Atoms Neither Fast Nor Feast: Reflections on Scientific Inquiry and the Good Life

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When we think about atoms or ask what they do, we would quickly deny them certain activities: laughing, thinking, fasting, feasting, and so forth. Atoms are obviously not the sorts of wholes to which such activities belong. Neither do atoms take a break like we do—if atoms ever "rest" at all. However, we are made out of atoms. Where or when, then, does the laughter, thought, fasting, feasting, and leisure enter into the picture? This brings me to Aristotle.

Now, Aristotle was right about some things. For instance, he was right about a crucial principle in natural philosophy, the principle of holism. This principle puts wholes prior to parts—wholes are more fundamental in being and more important to know. Parts are necessary but not sufficient conditions for the existence of wholes, and the reality of the whole is something more than the mere sum of its parts. How is this principle relevant to our topic?

Holism is, it seems to me, a necessary condition for scientific inquiry to be an integral part of the good life. That is, in order to do science well you have to pay attention to wholes, not merely parts; furthermore, in order for the sciences to be a part of a flourishing human life, scientific inquiry must be a good part. In other words, not only

must scientific inquiry attend to the holism present in the cosmos, but also the virtues integral to and coordinated with scientific inquiry are themselves parts of the good life as a whole.

This is the plan for the talk: First, we will discuss Aristotelian holism. Second, we will discuss holism among the human virtues, especially as this regards scientific inquiry as an intellectual virtue. Third, this preparation will help us to consider how scientific inquiry ought to be related to a good human life as part to whole. Throughout, this is our main target: trying to understand whether and to what degree good scientific inquiry must be about wholes and must be one part of a good life as a whole.

(1)

First, a closer look at Aristotle's principle of holism. One statement of this idea can be found in Aristotle's *Parts of Animals*. The following is from the passage sometimes called *the exhortation to study nature*:

> *If any person thinks the examination of the rest of the animal kingdom an unworthy task, he must hold in like disesteem the study of man. For no one can look at the primordia of the human frame—blood, flesh, bones, vessels, and the like—without much repugnance. Moreover, when any one of the parts or structures, be it which it may, is under discussion, it must not be supposed that it is its material composition to which attention is being directed or which is the object of the discussion,* ***but the relation of such part to the total form.*** *Similarly, the true object of architecture is not bricks, mortar, or timber, but the house; and so the principal object of natural philosophy is not the material elements but their composition, and the totality of the form, independently of which they have no existence.*[1]

[1] Aristotle, *Parts of Animals*, I.5, 645a30–35. In what follows, I use the *Basic Works* edition of Aristotle.

Note the key comparison upon which Aristotle relies: architecture's object is not so much the materials of the house but rather the whole house; so too, natural philosophy's object is not so much the material parts of natural things but the wholes themselves and their forms. One of Aristotle's own examples is the eye: "Suppose that the eye were an animal: sight would have been its soul . . . . When seeing is removed the eye is no longer an eye, except in name—it is no more a real eye than the eye of a statue or of a painted figure."[2] In other words, the eye is part of the organic matter of the whole—in this case, the whole is ***the seeing eye***, the capacity for sight and its organ ***united***. Apart from that whole, the organic matter of the eye is no longer truly an eye. Other organs seem to fit this pattern: disembodied hearts cannot serve the circulatory system, nor do disemboweled stomachs digest food.

All of this might lead us to think that parts and wholes are a bit more complicated than one might initially assume. Indeed, the terms "whole" and "part" are used in many ways.[3] A common thought is that wholes are composed of parts; parts constitute wholes. A whole is complete: it is ***that which lacks none of its required parts***. A whole is also one thing: ***it is a unity composed of its parts***. There are conceptual wholes and parts, like genera and their species. There are also integral wholes. Some are natural

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[2] *On the Soul*, II.1, 412b18–24.

[3] The following discussion paraphrases distinctions drawn by Aristotle in *Metaphysics*, V.25–27 as well some other passages of the metaphysical dictionary. Let's start with "part" (μέρος). Some parts are quantitative: these parts are those into which a quantitative whole is divided, such as half of a circle or the factor of a given number. Some parts are more conceptual: for instance, a concept such as "shape" compares to a concept such as "triangle" as whole to part. For the idea of "shape" contains more species than just "triangle." Lastly, some parts are more concrete or integral: these are the the sorts of parts which compose the whole the way elements compose a compound or the way bones compose a skeleton.

What about the term "whole" (ὅλον)? Aristotle says that a whole is "that from which none of the things of which it is said to consist by nature [ὅλον φύσει; be by nature a whole] are missing." A whole is complete: it is that which lacks none of its natural parts. Aristotle also offers this definition: a whole is "that which contains the things contained in such a way that they form one thing." (Metaphysics, V.26, 1023b26–28.) A whole is one thing: it is that which is a unity composed of its parts. What sort of containment is this? How might it help us think more clearly about different sorts of parts and wholes?

integral wholes, like elements in a compound or bones in a skeleton or the body and soul composing a living beings. Other integral wholes are artificial, like a car and its parts. Finally, there are wholes like the soul: a totality constituted through the various powers it realizes.

