotle's work might mean something almost entirely opposite to what we now call energy, they share a similar function, in that both concepts attempt to explain how what exists potentially comes to be actual; they delineate the natural boundary between what is and what isn't subject to change; and both ground change in what is immutable.

The concept of energy, arising within the context of 19th century thermodynamics, explains motion by recourse to the laws of thermodynamics. 'Energy' grew largely out of Gottfried Wilhelm

Leibniz's concept of *vis viva*. This concept was inspired by Leibniz's objection to Isaac Newton's description of inelastic collisions, which involve objects that do not separate after they collide (e.g., a dart sticking to a board). Whereas Newton argued that a part of the total force of the collision is lost upon impact, Leibniz argued that 'active forces' were conserved in the world, meaning that the active force of the dart could not have mysteriously disappeared [Coopersmith 2015, 40]. Rather, if you consider that a dart can shatter upon impact with the board, then Leibniz's argument that the active forces of the dart are transferred to its parts becomes easy to grasp. The force associated with the dart's movement does not vanish. The impact with the board transfers the force of movement into its parts. The dart would not shatter if the active forces simply disappeared. *Vis viva* is the technical term Leibniz gave to these forces, which he defined as the mass of a body times the square of its velocity: mv^2 . Leibniz's *vis viva* was only a factor of two greater than what we now call kinetic energy: $\frac{1}{2}mv^2$. Crucially, Leibniz was also arguing against Descartes' claim that the quantity of motion conserved in mechanical motion was the mass times the velocity of the body (what we would now call 'momentum'), but the mass times the *square* of the velocity. Leibniz stated the following:

And so it may be in agreement with reason that the same total motive power (*potentia*) is conserved in nature and is not diminished inasmuch as we never see a force given up by one body without being transferred to another, nor increased, because perpetual mechanical motion never takes place and no machine, not even the world as a whole, is able to maintain its force without an additional external impulse [Lindsay 1975, 119].⁶

As we will see in the following section, this quote shows that Bergson was spot-on in his analysis of the law of the conservation of energy. Bergson argued that the first law of thermodynamics works on the assumption that any change that occurs must be counterbalanced

⁶ This quote is from Lindsay's translation of the original Latin essay: *Acta Eruditorum*, Leipzig, 1686, in *Leibniz Mathematische Schriften*, Vol. 2, C.I. Gerhardt, ed., Halle, Druck und Verlag von H.W. Schmidt, 1860, pp. 117-119.

in an opposite direction [Bergson 2023, 213-214], which would not be the case, for example, if the force of the dart's movement suddenly disappeared upon impact. Notice also that Leibniz speaks of movement impersonally here, attributing no qualitative aspect to *vis viva*, which is quantitative by definition, but still resonates with the idea of 'activity' associated with Aristotle's *energeia*.

The transition from *vis viva* to energy came through thermodynamics. James Joule, one of the founders of thermodynamics, argued that heat was not a fluid but, rather, a result of molecular and atomic motion. The dominant theory in Europe in the early stages of modern physics was that heat was a fluid called 'caloric,' which flowed from hot to cold. Joule, on the other hand, argued that heat was not a fluid or a substance, but a state of vibration [Smith 1998, 65]. This was one of the key pieces to Lord Kelvin's crucial insight that he developed in his 'dynamical theory of heat'. Kelvin proposed that heat be defined as the kinetic energy (half the *vis viva*) of the molecules of a body or substance. The success of the dynamical theory of heat would eventually extinguish the caloric theory.

4. Critique of the Concept of Energy

Let us look first at what Bergson himself had to say about the concept of energy. Bergson did not go as far as to reconceptualize energy, but he did extend the physical meaning of energy to a more general, philosophical one when pointing out that the law of the conservation of energy is largely conventional, in that «[t]he law of the conservation of energy would thus express that indeed a constant quantity of *something* is preserved. But in fact, there are a variety of different types of energy, and the measurement used for each one of them was clearly chosen in such a way as to justify the principle of the conservation of energy» [Bergson 2023, 213-214]. When referring to different kinds of energy, Bergson refers to the work of French physicist and philosopher Pierre Duhem who, in *Évolution de la mécanique*, speaks of the qualitative aspect of materiality and criticizes the mechanistic approach that reduces all the qualities of matter to figure and quantity of movement. He argued that «*Nous sommes contraints de regarder comme une qualité première et irréductible ce par quoi un corps*

