Symphilosophie

International Journal of Philosophical Romanticism

Thinking Elasticity in Hemsterhuis, Novalis, and Beyond

Jocelyn Holland[*]

ABSTRACT

The essay focuses on writers who explored elasticity's metaphorical potential and allowed scientific perspectives of various phenomena associated with it to inform their philosophical and poetic writings. It argues that Hemsterhuis sets a precedent for speculative thinking about elasticity that is then integrated and expanded within Early German Romanticism and *Naturphilosophie*. It also shows how, around 1800, the philosophical discussions of elasticity are just as interested in metaphors of coil-springs as they are in those elastic phenomena that involve the media of light or air, and how Novalis proposes a way to synthesize these diverse yet related metaphors.

Keywords: science, elasticity, German romanticism, *Naturphilosophie*, Hemsterhuis, Schelling, Novalis

RÉSUMÉ

L'article se concentre sur les auteurs ayant exploité le potentiel métaphorique de l'élasticité et ordonné leurs écrits philosophiques et poétiques aux perspectives scientifiques des divers phénomènes qui lui sont associés. On soutient que la philosophie de Hemsterhuis sert de modèle de pensée spéculative sur l'élasticité au premier romantisme allemand et à la *Naturphilosophie*, qui lui donneront un prolongement inédit. On montre également dans quelle mesure les discussions philosophiques portant sur l'élasticité autour de 1800 s'intéressent tout autant aux métaphores des ressorts hélicoïdaux qu'aux phénomènes élastiques impliquant l'air ou la lumière ; et en quoi Novalis propose une façon de synthétiser ces métaphores diverses mais apparentées.

Mots-clés : science, élasticité, romantisme allemand, *Naturphilosophie*, Hemsterhuis, Schelling, Novalis

[*] Professor, Division of the Humanities and Social Sciences, Caltech (California Institute of Technology), 1200 E California Blvd, Pasadena CA 91125, United States – jholland@caltech.edu

Elasticity is a commonplace word, likely to conjure images as simple as a stretched rubber band snapping back into place.[1] In such contexts, elasticity is a relatively easy construct to visualize: a figure of departure and return in which materials are deformed before restoring themselves to an approximation of their prior shape. The ubiquity of phenomena associated with the concept of elasticity also makes it a core concept in introductory physics textbooks, where it appears in the context of collisions,[2] the properties of springs,[3] and as an example of potential energy. Yet however familiar these examples may be, they are not sufficient when it comes to a historical understanding of how elasticity was envisioned around 1800, and the ways in which physical descriptions of elasticity in the empirical sciences were transported into speculative discourses. The situation is complicated in part by the fact that there were a number of related words in circulation. In the German context around 1800, which I will focus on after setting the stage with the Dutch philosopher Hemsterhuis' groundbreaking metaphors of elasticity, the terms *Schnellkraft*, *Federkraft*, *Spannkraft*, and *Elasticität* could each make a legitimate case for being translated into "elasticity" in English. A second problem is that, along with the proliferation of technical terms, there was also a fundamental disagreement as to the origins of the phenomena associated with elasticity. Gehler's *Physical Dictionary*, the standard resource for recording the state of scientific knowledge at the end of the eighteenth century, has a section in its entry on elasticity devoted to "origins of the phenomenon" which begins with the joint disclaimers "we don't know anything about it" and "we are further behind in the explanation of this phenomenon compared to other phenomena" (Gehler 698). And yet a third challenge when it comes to describing the crossover between the empirical sciences and speculative thinking about elasticity has to do with the fact that the very different contexts in which elastic phenomena were described took speculative thought into distinct directions. It is one thing to work with the image of a weighted spring bouncing up and down before coming to rest, and quite another to use as a metaphor the image of the "elastic material" of light expanding in a three-dimensional volume.

Though an established scientific concept since Newton's day, the metaphorical potential of elasticity was only gradually realized in the years

[1] Thank you to Edgar Landgraf for providing feedback on a first draft of this essay.

[2] An "elastic collision" is defined as "one in which no [kinetic energy] is converted into other forms of energy, whereas an "inelastic collision" is "one in which some [kinetic energy] is converted to other forms of energy" (Benjamin Crowell, *Newtonian Physics* (1998-2001), p. 84.

[3] Hooke's law states that the force one needs to extend or compress a spring is in a linear proportion to the distance.

leading up to 1800. Goethe, for example, is much more interested in deploying *Elasticität* in descriptions of weather phenomena during his voyage to Italy than he is in incorporating it into his dramas, novels, and poetry.[4] Yet there were a few writers who explored elasticity's metaphorical potential by allowing scientific perspectives to inform their philosophical and poetic writings, writers whose work can offer an introduction to the emergence of speculative thinking about elasticity. The most important of these is François Hemsterhuis. Already in the 1770s, his philosophical dialogues connect the physics of elastic phenomena with metaphysical speculations, and they possess a degree of detail and breadth unrivaled by later writers. That said, among some writers associated with Early German Romanticism and German *Naturphilosophie* there is also a palpable interest in metaphors of elasticity. Around 1800, Friedrich von Hardenberg (Novalis), Johann Wilhelm Ritter, Carl von Eschenmayer, and Friedrich Schelling each engaged, in a novel way, in a kind of speculative thinking about elasticity.

The present essay is primarily concerned with the work done with elasticity as metaphor. It keeps in the forefront those aspects of elasticity that were present in late eighteenth-century science while exploring how the metaphor of elasticity was integrated into various contexts to test out speculative ideas. The two main goals of the essay are therefore to help draft a new chapter in the philosophical history of elastic phenomena and also to compare how Hemsterhuis and the later German writers integrate this scientific concept into their philosophical and poetic thinking. The fact that elasticity is a relatively unexplored concept in poetic and philosophical discourses may be due to a certain semantic confusion associated with it, as will be explored more closely below. It may also be due to the fact that "elastic" phenomena could encompass a very broad spectrum of materials, even including light, which was considered by some eighteenth-century scientists to be the least dense of materials. Such a broad spectrum translated into metaphors of elasticity that accomplish very different purposes, as the following pages will show.

