Reductionism in Everyday Life, Technology, and Science
An Exploration of What is Concealed and Revealed in Practice

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ABSTRACT

In this paper, I draw upon a diverse selection of observations made by philosophers and scientists to think about habitual ways in which human beings reduce things in their world to a convenient subset of their total properties. This is a natural and important activity, however in invoking Heidegger's concept of *Enframing*, we can establish a vantage point from which to think about tensions and issues that this introduces to various spheres of human activity.

Keywords: Technology, Science, Philosophy, Art.

> *The threat to man does not come in the first instances from the potentially lethal machines and apparatus of technology. The actual threat has already affected man in his essence. The rule of Enframing threatens man with the possibility that it could be denied to him to enter into a more original revealing and hence to experience the call of a more primal truth.* [1]
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> - Martin Heidegger
> *The Question Concerning Technology*

1. INTRODUCTION

The term *reduction* is used in various ways in science and philosophy. With respect to theories, multiple theories can be reduced to a simpler theory if the simpler theory explains all that the other theories explain. For example, prior to Newton's laws of motion, there were many unrelated theories that seemed to explain particular phenomena, yet they were all successfully reduced to Newton's laws. However, there is another type of reduction that is also important to matters of science and inquiry. As soon as one names or labels an object as a member of some category or group, this other form of reduction takes place. When we call an object an apple there is a set of properties that are shared with other object that designate this type of fruit. Yet every apple is different from other apples in many ways and therefore when we reduce our conception of the object to apple, we are ignoring all of those other properties. Therefore, reduction in this sense ignores or conceals much of what is unique about a particular object and this is a practical move that we naturally and habitually make in spheres of activity ranging from our day to day lives, to technology, and to science. This paper explores reduction as a form of practice and considers some of its limitations and potentialities.

2. REDUCTION

Let us begin with a lengthy yet provocative passage from the eminent psychologist Carl Jung,

> School came to bore me. It took up far too much time which I would rather have spent drawing battles and playing with fire. Divinity classes were unspeakably dull, and I felt a downright fear of mathematics class. The teacher pretended that algebra was a perfectly natural affair, to be taken for granted, whereas I didn't know what numbers really were. They were not flowers, not animals, not fossils; they were nothing that could be imagined, mere quantities that resulted from counting. To my confusion these quantities were now represented by letters, which signified sounds, so that it became possible to hear them, so to speak. Oddly enough, my classmates could handle these things and found them self-evident. No one could tell me what numbers were, and I was unable even to formulate the question. To my horror I found that no one understood my difficulty. The teacher, I must admit, went to great lengths to explain to me the purpose of this curious operation of translating understandable quantities into sounds. I finally grasped that what was aimed at was a kind of system of abbreviation, with the help of which many quantities could be put in a short formula. But this did not interest me in the least. I thought the whole business was entirely arbitrary. Why should numbers be expressed by sounds? One might just as well express *a* by apple tree, *b* by box, and *x* by a question mark. *a, b, c, x, y, z* were not concrete and did not explain to me anything about the essence of numbers, any more than an apple tree did. But the thing that exasperated me most of all was the proposition: If a=b and b=c, then a=c, even though by definition *a* meant something other than *b*, let alone with *c*. Whenever it was a question of an equivalence, then it was said that a=a, b=b, and so on. This I could accept, whereas a=b seemed to me a downright lie or fraud. I was equally outraged when the teacher stated in the teeth of his own definition of parallel of parallel lines that they met at infinity. This seemed to me no better than a stupid trick to catch peasants with, and I could not and would not have anything to do with it. [2][pp. 27,28]

This passage is interesting because it represents a certain epistemological crisis for Jung that most of us never experienced because we simply and quickly accepted the mapping of symbols,

names, and numbers onto categories of things in our world. Yet it is a crossing of a threshold that should not be crossed so comfortably and unconsciously and Jung's confusion helps to reveal what is being crossed.

This threshold is a form of reduction based upon *abstraction*. The world of things was his full reality and a move toward abstraction was deeply unsettling, "They were not flowers, not animals, not fossils; they were nothing that could be imagined, mere quantities that resulted from counting." [2]. To assert a=b is an algebraic move that most of us are comfortable with but Jung would not accept it because a and b as symbols/letters are already, in essence, different.