est chaud, ou éclairé ou électrisé ou aimanté» [Duhem 1905, 197-198].⁷ What Duhem is referring to here is the leveling of the various qualities of material objects to what they all have in common: extension and quantity of motion. What we lose in the process of this abstract leveling are concrete qualitative aspects of matter, such as heat, luminosity, electricity, magnetism, and the innumerable qualitative characteristics that we actually encounter in the world. In other words, since energy is not merely quantitative but presents qualitative characteristics that cannot be subsumed by its quantification, the principle of the conservation of energy is conventional insofar as it *de jure* applies a common unit of measurement to different kinds of energies, thereby leveling the qualitative differences that exist *de facto* in energetic processes. Bergson argues that «[t]he law of the conservation of energy will no longer be able to express here the objective permanence of a certain quantity of a certain thing. Rather, it will express the necessity that each change that takes place be somewhere counterbalanced by a change in the opposite direction» [Bergson 2023, 214]. The fact that we are able to account for the counterbalance of many of these changes quantitatively by treating them as mechanistic processes does not mean that these processes in-themselves are mechanistic by nature, which is obvious if we do not ontologically relegate the qualitative aspects of energy to be secondary to its extensive properties.

It is different with the second law of thermodynamics, however, which Bergson famously claimed «is the most metaphysical of the physical laws in that it shows us – without any interposed symbols and without any of the artifices of measurement – the direction in which the world marches» [*ibid.*, 214]. In other words, the second law of thermodynamics stipulates the tendency that all physical changes have to «be degraded into heat, and that heat tends to be distributed among bodies in a uniform manner» [*ibid.*, 214]. Whereas the first law of thermodynamics depends on a conventional leveling of qualitative aspects of energy to a common unit of measurement, the second law follows the direction of the flow itself, and the tendency that Bergson describes for physical changes to be degraded into heat does not depend on any convention or artifice.

⁷ «We are forced to regard as a first and irreducible quality that by which a body is warm, or illuminated, or electrified, or magnetized» (author's translation).

Bergson makes some interesting observations regarding the second law of thermodynamics and life, anticipating the findings of Nobel Laureate Ilya Prigogine who found that entropy – in open, non-equilibrium thermodynamic systems with a constant energy input – can be productive of organized and dynamic forms, which is opposed to the one-sided 19th century conception of entropy as the arrow that points the universe towards heat death. Prigogine claimed that his findings lent credence to Bergson’s view of the passage of time being inextricably «related to the creation of unpredictable novelty, where the possible is richer than the real» [Prigogine and Stengers 1984, 72]. Bergson argued that, in terms of energy, what distinguishes life from materiality is «that life is possible everywhere that energy descends the incline described by [the second law of thermodynamics] and where a cause, moving in the inverse direction, can slow that descent» [Bergson 2023, 225]. Here Bergson anticipates contemporary findings in non-equilibrium thermodynamics that entropy, rather than simply pointing energy in the direction of degradation, can lead to the formation of organized and dynamic structures. Life is precisely that which moves towards novelty and higher degrees of organization. Of course, we know this does not mean that life violates the second law of thermodynamics. The extraordinary ability of living beings to reduce entropy locally (that is, ascend the incline indicated by the second law) is compensated by an even greater increase in the entropy of its environment. Nevertheless, Bergson recognized that the movement of life opposed the dissipative direction indicated by the second law of thermodynamics as it was originally conceived.

It is clear that Bergson was critical of the concept of energy in his insistence on the differences in kind of energetic processes and his insights regarding the relationship between life and the second law of thermodynamics. Nevertheless, he never attempted to reconceptualize energy *in toto* in light of his philosophy of duration, but he does pave the way for this project. When discussing the origin of the energy and motion of the universe, Bergson argues that

the problem is unsolvable if we remain within the field of physics since the physicist is obliged to attach energy to extended particles and, even if he sees these particles as nothing but

reservoirs of energy, thereby remains within space. The physicist would betray his role were he to seek the origin of these energies in an extra-spatial process. Nevertheless, the origin must, in my opinion, be sought precisely in some such extra-spatial process [*ibid.*, 215-216].