[4] In notes from September of 1786 made near the Brenner Pass, Goethe refers both to the "elasticity of water" and to the "elasticity of air" as it relates to cloud formation (MA 3.1, 32). He also reflects on his use of the term: "Ich habe das Wort Elastizität, statt des in dieser Materie auch gewöhnlichen Wortes Schwere gebraucht, und es ist auch besser. Überhaupt aber sind meine Kunstwörter nicht die besten, komme ich zurück, so wollen wir meine Bemerkungen und Erfahrungen mit den Grundsätzen der Phisiker [sic] ihren Theorien und Erfahrungen zusammen halten. Ich bin leider nicht gelehrt wie du [Charlotte von Stein] weißt" (ibid.).

1. Elasticity's Plurality

Gehler's heading for *Elasticität* in his physical dictionary has a peculiar feature. While it is common for a heading to be followed by its equivalents in Latin, French, English, and other languages (such as the case with *Elektricität*, under which one finds *Electricitas, Electricité*, and *Electricity*), the one for *Elasticität* stands out for being followed first by three etymologically distinct German terms, as well as others from Latin and French:

> Elasticität
>
> Schnellkraft, Federkraft, Spannkraft, Elasticitas, Elater, Contentio, Palintonia, Elasticité, Ressort (Gehler 695)

The root meanings of these terms encompass a broad semantic field. *Schnellen* denotes leaping; *spannen* and *contensio* refer to the tension between two points. *Elasticitas* and *Elater* both give the sense of something that is being pushed away, which corresponds to the French *sortir*, the basis of the French word for spring, *Ressort*. For its part, *Palintonia*, as the Latinized form of the Greek *palintonos*, conveys the additional impression of a doubled, reversible movement back and forth. *Federkraft* takes its name for the German word for spring, *Feder*, thus relying on a biological metaphor whose original intuition – the "elasticity" of bird feathers – has almost entirely vanished.

As the proliferation of terms connected to the phenomenon of elasticity suggests, the semantic confusion has an epistemological basis. When Gehler clearly states that one does not know anything about the origin of elasticity (circa 1800, at least), he backs up his statement with a historical overview of attempts at explaining the basis of elasticity as a physical phenomenon that includes such names as Descartes, Newton, Johann Bernoulli, and 's Gravesande. From his overview, one can see that very different aspects of elastic phenomena were identified and discussed under the auspices of the general phenomenon, including the relative elasticity of solid, liquid, and gaseous materials, the transmission of sound, and others. A further example of how physical examples of elasticity can look very different from one another can be found in Kant's *Metaphysical Foundations of Natural Science* (1786), where he begins by defining the general phenomenon as follows: "Elasticity (spring-force) is the capacity of a matter, *when its magnitude or figure are changed by another moving force, to reassume them again when this latter is diminished*" (Kant 68, italics in the original). However, Kant then goes on to distinguish between "expansive" and "attractive" elasticity. The term "expansive elasticity" is used to describe situations where an object expands

after being compressed. Expansive elasticity can be either original (as in the case of "the fundamental material of the fluid we call air") or derivative, when it is coupled with a second phenomenon – Kant states that air has a "derivative elasticity in virtue of the matter of heat" (Kant 69). Attractive elasticity is, by contrast, "obviously derivative, as the term already shows" (Kant 68). In this case, Kant gives the example of an iron wire (such as a spring) that has been extended by a weight hanging upon it, and which snaps back into its original volume when the weight is removed. Not all scientific thinkers active around 1800 make the same distinction between "expansive" and "attractive" elasticity. Gehler's synopsis of theories of elasticity mentions nothing of the sort. Modern science also finds no use for "attractive" and "expansive" elasticities, since these each concern one and the same phenomenon. But the distinction does matter for the current discussion – even if not in the way Kant intended – because it helps situate the phenomenon of elasticity more directly in the kind of thinking governed by polarities, already present in Hemsterhuis, that comes to dominate Romantic and nature-philosophical thinking at the end of the eighteenth century.

2. Hemsterhuis

Elena Tavani has shown that even if "like Newton," Hemsterhuis understands attractive and repulsive forces as "ultimately responsible for various properties of bodies," he also "extends analogically the same explanations to the various relationships and properties of minds and souls and, therefore, he attributes to force a content that goes clearly beyond all its empirical effects" (Tavani 164). This idea certainly holds true for how Hemsterhuis uses the idea of elasticity in his writings. Understanding elasticity within a polarity that manifests in terms of action expanding either away or returning towards a central point not only helps bring Hemsterhuis and German Romantic and nature-philosophical thinking into dialogue, doing so can help complicate what Wiep van Bunge has referred to as the "three categories of secondary literature on Hemsterhuis" categorized by importance of his work for German philosophers such as Jacobi, Herder, Novalis, and the Schlegel brothers, the significance of Hemsterhuis's Newtonianism, and his connections to Greek philosophy.[5] But what a focus on a particular mechanical concept in Hemsterhuis's writing such as elasticity (rather than on the concepts of attraction and repulsion more generally) can accomplish is to help show how scientific ideas interact with areas of thought traditionally

[5] Wiep, "The Philosopher as Escape Artist," 172.

subsumed under aesthetics and morality. One finds this kind of crossover, for example, when images connected to the mechanical concept of elasticity are deployed in metaphysical contexts, for example as a metaphor for the soul, an idea that connects Hemsterhuis and German Romanticism. In his essay *Letter on Man and His Relations* (1772), Hemsterhuis defines elasticity as a basic quality of the soul, and Novalis equates the soul with a spring (*Feder*) in his own writing. The metaphor can serve a dual purpose for both thinkers, at times signaling attraction, and at times engaging in a kind of innovative and "expansive" speculative thinking, much in the way that the expansion of the "fluid" medium of air was characterized as a kind of expansive elasticity. Hemsterhuis goes so far as to state that "everything is coil-spring," and Novalis thinks of elasticity almost as broadly: in conjunction with such seemingly unrelated qualities as innocence and patience, in the context of thoughts in general, and also as a definitive feature of a poet's creativity. For the purposes of the following discussion, then, attraction and repulsion will be subsumed under the phenomenon of elasticity; readers can keep these two orientations in mind – elasticity as movement away from the center, and elasticity as a kind of return to an attractive focal point – and will also be able to see how the use of one on the other tends to correlate to the degree of materiality in the physical or metaphorical context.