Now let us think more about how this can get us into trouble. When we name things as members of a class of things we cross a threshold between existential uniqueness to practical convenience. Consider the word *apple*. This word refers to a type of fruit that we are able to obtain at our local market, and while it may refer to other things such as a computer company or something metaphorically in one's eye, let us restrict ourselves to the actual fruit that we eat. If I bring home four apples and place them in my fruit basket, it is quite natural for me to say I have *four apples*. Yet, it is also true that these four entities are in many respects *not* equal to one another. At first blush, they are separate and distinct in time and space. Their shapes, weights, flavors, and textures are likely to have subtle but measurable variations. As compositions of molecules they may possess the same sugars, proteins, and structures, yet each *composition* is wholly unique. They are not the *same* things. Yet for purposes of orchards, harvesting, distribution, labeling, and consumption, we *naturally* treat them as if they are the same things.

But, you may ask, what harm is done by assuming they are the same? It's not as if we have confused apples with oranges after all. And my answer is that in many spheres of life it does do no harm at all. We can't approach all objects in our world as unique inherently different *beings* or our practical actions would be paralyzed. But this is where Martin Heidegger helps us to understand where the real problems arise.

3. ENFRAMING AS A FORM OF REDUCTION

In *Being and Time*, Heidegger argues that as human beings we are a special kind of being (*da sein*) for which being can be a question [3]. More importantly, as this is a question that man *can* ask himself, it is a question that he *does* ask himself and has throughout history produced a variety of answers. To Heidegger, each of the apples we discussed earlier are *phenomena*. To him, a "phenomenon" is the showing-itself-in-itself that "signifies a distinctive way in which something can be encountered." [3][p. 54] It just so happens that the four apples are encountered by subjects as exhibiting important properties of shape, texture, flavor, size, etc. that *fit* the categorization/name of "apple."

Again, no harm done. They are apples and unless we are artists or philosophers we do not need to dwell on their existential/phenomenal properties. Yet, this migration in our thinking away from the existential/phenomenal is *habitual* and when applied universally and consistently to most or all things in our world, Heidegger believes we now have a problem. Based upon his analysis in the essay *The Question Concerning Technology* of ancient Greek language he believed that, in contrast to us moderns, the ancients Greeks were much more attuned to the uniqueness of being of phenomena [4]. The showing-itself-in-itself of the phenomenon revealed much more to them than it does to us. Modernity, he claims, takes this business to the extent where all of the phenomena in our world are revealed to us primarily as *resources* to achieve our ends and not merely resources but a reserve of *resources-at-hand*. According to Heidegger there is a:

> …rule of Enframing, which demands that nature be orderable as standing-reserve. Hence physics, in all its retreating from the representation turned only toward objects that has alone been standard till recently, will never be able to renounce this one thing: that nature reports itself in some way or other that is identifiable through calculation and that it remains orderable as a system of information. [1][p. 23]

This is a fascinating way to reconsider the taken-for-granted ways in which we have been conditioned to approach things in our world. *Nature reports itself in some way or other* – the apples report a red color, a tangy sweetness, a shiny skin, and a crisp texture. Surely these kinds of phenomena (apples) that *report themselves* in consistent ways support *systems* of agriculture, distribution, and consumption. Heidegger's critique is that in modernity we select/value *only* the properties of phenomena that can be used as resources towards our ends. He calls this psychological/cultural tendency to frame phenomena merely as resources *Enframing* and it is problematic because it blinds us from all other possible ways of acknowledging what the phenomenon can reveal about itself. Given this context, he was particularly disturbed by the growing practice in organizations to refer to employees as *human resources*.

In modernity, there are not only resources and ends, but technologies and systems that *order* these phenomena in relation to one another and extinguish all other modes of revealing:

> But Enframing does not simply endanger man in his relationship to himself and to everything that is. As a destining, it banishes man into that kind of revealing which is an ordering. Where this ordering holds sway, it drives out every other possibility of revealing. [1][p. 27]

We, as moderns, are culturally conditioned to these systems, technologies, and modes of ordering and therefore Heidegger's claims can be unsettling as he reminds us the ancient Greeks likely approached their world in a much less ordered and much more revelatory and receptive way – they were much more likely to appreciate and value the intrinsic qualities of things in their world.

While some have argued that Heidegger overly romanticized the ancient Greeks, he nonetheless helps us to see how we moderns do tend to approach phenomena in our world in this manner – as ordered resources in the context of systems and, culturally, this may blind us from seeing phenomena in other lights (e.g., appreciative, artistic, expressive, creative, intrinsically valuable).

In science, information technology, industry, etc., however, this tendency of Enframing is not only sustained but is distilled and purified. At the heart of technology is the design, production, and use of objects that will function in a system in a particular way. Standardized bolts, resistors, widgets, RAM, semiconductor elements, role occupants, etc. support combinations into more and

more complex systems to the point where a great deal of systems engineering today is focused on *systems-of-systems* problems. When we think about inserting more RAM into our computers we certainly never think about how, as with the apples, one 4MB RAM chip may be existentially different than another (even though they are) because this phenomenon/object, for us, exists in our world only for its reliable *functioning* within a man-made system.