Here, Bergson is criticizing the spatialization of energy, namely, the idea that energy is something supplemented to extended particles in space. This makes sense, given his analysis of intelligence and intuition where we saw that static space and extended objects, for Bergson, are carved within the flow of duration by intelligence – there are no extended particles with energy attached to them. If reality is process, then we cannot think of energy as something we attach to particles or as a substance that remains self-identical through flux. If materiality is a constant flux, and the lines drawn by perception are merely footholds for our potential actions over matter, then energy, too, must be understood as flux. In other words, Bergson's project invites us to reconceptualize energy as change itself, rather than what remains constant through change or as something supplemented to discrete entities.

5. Conclusion: Energy and Duration

Let us summarize the argument up to this point. My contention is that the genealogy of energy reveals the ontological faith that there is constancy amid change, and that this constancy takes ontological priority in explaining the causes of motion in nature. Bergson's analysis in *Creative Evolution* of the cinematographic mechanism of thought deconstructs the assumption that movement can be derived from the immobile, and that this epistemological bias, present in ancient Greek philosophy and in modern science, is due to the suppression of instinct by intelligence, whose natural tendency it is to carve duration into terminal points of action that reveal to consciousness a world of static objects. Thus, out of the cinematographic mechanism of thought, we derive a spatialized concept of energy, where energy is motion supplemented to what is passive and extended, moving in the direction indicated by the second law of thermodynamics.

Thus, what we find at the birth of energy is that, although energy cannot be destroyed (the eternal) in accordance with the first law of thermodynamics, the second law of thermodynamics ensures that energy is always in flux (the ephemeral) in the direction of dissipation of useful mechanical work, because the universe must always move from states of lower entropy to states of higher entropy. The cosmology behind the idea of the ‘dissipation’ of ‘useful’ mechanical energy recalls the descent of levels of reality in Greek metaphysics from perfection to nothingness, the modern iteration consisting of the descent from the big bang to heat death. However, we should also note that energy is a distorted iteration of the actuality denoted by Aristotle’s *energeia*. That is, early energy science paints a picture of a mechanistic universe where the ‘actuality’ of energy is reduced to the conservation of its quantity over time, whereas Aristotle wanted to account for the teleology and differences in kind of motion through the concept of *energeia*. Nevertheless, regarding the first law of thermodynamics, Cara Daggett in her genealogical study of energy argues that

the conservation of energy reflects the scientists’ desire to know and understand the world, which requires that the world is knowable. Energy points to the enduring faith in nature as divinely designed to be accessible to human perception. In order to be knowable, the world must have some constancy through time – pure, random chaos would mean prediction and calculation are impossible [Daggett 2019, 41-42].

This reminds us of Bergson’s conclusions in his analysis of the cinematographical mechanism and its origin in the dynamics of intelligence and intuition, which offers the world up to consciousness in terms of static, knowable objects.

Bergson’s ideas in *Creative Evolution* offer us conceptual tools to interpret the history of the concept of energy as the history of attempts to provide an account of change in terms of spatialized conceptions of time. Conversely, this realization also opens the door to thinking of energy not as ‘what’ is constant in time, but as change itself. This is what it might mean to think of energy in terms of duration. Similar to how relativity subsumed Newtonian physics, the latter being a special

case of the former, expanding the concept of energy into the sphere of duration would imply that spatialized conceptions of energy would only be a special case of energy in the full context of duration. A spatialized conception of time reflects the limit of duration's tendency to materialize; the point at which the past loses its connection to the present and duration is decomposed into the simultaneity of frames/states that are characteristic of the cinematographical mechanism. Indeed, Bergson argues that at this limit «we catch sight of an existence made up of a present that endlessly begins anew – no longer any real *durée* [duration] nothing but the instantaneous that continuously dies and is reborn» [Bergson 2023, 179]. Furthermore, at this limit, duration is decomposed into perfect spatiality, which «would consist in a perfect exteriority of the parts in relation to each other i.e., in a complete and reciprocal independence» [*ibid.*, 181]. It is near this limit of duration that we encounter matter, and thereby the domain of modern energy discourse. I say 'near' because even at the smallest scales all we seem to find are fluctuations of energy, a fact encapsulated by the third law of thermodynamics which says that absolute rest is a physical impossibility.