It is no simple matter to generalize the tendencies in Hemsterhuis's thinking about elasticity, given that he tests out quite different aspects of it in the *Letter on Desires*, the *Letter on Man and his Relations*, *Aristaeus*, and *Simon*. As a metaphor, elasticity first appears in Hemsterhuis's essays to describe an impulse that originates within ourselves and is directed outwardly. The *Letter on Desires* (1770), for example, describes how some people possess an internally generated "elasticity" that expresses itself in outward-reaching acts of love and desire. This may occur in moments of aesthetic appreciation of an external object, such as a painting or other work of art,[6] even though such moments are also prone to the failure for their inability to achieve an ideal unity of one's being and essence with the "beautiful thing" under regard (1.80).[7] The perception of heterogeneity – that the statue or other object is,

[6] Daniel Whistler reads Hemsterhuis's "Letter on Desires" as the writing of someone "very influenced by the mechanistic sensualism of his French contemporaries" and for whom, as well, a "neoplatonic metaphysics" resides "beneath the empiricist terminology" (Whistler, "Discipline of Pious Reason," 59). With regard to the soul's desire for a perfect union with a desired object, Whistler writes "the comparison with Plotinus is revealing: as for Plotinus so for Hemsterhuis, to desire something is to desire to become one with it. Moreover, and also in line with Plotinus, such desire is a force of attraction inherent in all matter" (60).

[7] All quotes are from the two-volume translation of Hemsterhuis's early works and dialogues by Jacob van Sluis and Daniel Whistler. References are to volume and page number.

in its perfect beauty, so dissimilar to one's imperfect self – acts as a hard limit to the elastic expansiveness of desire. Hemsterhuis nonetheless salvages the value of this failure by suggesting that it only goes to prove the great sensitivity of those souls who "join the finest and most exquisite tact to this enormous internal elasticity that makes them love and desire furiously and sense [things] excessively – that is, to those souls who are either modified or disposed in such a way that their attractive force [i.e., the force of their attraction directed toward external objects, J.H.] finds as few obstacles [as possible] in its tendency toward this goal" (1.80). Semantic clues, such as the "internally generated" elasticity, its act of "expression" in the contemplation of an exterior object, and the fact that it is a force that "tends toward" a particular goal, reinforce the idea of an originally interior state of the soul that strives towards and ultimately fails in a desired unity with something exterior to itself.

In the *Letter on Man and His Relations* (1772), Hemsterhuis expands upon the idea of the soul's elasticity, shifting his attention from the aesthetic context of an individual's appreciation of a work of art to the context of social relations. Just as one needs light and air to see and to hear, the heart and conscience are only "manifest" when humans are in social settings rather than alone: "It is then that passions and desires crowd in, that the soul acquires its elasticity, senses itself, loves itself, esteems itself, and recognizes its source" (1.104). In other words, Hemsterhuis believes that we only become cognizant of the fact that the soul possesses elasticity when we become aware that there are other expressions of volition (or, to use Hemsterhuis's term, other "velleities") in our environment in addition to our own. For Hemsterhuis, such a plenitude of velleities, each desiring its own elastic expansion, connects to the Aristotelian idea of the "horror vacui," and also to the physical idea of the elasticity of air that expands to fill any given space. So too does the soul, until it encounters resistance, just as air or light might meet a particular obstacle. The idea of the soul's elasticity is repeated in subsequent essays. *Simon* (1787), for example, also articulates this idea as an expression of order from chaos through the suggestion the soul determines itself from indeterminate velleity into particular acts of will (2.116).

At the same time, these scenarios where elasticity is formulated in terms of outwardly-directed metaphors of desire and volition which originate within the soul, compatible with the intuition of the elasticity of air, do not tell the whole story of his inventiveness with the metaphor of elasticity. Hemsterhuis also uses it as an instrument for philosophical reasoning in the *Letter on Man and His Relations* to articulate the transition from human capabilities (i.e., man as a "being who has the faculty of sensing, thinking, and reasoning") to

a "man as an acting being" (1.94). He stages the transition with reference to the laws of physics, beginning with the idea of inertia encapsulated by Newton's first law – that a body at rest will stay at rest, and a body in motion will stay in constant motion, unless acted on by a force. By analogy, the question of overcoming inertia raises the question of how bodies – specifically, human bodies – manage to move from states of rest to motion, or from uniform motion to accelerated motion, and leads Hemsterhuis to conclude that the soul, though distinct from the body, is its "motor principle" (1.94). The act of velleity is, in this framework, the formal expression of the soul's desire to move the body. This idea is tested out a few pages later in the form of a thought experiment that connects the velleity of the soul directly to the elastic force of a spring.

Hemsterhuis sets up the thought experiment by first positing that velleity is the "necessary effect [=motive force] of a physical cause" (1.98). He then imagines a scenario where an "act of will wants to produce a physical effect," and "this effect is to be the displacement of a weight of a hundred pounds" (1.98). The problem, however, is that one lacks the necessary physical strength and is only able to move a weight of fifty pounds. Hemsterhuis claims that there are three possible ways of envisioning an outcome to this situation: that the velleity will either "be annihilated, be negative, or continue" (1.98). His uses the mechanical spring as a metaphor to arrive at an answer:

> one will say that the case I am supposing is exactly like that of a coil-spring. Without entering here into an inquiry into the nature of the coil-spring, although it would be infinitely curious, I answer that the means the act of will employs may in fact be like the case of the coil-spring, but not the act of will itself. Let us posit that a coil-spring with a force of fifty pounds acts against an obstacle of a hundred pounds, then it is true that the action of the coil-spring is neither destroyed nor negated but will continue permanently. And this coil-spring continues its action only in a uniform manner, that is, with the force of fifty pounds, just like the means the act of will employs that are just as powerful. Now if the act of will was a modification caused by the impulses of some parts of matter, one of three would have to be [the case], according to good physics: either that this act of will was negated, or that it was annihilated, or that its intensity remained the same in accordance with that of the means employed, that is, with the power of fifty pounds. But none of these happens in this case: the will carries on regardless and still wills to move one hundred pounds. (1.98)