However, I believe empirical sciences in general and social sciences in particular need to be more sensitive to the assumptions of sameness that they are making with respect to the phenomena they are studying. It is to this subject that we will now turn.

4. ISSUES WITH ENFRAMING

As discussed earlier, in conceiving of four apples we are unconsciously ignoring what is unique about each apple in a move toward practical convenience. Yet this is still an instance of Enframing as it means the apples are presenting themselves to us as practical resources for consumption ready-at-hand. In this section, we will think whether or not we can escape Enframing for objects like these and then consider very special kinds of objects.

Art: In Heidegger's later work *Poetry, Language, Thought*, he strove to identify remedies for Enframing [4]. As Enframing conceals the totality of being he sought methodologies for un-concealing what has been concealed to arrive at the truth of being – *aletheia*. He believed that as we are conditioned to being a particular kind of subject that frames objects in these ordered and practical ways, that what is needed is to suspend the subject/object dichotomy in a way that reveals the truth of a phenomenon. He uses Van Gogh's series of peasant shoe paintings as one way to do this. In these paintings, the worn and soiled shoes are depicted in a detailed way while set against a background of vague and softened contours and colors [4]. Heidegger believed that in doing this Van Gogh is not representing a set of peasant shoes, but the *essence* of peasants that invites us to appreciate all that they could mean as phenomena of our culture, politics, agriculture, and possible ways of being. In the same vein, he identifies poetry as the most effective and ideal methodology for overcoming what is concealed in Enframing. Analogous to the peasant shoes, poetry leverages the dynamics of language to reveal what is typically hidden in our habitual ways of perceiving and interpreting things in the world. [4]

Technology: In a systems context, we may be reminded that phenomena will still reveal or report themselves within our systems in unintended ways whether we appreciate it or not. At the simplest level, the design of technical systems is reliant upon system elements that will interact with one another in patterned and reliable ways. Of course, when a component of a system malfunctions, we are keenly aware that as resources-at-hand, they may sometimes fall short and need to be replaced. This does not escape the Enframing paradigm and really only strengthens it because as a resource it is expected to reveal itself in a particular way and when it does not it is a system failure – a failure in *ordering* that reminds us that ordering is at the center of what we care about.

Yet in this context we can also think about more sophisticated systems and how variations in system elements need to be accounted for carefully. In my tenure as a systems engineer I worked on developing test software for the D5 Missile Guidance System. The precision and accuracy of instrumentation on-board this system that is required to reach a target thousands of miles away with dead-reckoning (no external navigation aids), is extraordinary. This meant that as much as manufacturers of components in these systems strive for each of them to be consistent and uniform in their performance, there were nonetheless variations that needed to be addressed for the overall system to perform well. Because of this, *calibration* of over one hundred components became a central and vital practice in the development and test of these systems. Through calibration, each component's uniqueness was measured and entered into the system to properly account for this variation in the context of overall system behavior. While this reality still remains squarely within Heidegger's concept of Enframing, it nonetheless reminds us that in certain kinds of systems apples may be different enough from one another in a way that we need to take into account. In a sense, the closer one comes to perfection/truth, the more these kinds of differences make a difference.

Science: Science is empirical and as such it relies wholly on measurements. And of course, an apple will reveal/report itself differently to the shopper than it will to the scientist. The scientist has theories to confirm or disconfirm and will be interested at any given time with precise measurements of particular features of the phenomenon under study. Therefore, it escapes Enframing from the point of view that it does not approach the phenomenon as a resource-at-hand, but rather as a phenomenon to be understood or predicted. However, this understanding is different than the understanding obtained through art and poetry as we saw in art, but one that is focused entirely on raw information as opposed to interpretation and appreciation. According to the philosopher of consciousness David Chalmers,

> Physics tells us nothing about what mass *is*, or what charge *is*: it simply tells us the range of different values that these features can take on, and it tells us their effects on other features. As far as physical theories are concerned, specific states of mass or charge might as well be pure information states: all that matters is their location within an information space. [5][p. 302].