The implication of this is that a purely materialistic understanding of energy corresponds to the limit where real duration tends towards materiality, and that energy as it is conceived in physics is ahistorical because it refers to what is conserved in the instantaneous present *despite* the passage of time. Thus, expanding the concept of energy into the domain of duration would involve incorporating historicity into our understanding of energy. Since duration proceeds by the swelling of the past into the present (the passage of time being characterized by the novelty of forms resulting from the creative evolution of the past in the present) the creative repetition of the flow of duration is the only thing that can be said to be constant through change. This is another way of saying that change is the only constant in time, an idea well-put by Bergson's belief that time is invention or nothing at all. Our understanding of what is constant through time, then, which has progressed under the banner of the concept of energy, would come closer to its end by expanding the concept of energy into the domain of duration.

I would like to conclude by offering an example of how Bergson's legacy of opposing descriptions of nature based on mechanical

causality or finalism has already been felt in the construction of contemporary science, perhaps most notably through the work of Ilya Prigogine, mentioned above. Prigogine's contributions to the field of non-equilibrium thermodynamics indicate the influence of a certain Bergsonism on contemporary physics. Prigogine's dream was to «contribute to the unification of science and philosophy by resolving the enigma of time» [Prigogine and Stengers 1984, 72], an endeavor largely inspired by the process philosophies of Bergson and Alfred Whitehead. He attempted this unification with his work on dissipative systems, for which he won a Nobel Prize in 1977. Dissipative systems clarify and extend Bergson's claim that life ascends the decline indicated by entropy, a claim similar to that of physicist Erwin Schrödinger who claimed that life feeds on «negative entropy» [Schrödinger 1992, 71]. Whereas classical thermodynamics dealt mostly with closed systems close to or at thermal equilibrium – where entropy always acts towards the degradation of complexity and the leveling of thermal gradients towards thermal equilibrium – it has been found that «in special cases in systems that are not in a state of equilibrium, the flow of energy and the reduction of gradients produces and sustains patterns, forms, and structures» [Crockett 2022, 50]. These special cases are what Prigogine referred to as dissipative structures. Dissipative structures reveal that, in far-from-equilibrium (open) thermodynamic systems with a constant energy input from the environment, entropy can actually be productive of organized and dynamic forms, such as organic life. The crucial implication of this discovery for our purposes is that it provides an account of the genesis of life that is immanent to materiality, rather than having to compartmentalize the science of life on the one hand and the science of matter on the other. The idea that life is immanent to material reality echoes Jankelevitch's description of Bergsonism as a monism of substance and dualism of tendency, where the tendency for novelty and the production of complex forms are immanent to materiality. This seems analogous to the dual capacity of entropy to degrade or produce complex, self-organizing structures. Prigogine's work on dissipative structures is thus a testament to the value of Bergson's thought of creative evolution for our understanding of the relationship between energy, matter, and life.

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Keywords

energy; duration; time; genealogy; metaphysics; epistemology

Abstract

I will diffract the genealogy of the concept of energy through Bergson's *Creative Evolution* to argue that, historically, energy and its proto-concepts are grounded in spatialized notions of time. Bergson's work not only demands that we rethink energy and its relation to time, it also allows us to see that the concept of energy as we know it depicts time and materiality as a numerical multiplicity, which effaces the differences in kind which are characteristic of energy transformations and real duration. To make this case, I first provide an analysis of Bergson's concept of the cinematographical mechanism of thought, which splits duration into a composition of distinct states strung together by the idea of an impersonal becoming. Bergson claimed that this is the epistemological model for both ancient philosophy and modern science, meaning that it is also the epistemological ground within which energy concepts in western philosophy and science have been theorized. I then show how Bergson offers a way to overcome this model of theorizing through his method of intuition, and how these conclusions might be extended to future energy concepts. Thus, I argue that 1) Bergson's work on duration allows us to interpret the genealogy of energy as the history of attempts to provide an account of change in terms of spatialized notions of time; 2) that his work offers a way of incorporating historicity into our understanding of energy; and 3) that thinking energy in the context of duration offers the possibility of conceptualizing energy as change itself rather than what remains constant through time.

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