The central problem of Hemsterhuis's thought experiment becomes clearer against the backdrop of a comparable model Kant used to illustrate the idea of "real contradictions" in an essay on negative magnitudes, published in 1763, some nine years before Hemsterhuis's *Letter on Man and His Relations*. In a "real contradiction," Kant writes, two predicates associated with a thing can exist in opposition to each other without invoking the law of contradiction. Kant provides the example of a ship at sea held motionless by two winds of equal strength that blow in opposing directions.[8] The product of two canceling forces is still "something," however, and he qualifies that statement by adding that the "consequence of such an opposition is rest, which is something (*repraesentabile*)."[9] "Rest," in the sense Kant uses it here, is one of the most common concepts of static mechanics and is used to describe a state where a body or system is in equilibrium due to a balance of forces.

When one considers Kant's image of the ship being held in place by two equal and oppositely-directed gales of wind alongside the stasis central to Hemsterhuis's image of a coil-spring pushing against a rock while being "motivated" by a veillity greater than the actual material strength, certain similarities and differences become apparent. From a purely physical point of view, there is the similarity that both cases exemplify static equilibrium. In the one case, two equal forces hold the boat in place, and in the other case, one also does not see any movement: in physical terms, the amount of force the coil-spring exerts on the rock is equal to the amount of force the rock exerts on the coil-spring. The extra fifty pounds the rock weighs does not factor into this scenario, except for the fact that it constitutes an immoveable mass from the individual's point of view. From a different perspective, however, an important distinction arises. Kant's point is that the "positive" and "negative" forces cancel each other out in terms of effect, but they both still remain active and present. Hemsterhuis, for his part, couples a physical phenomenon with the metaphysical idea of volition. The velleity of the soul, even though it is expressed as the desire to move an object of one hundred pounds, remains a constant until the soul decides otherwise and is qualitatively different than any measurements of physical strength.

[8] Iain Hamilton Grant remarks that "it is instructive that Kant's sailing ship example pitches logical contradiction against opposing *forces*, since this tallies with Fichte's practical–theoretical concept of *positing* as activity" (Grant 88). Grant connects the forces of real opposition to the striving of the I and not-I in Fichte's model: "The I's continuous forces and quanta of activity produce and form reality" (ibid.).

[9] Kant, "Negative Magnitudes," 211.

These examples testify to Hemsterhuis's originality as well as to the degree he is willing to mine the potential of elasticity as a metaphor for the actions of the soul. Unlike contemporary thinkers who understand the activity of the "soul" entirely as a problem of the "body" (such as Diderot, for example), Hemsterhuis retains the idea of a soul even as he is interested in keeping mechanical phenomena as a reference point. These same examples also underscore the fact that there are limits to be respected when constructing physical and metaphysical comparisons – that the physical strength of a human body is certainly not the same as the metaphor of will informing a soul's desires although they exist in a relationship of instrumentality (just as Hemsterhuis is careful to distinguish between the "means" the act of will uses and the act of will itself).

With the introduction of the notion that the soul is not alone in its desires – that there are other desiring and acting souls in the world with velleities that might be directed in ways that compete with our own – Hemsterhuis raises the broader question of to what degree we are "active" as opposed to "reactive" individuals. Precisely the question of how it can be difficult to distinguish between action and reaction with metaphors of elasticity arises in Hemsterhuis's philosophical dialogue *Aristaeus* (1779). Aristaeus and Diocles begin the dialogue with a rumination on order and disorder, both from a cosmic perspective and from a personal one. At the same time, the question is also raised of what we are even able to comprehend with our limited human faculties. As the conversation shifts from the notion of a "relative" order innate to the person who perceives it, to the notion of a universal intelligence or "world soul," Aristaeus and Diocles stake out different claims. For Diocles, this shift amounts to a change in perspective from thinking about the universe as an assortment of physical phenomena towards thinking about the universe as intellectual. As Hemsterhuis shows, when one adopts the latter perspective, further adjustments in perception necessarily ensue: "images of relationships and relations between things are concentrated into or placed in the imagination of another Being; and this Being is endowed with a faculty called intellect" (2.76). Another consequence of adopting the notion of a world soul as a governing intellect is that matter is relegated into the category of the reactive: its "most incontestable essential property," according to Diocles, "is to react against all action" (2.77). He then introduces the term elasticity – "a rather vague word, and one which masks our ignorance in many cases" (2.77) as he admits – to stand in as an example that applies to a broad range of phenomena.

Diocles begins with a single image: an illustration of elasticity that refers to an uncompressed spring, one which can only be compressed "by the action

of an alien force" (2.77). The compression occurs in proportion to the "tenacity" of its material, and when the cause is removed, the spring returns to its original state (2.77). From this single image, Diocles arrives at a number of generalizations regarding both the cause of compression and the reaction of the spring. One is the claim that "what we call elasticity is but one and the same thing as inertia or that faculty of reaction" (2.77). Another is the cause which compresses the spring in the first place is more scientifically interesting than "[the cause] of the activity of the spring which is manifest in the reactivity of its inertia" (2.77), which leads to the claim that "this cause, taken in general, is the same as that which governs organization, the formation of substances, and the direction of planetary orbits" (2.77) and that it is the same force as that which "links dead and inert parts of matter, and forces them to live and to act, by way of the very principle of their own inactivity" (2.77-78).