In other words, science is looking for predictable relations among measurable phenomena and cares not at all about *what* they are, their *ontology* and Chalmers adds,

> This is reflected in the fact that physics makes no commitment about the way these states are *realized*. Any realization of these information states will serve as well for the purposes of a physical theory, as long as it maintains the correct structure of causal or dynamic relations between states. After all, as long as the shape of these relations is the same, physics will *look* the same to our perceptual systems: we do not have access to any further properties of the realization in the external world, over and above the shape of the causal network. [5][pp. 302, 303]

This limitation of science becomes more problematic when we approach phenomenology or way in which human subjects consciously experience the world,

> The ontology that this leads us to might truly be called a double-aspect ontology. Physics requires information states but cares only about their relations, not their intrinsic nature. This view postulates a single basic set of information states unifying the two. We might say that internal aspects of these states are phenomenal, and the external aspects are physical. Or as a slogan: Experience is information from inside; physics is the information from the outside. [5][p. 303]

Therefore, while to some extent escaping the concealing tendencies of Enframing, science is forever constrained to a third-person perspective on information. This is often exemplified by a thought experiment that philosophers of consciousness like to employ. They posit a brain physiologist named Mary who in the future has learned everything there is to know, physically, about the brain and how it processes information. The subject may perceive a red stimulus and Mary will understand perfectly how the light is received by the retina, converted into electro-chemical impulses in the optic nerve, distributed to various locations in the brain and processed. She will know that the subject is perceiving and interpreting a wavelength of the electromagnetic spectrum that we correlate with the color red. However, if she had been brought up in a black and while world and had never herself experienced the red sensation, then could she, based upon her exhaustive knowledge of the physics of the brain, know what a red experience would be like for her? If someone were to bring her a red rose would she be surprised by its redness or could she have already known what it would be like? As we cannot imagine a way in which she could, we need to resign ourselves to the reality that the red experience is *new information* for her that was previously unavailable based solely on a physical (third-person) understanding of the brain.

It is no surprise, then, that science has more or less ignored the topic of phenomenal consciousness because aside from phenomenological self-reports, it has no way of measuring what consciousness is. Instruments cannot perceive redness or feel a throbbing pain. In his famous 1979 essay *What is it Like to Be a Bat*, Thomas Nagel brought this issue front and center in the scientific and philosophical communities and it is still resonating today [6][7]. More recently in *Mind and Cosmos* Nagel considers in more depth how mind has been altogether ignored in the history of science/physics and how this leads to an imbalance in our understanding of the universe [8]. He states,

> The great advances in the physical and biological sciences were made possible by excluding mind from the physical world. This has permitted a quantitative understanding of the world, expressed in timeless, mathematically formulated physical laws. But at some point it will be necessary to make a new start on a more comprehensive understanding that includes the mind… And that poses the question: To what extent will the reductive form that is so central to contemporary physical science survive this transformation? [8] [p. 8]

In much of the book he argues that we need to include consciousness in our conception of the physical universe and this will require a completely different way of thinking about the *design* of the universe. That is, he dismisses religious notions of "intelligent design" but he believes that new theories about the role of consciousness in the universe will transcend the current notion that Big Bang happened and everything since then can be explained by physical laws that do not allow a role for consciousness. In this context, he offers a simple analogy with respect to underlying design in a system,

> Or consider the different conjunctive explanation in the case of the pocket calculator. A is the physical explanation of what happens when I tap in "3+5=," which causes B, the display on the screen of the figure "8." It is a further fact that this figure is the symbol for the number 8, and the figures I tapped in are the symbols for a certain sum, so we have the consequence C that the device produced the right answer for the sum entered. But without more, this is merely an assertion, and not yet an explanation of why the calculator gave the answer. Without the further fact that the calculator was designed to embody an arithmetic algorithm and to display its results in Arabic numerals, the physical explanation alone would leave the arithmetical result completely mysterious. [8][pp. 51, 52]

Extending this analogy to the universe he argues future theories in physics will need to entertain an underlying design in which consciousness and physical laws are both explained.

5. CONCLUSION

In Jung's non-acceptance of algebra, our own practical labeling of apples, and in science and technology there is a conceptual threshold between what we reduce things to and what remains unacknowledged or concealed. Jung and Heidegger were both uncomfortable that modern man is so quick to reduce objects in the world to categories and practical resources which prevents us from seeing the inherent value and uniqueness of things in our world. While art may offer a means of escape from this limited way of perceiving one's world, technology cannot escape it because at its heart it strives to design systems of elements that will interact reliability with one another so only the functional facet of the object is relevant. Science, furthermore, limits itself to what can be measured and correlated with other measurements so there is no goal to understand their *intrinsic* or ontological properties. Consciousness is emerging as a mysterious phenomenon that science cannot reconcile with its dominant paradigms and this leads to a context in which a wholly new mode of theorizing will be needed if progress is to be made.

Each of these fields of inquiry chooses a subset of the totality of properties existing in phenomena and therefore there are always some properties that are omitted and ignored. In this paper, I have explored what this means with an eye toward how both practitioners and theorists may be more sensitive to what is being concealed so that they may more consciously explore what it is about these phenomena that should be brought to light and revealed.

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