The idea that the compression of a spring occurs "by the action of an alien force," coupled with the notion that there is a universally active intellect – the world soul – that positions itself as the ultimate origin of all conceivable phenomena, raises questions which are, as Hemsterhuis himself intuits, not aided by the "rather vague" term elasticity. One question is how to interpret the motive quality of the soul in terms of action and reaction. Is it active, intruding as an external force onto the inertial frame of reference of the body, causing it to move – or to increase its rate of speed? Or is the human soul itself simply to be understood as reactive when it comes to the activity of the world soul? A second, equally pressing question has to do with the materiality of the metaphor. The coil-spring described in *Man and His Relations* and the compressed spring of *Aristaeus* each take advantage of an image that is quite easy to visualize: that of a metal spring that may be compressed or distended. But the same image does not quite fit with descriptions of an outwardly-oriented desire that streams constantly away from the hypothetical central point of the soul. The metaphorical connections Hemsterhuis engenders through his references to elasticity in those cases do not specifically mention materials such as light or air. But to a latter-day reader – and in particular, a reader grounded in German Romanticism and *Naturphilosophie* – these are precisely the models that best fit Hemsterhuis's descriptions. To accept this distinction is to see in Hemsterhuis's writing the nascence of two co-existing material metaphors of elasticity, each with their own language and parameters, and each with their unique ability to contribute to metaphysical speculations.

3. Elastic Speculations in Romanticism and *Naturphilosophie*

The first part of this essay showed how Hemsterhuis sets a precedent for later speculative thinking about elasticity by constructing philosophical scenarios that draw upon different physical phenomena grouped under the heading of elasticity. Hemsterhuis's use of the coil-spring as a metaphor has not escaped scholarly attention. In a recent essay on Hemsterhuis's reception in the German context, Gabriel Trop describes how the spring was a "basic figure" of the philosopher's thought, functionally equivalent to Goethe's 'primordial phenomenon': "by archetypally embodying and disclosing an ontological dynamic that subtends all individuated things" (Trop 36). As far as this description of a figure of elasticity goes, however, it perhaps does not go far enough. As the following pages will show, there is more to the idea of elasticity than can be captured by the metaphorical image of the coil-spring, and the aspects of elasticity compatible with light rather than solid metals, already suggested in Hemsterhuis's writings, have a more significant role to play around 1800. The present section will show how, around 1800, the philosophical discussions of elasticity are just as interested in metaphors of those elastic phenomena that involve the media of light or air -- where it is no simple matter of a material "deformation" and return. When Hemsterhuis's readers make the case that he is a "paradigmatic thinker" for the Romantics in various ways, they are usually thinking about these writers' use of moral and aesthetic categories rather than how they integrate scientific concepts into their work.[10] The following pages will first take a broad look at how nature-philosophical writers such as Carl von Eschenmayer, Friedrich Schelling, and Johann Wilhelm Ritter construed elasticity beyond the coil-spring. These examples will set the stage for the concluding section of this essay, with its focus on how Novalis integrates various metaphors of elasticity within a single conceptual framework while also achieving a balance between the moral / aesthetic categories and scientific discourses.

Just as it is for Hemsterhuis, elasticity is directly related to forces of attraction and repulsion in Eschenmayer's 1797 *Säze aus der Natur-Metaphysik auf chemische und medicinische Gegenstände angewandt* [Propositions from Nature-metaphysics Applied to Chemical and Medicinal Objects]. Like his contemporaries, such as Ritter, Eschenmayer imagines a spectrum of materials differentiated by their respective balance of attractive and repulsive forces. His speculative leap occurs when he transposes this spectrum of balanced forces into a relation whose terms are defined by elasticity (which for him is correlated to the force of repulsion) and mass (correlated to the

[10] Trop, "Hemsterhuis as Provocation," 37.

force of attraction): "Thus a material of single mass and double elasticity would maintain equilibrium with a material of doubled mass and single elasticity" (*Propositions* 24). He then makes his comparison more explicit: "Since elasticity behaves precisely as velocity did in the above proposition, from which the law of the lever was derived, both of them must therefore be able to be returned to one another, and to deliver the same results in their application to mechanical or dynamic quantities" (*Propositions* 25). To drive the point home, Eschenmayer introduces the example of water temperature. "Every temperature of water between its boiling point and freezing point can be understood as having emerged from two different temperatures, of which the one is larger, the other smaller, than the middle temperature" (*Propositions* 25). Because every temperature can be understood as a composite of the weight of the water and the "degree of elasticity of the warmth," it can therefore, "according to the analogy with the lever, be called a quantity of motion, and the middle temperature can be seen as a common hypomochlion, against which two such quantities of motion are working" (*Propositions* 25). If one recollects the proposition associated with the mechanical lever that says in the case of equal weights and velocities that the distance from the fulcrum point must also be the same, then, Eschenmayer argues, it must also be true that in the case of equal masses of water, the negative and positive degrees of elasticity are also in equilibrium: "thus the mechanical law of the lever can be applied precisely to dynamic quantities" (*Säze* 26). Eschenmayer does not clearly explain what the "elasticity" of warmth is in physical terms. As it was for Diocles, here too elasticity is "a rather vague word." Eschenmayer certainly exploits elasticity's terminological vagueness, however, because it allows him to create relations of balance and proportion among a number of different concepts – such is the intellectual exercise of the *Säze* in regimes ranging from chemistry to physics to the mind.

In contrast to Eschenmayer, Friedrich Schelling's interest in elasticity is focused much more on light, considered the least material of substances. This is evident in two of his key nature-philosophical treatises published contemporaneously to Novalis's own philosophical work: the *Ideen zu einer Philosophie der Natur* (1797) and *Von der Weltseele* (1798). In each case, when the phenomenon of elasticity is connected to an analysis of light, it is generally understood as a tendency to expand in space unless resistance is encountered. In the *Ideen*, Schelling conceives of light's elasticity by setting it in an analogical relationship to air:

> in physics it is advantageous to make reference to analogies. Thus the elasticity of air is proportional to the pressure (the resistance) it suffers.

> Air would stop being elastic as soon as it encounters no resistance, that is, as soon as it expanded infinitely. Based on this analogy, light can only be elastic insofar as it encounters *resistance* (Schelling, *Ideen*, 127)

This analogy exhibits a kind of parallelism with its own subject matter: like air, since the analogy encounters no hypothetical resistance, it extends even further. When we pursue the analogy, claims Schelling, we can come to know something about elasticity: that it is only possible between two extremes (which themselves are never found in nature), understood as "infinite expansion" on the one end and infinite compression on the other. The physical image informing this analogy is demanding for any reader who tries to share Schelling's spatial intuition: the mind is invited to imagine an elastic movement from a point in space to the unimaginable extent (volume) of the universe. Another physical phenomenon will eventually connect to this line of thought: Schelling engages in further analogical thinking in the chapter on electricity, where, based on the examples of the elasticity of light, he arrives at the idea that everything that either promotes or hinders elasticity seems to do the same for electricity (*Ideen* 149). An actual definition, equating elasticity with "the force of repulsion of bodies, insofar as it has its *determined* degree," is only introduced at a later point in the treatise (*Ideen* 222).

Schelling's reflection on the elasticity of light in the *Weltseele* treatise, published one year after the *Ideen*, uses a slightly different conceptual apparatus. In Part One of the treatise, "On the First Force of Nature," light is considered for its quality as the finest fathomable material, and not as an analogy to air: "The matter that in every system radiates from the center to the periphery – light – moves with such force and velocity that some have even doubted its materiality" (Grant translation, 74). And even though the image Schelling conjures seems a far cry from more conventional models of an equilibrium of forces, such as one would find on a weighted balance, Schelling assures his readers that the difference is only one of degree. Equilibrium will always be reached, eventually, because there is no infinite space for light to stream into. This is not Schelling's final word, however: his aim in this passage is for readers to understand light as something "complex" or "composed" (*zusammengesetzt*), much as a point on the arm of the balance correlates to a tension of opposing forces. The purpose of this passage in the *World Soul* can therefore be read as a thought experiment geared towards pushing the concept of static equilibrium to a material limit by imagining a scenario where it applies to what was believed to be the least dense material of all substances. By contrast, the standard examples, such as that of a balance held motionless by two weights at distances from the fulcrum point

that the mechanical moments are equal, do not require any concept of elasticity at all for Schelling. In the case of light, however, it becomes indispensable.

> We will consider *light* not as a simple element, but rather as the product of two matters, one of which, as elastic as light, can be called the *positive* matter of light…and the other, less elastic by nature, the *negative* (ponderable) matter of light.
>
> The positive matter of light is, in relation to light, the ultimate ground of its susceptibility to expansion and to *that extent*, absolutely classic, although we cannot at all think it *as* matter without considering even *its* elasticity in turn as finite, that is, as itself *composite*.
>
> (*World Soul*, Grant translation, 79)

Schelling's image of light's elastic expansion is one of bounded unboundedness – the reader is challenged, conceptually, to create a framework or scale whose endpoints exceed the unbounded phenomenon itself. Unlike Hemsterhuis, for whom the elasticity of the soul's velleity was also eagerly expanding to fill the vacuum around it, before coming into contact with other velleities with the same goal in mind, Schelling's image contains no agency to anchor it.

Schelling's contemporary, Johann Wilhelm Ritter, found himself confronted with a similar challenge, which he framed in a much different way. In Fragment #111, from the collection titled *Fragments from the Estate of a Young Physicist* (1810), he uses elasticity analogously to Eschenmayer, as a way of visualizing the scale of chemical affinities by conjuring a scenario in which a fluid dissolves a gas ("or has [the] gas dissolved within itself"). In this scenario – a common one for chemical reactions in the laboratory – the fluid, according to Ritter "does the same thing which an infinite pressure would do." At the same time, from the gas's perspective, there occurs the removal of its chemical "cohesion" (what we would today describe as a breaking down of chemical bonds). The water thereby "removes" all elasticity from the gas, through a finite pressure applied "equally in *every* point of the gas. This leads Ritter to the following chiastic statements:

> Infinite pressure on finite surface = finite pressure on infinite surface
>
> Infinite antipressure in finite surface = finite antipressure in infinite surface
>
> (Fragment #111)

His conclusion is that all values that fall within the notion of "finitude" – values that denote the finite pressure and antipressure – correlate to a particular chemical affinity. Compared to Schelling's attempts to frame the equilibrium of expanding light, one can see that Ritter also conceives of elasticity as a physical phenomenon on a scale between two extremes not found in nature. Whereas Schelling points towards the infinite, Ritter attempts to bind it chiastically, but in each case, elasticity acts as the conceptual instrument to facilitate thinking beyond what is possible.

4. Novalis, Synthesis

In the work of Novalis, the various strands of "elastic" thinking that have been in play since Hemsterhuis – elasticity as the expression of desire and other states of mind, and its distinct usage when connected to metaphors of coil springs and "elastic light" – come together.[11] In the key novel of Early German Romanticism, Novalis's *Heinrich von Ofterdingen*, the elasticity of light appears as a metaphor that structures an analogy between the way our outwardly-reaching mind (*Gemüth*) encounters nature and the refraction of light on a solid body: "[a body] holds [light] back; it breaks it into proper [*eigenthümliche*] colors; it ignites a light on its surface or within it" (I.281). The elasticity of light, ceaselessly expansive, is something to strive for, and to imitate: "the true mind [of the poet] is like light, just as calm and sensitive, just as elastic and penetrating, just as powerful and just as unobtrusively effective as this delectable element" (I.281). What for Schelling was at the limit of the conceivable becomes for Novalis an instrument of poetic technique. Rather than being overwhelmed by what appears to be a potentially infinite expansion, one should strive to imitate it.

A note from the *General Brouillon* operates in the same vein with an observation couched in an ambivalent syntax: "Ächte Unschuld – ist absolute *Elasticität* – nicht zu überwältigen" [genuine innocence – is absolute *elasticity* – not to overpower] (III.273.188). The actual confusion lies in whether innocence and elasticity both occupy the subject position, or whether they

[11] Dalia Nassar has called attention to the pivotal role Hemsterhuis played for Novalis's thinking about morality through an analysis of the notes collected under the heading of "Hemsterhuis-Studien" in the Novalis critical edition. The present essay's focus on elasticity as a guiding concept does not naturally lead to that part of Novalis's writing, but Nassar's claims that "in his notes on Hemsterhuis … Novalis introduces the idea of an organized body of knowledge that seeks to overcome the divisions of the disciplines" and that it is in the *Hemsterhuis-Studien* that Novalis "begins to develop a conception of the organic, which reappears throughout his work", and can serve as solid reminders as to the extent of Novalis's intellectual engagement with Hemsterhuis (Nassar 40).

are split here into a subject-object relationship, but more important for the present discussion is the fact that Novalis's notes accumulate an array of psychic phenomena where elasticity is allowed to operate as a metaphor. In addition to innocence, for example, there is another worthy quality: patience, in the sense of the acquiescent sufferance of a lack or of an excess. In a note framed under the heading "psychology" dating from September through October of 1798, Novalis writes that "True patience testifies to great *elasticity*" (III.291.289).

Novalis's scientific notes on elasticity group it with concepts he deems to be related: "coherence, density, absolute gravity, specific gravity, and hardness" (III.52). These are all-purpose concepts which could lend themselves to describe phenomena in various physical and chemical experimental contexts. Another note grouped under the heading, *Großes Physikalisches Studienheft*, however, takes up the idea of elasticity in the context of electrical conduction: "To arm [*armiren*] means … to bring into contact with a specifically elastic body" (III.55). Rather than finding ourselves in a physical environment where light or air is ceaselessly expanding, Novalis integrates the notion of constant movement in a different way, by granting the elastic body the function of medium through its ability to conduct electricity. Novalis continues in the same fragment by structuring a parallel between elasticity and conductibility, where "incomplete" conductors and nonconductors are incomplete specifically elastic[12] bodies, and a "complete" elastic conductor is a complete conductor *and* a complete nonconductor at the same time. Elasticity, he concludes, is therefore "*relative* Capacity and excitability [*Erregbarkeit*]," which leads him to the blanket statement: "Everything synthetic is *elastic* – more or less. Complete synthesis – complete elasticity" (III.55). The term "synthetic" underscores the fact that the concept of elasticity, for Novalis, exists in a relation of two discrete qualities to one another, rather than in an isolated state.

Novalis's most illuminating statement on elasticity is also the one with the greatest claims to universality, beginning with the phrase "there are several kinds of *unknowns*" and ending with the question "what is a *phenomenon*?" (III.403.703). These open-ended lines of philosophical questioning frame a cluster of further concepts. Subject, object, space, time, sickness,

[12] Gehler's *Physical Dictionary* defines specific elasticity as follows:
"Through this word, one expresses the relation between absolute elasticity and density [*Dichtigkeit*] of the elastic material, so that one attributes to the material a *greater* specific elasticity if it presses by the same density *more strongly*, and attributes to the material a *lesser* specific elasticity if it presses by the same density *less*. … This word thereby expresses a relative concept, just like the word thickness itself." (vol. 1,711-2).

soul – they all have a role to play. It is the concept of elasticity, however, that facilitates the desired connection. Here is the note in its entirety:

> There are various kinds of *unknowns*. / Subj[ect] and Obj[ect] is as much as sense [*Sinn*] in general and object [*Gegenstand*] – or stimulus [*Reitz*]. A constant change is a temporal change. Emergence of times – from the relative, and thus gradually decreasing elasticity of our thought-action. Spaces and times are symptoms of weakness. / Every true sickness is *fever – broken health* – (see colors.) Exchange of a pos[itive] and neg[ative] condition of health.
>
> (Application of the concepts of *elasticity*, brittleness – softness – hardening etc. to the body etc. and the explanation of its phenomena. The soul = *spring* [Feder] = maximum of the spring effect – *pushing over* [*übertreiben*] – *driving under* [*untertreiben*].
>
> (Mixture of chemical and mechanical elasticity.)
>
> The external is as it were only a partially translated inside – a *higher* inside. (What is *phenomenon*?) (III.403.703)

The first sentences are not joined by any particular sequential logic but, taken together, they establish conditions for spatial and temporal coordinates: the existence of multiple objects in space, and the perception of their duration framed as change over time. As indicated by the opposition of subject and object, the initial discursive context of this note is psychological, the realm of thought-actions. Novalis situates the "emergence of times" in proportion to a loss of elasticity in our thinking. It is not surprising, then, that he diagnoses the loss of cognitive elasticity as a kind of pathology, based on the claim that the manifestation in spaces and times are symptoms of weakness. Imagining the condition whereby one would possess a perfectly elastic "thought-action" – such as Klingsohr describes the mind of the poet in Novalis's *Heinrich von Ofterdingen* – could help, however, because in such an imagined state of mind where the action of thinking is immeasurably fast, faster than any physical phenomenon, thinking becomes perfectly expansive. As it accumulates references to pathologies – in the form of "sickness," "weakness," and "broken health," as they are accompanied by their physical counterparts of "brittleness" and "hardening" – the note then incorporates the more materially dense metaphor of the coil spring, allowing the two dominant metaphors of elasticity we have been working with all along, that of the elasticity of light and of the coil-spring, an uneasy cohabitation in the fragile house of the body. It is from within the framework of the body that the mind can practice its elastic expansions, that the soul can assume its spring-like operations, and

that the surrounding parts can also come together in varying degrees of material elasticity, some brittle, others pliable. In this model, constructed as it has been with the help of what has been decried as a vague and poorly understood term, the concept of elasticity finds a home, as it were.[13] The body as articulated in Novalis is not just the physical container of velleity in Hemsterhuis's sense of the word, but an amalgam of qualitatively and quantitatively different phenomena, an architectural structure whose pliable joints reveal elastic resilience.

The Romantic-era coupling of two models of elasticity – one in the easily visualizable form of the coil-spring and the other in the more challenging idea of an "elastically" expanding light that seems to exist at the border of materiality – proves with hindsight to be a fleeting constellation. The scientific discourse on light shifts precipitously throughout the next decades. Already prior to the eighteenth century, the argument about whether light is best understood as a particle or as a wave had emerged, with Newton and Huygens at the forefront. At the very beginning of the nineteenth century, Thomas Young's 1803 address to the Royal Society detailed experiments, published one year later in the paper *Experiments and Calculations Relative to Physical Optics*, that he took as proof that light is best understood as a wave rather than as a particle. Subsequent theories and experiments by Maxwell, Einstein, and others create a more complicated picture: from today's perspective, light is considered to be comprised of particles, photons, which have no mass.

The notion of light's "elasticity" fell by the wayside in the course of the nineteenth century. From the perspective of a philosophical narrative reaching from Hemsterhuis to the Romantic era, however, it had already served its usefulness as a metaphorical counterpart to the elastic coil-spring. The "looseness" of elasticity, in terms of which phenomena it encompasses and the language one uses to express it -- offers a flexible way of relating Hemsterhuis to Novalis and the nature-philosophical tradition without having to define the relationship in terms of a reception history. What for Hemsterhuis is an openness to testing out various aspects of elasticity through extended metaphors and thought experiments manifests in Novalis as a desire to synthesize the various metaphorical manifestations of elasticity.

[13] As Gabriel Trop has shown, Hemsterhuis "insists on a stark distinction between body and soul," but still "explores conceptual operations – specifically those attributed to the figure of the organ – that integrate these two differentiated domains into an overarching functional framework and bring them a zone of commensurability with one another" (Trop, 37). In the note from Novalis, one can see the concept of elasticity, within the general framework of the body, taking a similarly mediating position.

With reference to Hemsterhuis and Novalis, as well as to Novalis's nature-philosophical contemporaries, one can therefore speak of a shared affinity for elastic metaphors that use late-eighteenth-century scientific understandings of elasticity as a focus through which more familiar concepts such as desire and aesthetic appreciation are channeled, and one can also see how elasticity becomes a reference point for a broad array of phenomena that fall under the rubric of Romantic-era polarities.

Works Cited

van Bunge, Wiep, "Frans Hemsterhuis: the Philosopher as Escape Artist" in *From Bayle to the Batavian Revolution* (Leiden, Boston: Brill, 2018).

Crowell, Benjamin. *Newtonian Physics* (Fullerton: Light and Matter, 1998-2001).

von Eschenmayer, Carl August. *Säze aus der Natur-Metaphysik auf chemische und medicinische Gegenstände angewandt* (Tübingen: Jakob Friedrich Heerbrandt, 1797).

Gehler, Johann Samuel Traugott. *Physikalisches Wörterbuch oder Versuch einer Erklärung der vornehmsten Begriffe und Kunstwörter der Naturlehre*, volume 1 (Leipzig: Schwickert, 1787), 695-711.

von Goethe, Johann Wolfgang. *Italien und Weimar 1786-1790*. Münchner Ausgabe 3.1. Edited by Norbert Miller and Hartmut Reinhardt (Munich, Vienna: Carl Hanser, 2006).

Grant, Iain Hamilton. "Schelling – On the World Soul" in *Collapse VI* (2010), 66-95.

Grant, Iain Hamilton. *Philosophies of Nature after Schelling* (London and New York: Continuum, 2006).

Hemsterhuis, François. *Early Writings, 1762-1773.* Volume 1 of the *Edinburgh Edition of the Philosophical Works of François Hemsterhuis*. Edited and Translated by Jacob van Sluis and Daniel Whistler (Edinburgh: Edinburgh University Press, 2022).

Hemsterhuis, François. *Dialogues, 1778-1787.* Volume 2 of the *Edinburgh Edition of the Philosophical Works of François Hemsterhuis*. Edited and Translated by Jacob van Sluis and Daniel Whistler (Edinburgh: Edinburgh University Press, 2022).

Kant, Immanuel. *Metaphysical Foundations of Natural Science.* Trans. and ed. Michael Friedman (Cambridge, New York: Cambridge University Press, 2004).

Kant, Immanuel. "Attempt to Introduce the Concept of Negative Magnitudes into Philosophy." In *Theoretical Philosophy, 1755–1770*, translated and edited by David Walford with Ralf Meerbote (Cambridge: Cambridge University Press, 1992), 203–42.

von Hardenberg, Friedrich (Novalis). *Schriften*, eds. Richard Samuel, Hans-Joachim Mahl and Gerhard Schulz, 5 vols. (Stuttgart, 1960f).

Nassar, Dalia. *The Romantic Absolute. Being and Knowing in German Romantic Philosophy (1795-1804)* (Chicago: University of Chicago Press, 2014).

Ritter, Johann Wilhelm. *Key Texts by Johann Wilhelm Ritter (1776-1810) on the Art and Science of Nature*. Edited and translated by Jocelyn Holland (Leiden: Brill, 2010).

Schelling, Friedrich. *Werke* vol. 5, *Ideen zu einer Philosophie der Natur*. Edited by Manfred Durner with Walter Schieche (Stuttgart: Frommann-Holzboog, 1994).

Schelling, Friedrich. *Werke* vol. 6, *Von der Weltseele – Eine Hypothese der höhern Physik zur Erklärung des allgemeinen Organismus*. Edited by Kain Torsten Kanz and Walter Schieche (Stuttgart: Frommann-Holzboog, 2000).

Tavani, Elena. "Economy of desire in Frans Hemsterhuis," C. Melica ed. Frans *Hemsterhuis: a European Philosopher Rediscovered* (Napoli: Vivarium, 2005).

Trop, Gabriel, "Hemsterhuis as Provocation: the German Reception of His Early Writings" in *François Hemsterhuis, Early Writings, 1762-1773*, edited and translated by Jacob van Sluis and Daniel Whistler (Edinburgh: Edinburgh University Press, 2022), 36-54.

Whistler, Daniel, "The Discipline of Pious Reason: Goethe, Herder, Kant" in *Moral Powers, Fragile Beliefs*, Joseph Frederick Henry Carlisle, James C. Carter, and Daniel Whistler, eds. (New York: Continuum, 2001), 53-82.