What is crucial is that, on the one hand, the Aristotelian idea of holism holds that, for many kinds of parts, the parts cannot fully exist, cannot fully act, and cannot be fully understood apart from their wholes. Conversely, the idea of holism maintains that many kinds of wholes exist and act and are intelligible in ways that exceed their parts. For example, carbon, the sixth element, is itself a type of whole. In its ground state, it is composed of six electrons, six protons, and (most frequently) 6 neutrons. Carbon has characteristic behaviours at certain temperatures and pressures. However, these behaviours change when carbon enters into compounds. Indeed, we most frequently encounter carbon and study it as a part, in organic chemistry, say, a whole field defined as "the chemistry of compounds that contain the element carbon."[4] For example, carbon as a part conditions and structures the bonds in DNA base pairs, something that carbon cannot do as a mere, solitary whole. Carbon contributes to but cannot account for the entire human karyotype, the 23 pairs of chromosomes. Nor do a specific number of carbons in the karyotype make you human—much less do a certain number of chromosomes, for what about a karyotype of someone with trisomy 21? We are carbon-based life forms, they say. But carbon is a necessary and not sufficient condition of our humanity. Our carbon is fungible; metabolism is the proof of that. Indeed, which individual carbon atoms are present where in our bodily structure is less important than the fact that carbon as such is found in certain parts of that structure, itself a specific whole—the metabolizing, mammalian body which sustains a narrowly regulated environment that both maintains and uses DNA molecules to map its growth,

[4] Janice Gorzynski Smith, *Organic Chemistry*, 6th ed. (McGraw Hill, 2019), 1.

maturation, healing, and innumerable other physiological functions. **The carbons participate in such being and activities, and their organic roles as carbons cannot be understood without the whole living thing.** But some features of the whole exceed the boundaries of carbon's narrower reality. The carbons in *this* cytosine are the ones helping to code for a muscle protein while the carbons in *that* cytosine code for some part of your big toenail. Simply as parts, their placement and role are not determined without the whole. This point becomes a bit more acute when we consider different sorts of living wholes.[5] What about animal life? This adds sensation to the mix. A living thing with sensation becomes connected to its environment in a different way than mere breathing and eating. To be aware of one's environment is more than mere physico-chemical exchange with one's environment. What is more, in the human case, conceptualization and intellectual insight afford us a relationship to the environment that transcends the very concrete particularity of that environment. Beyond metabolic life, having perception and thought demarcate an environment that is *other than* ourselves in a way distinct from how my left hand is *other than* my right hand. **The environment is not simply *more of our parts* but rather our *surroundings***, a set or system of independent wholes composing an ordered totality of a different order. We are substances independent of our environment as far as being unified things in our own right, but our activity and continued existence still depend upon our surroundings as far as change, interaction, and learning are concerned. Where does such a system of environments bottom out—or, perhaps, top off? Surely we shouldn't stop until we included the whole cosmos. The universe is a whole that is a system of other wholes—this cosmos is made one by the very unity of its order in place, time, and causal structure.[6]

[5] Comments here based upon Aristotelian ideas, but see especially *ST*, Ia, q. 18, a. 3.
[6] My paraphrase of Aquinas, from a number of places.

So much for Aristotelian holism.

(2)

Now we examine the virtues and the whole which they help to constitute. We will focus on one particular virtue: prudence. Prudence as a virtue has certain "parts," or so claims St. Thomas Aquinas. Perhaps there are analogous parts of scientific inquiry, parts which are the virtues contributing to scientific inquiry as a virtue. We will try to find such parts using prudence as a model. Furthermore, just as prudence and its parts are integral to the good life, so too might science and its parts be integral to the good life. This is not to say that one must know a lot of science in order to be a good person in the moral sense. Rather, intellectual virtues such prudence or the natural sciences are ***still parts of the good life as a whole***. First, about prudence.

Prudence is the virtue concerned with truth in regard to human choices. Medieval thinkers called it *recta ratio agibilium*: right reason about what should be done. It is integral to the good life—to happiness or *eudaimonia*—because the prudent choice must be made to realize the acts of the virtues and in a virtuous way. Without prudence, the good life is rudderless—one cannot make the sorts of choices that build up, perpetuate, and activate the good life. Prudence is only one of the Aristotelian intellectual virtues—it joins virtues such as art (or technical skill), understanding, science, and wisdom. Particularly, our interest is in science—here, by "science," I mean ***a grasp of the causes or reasons underlying natural phenomena***. (This is not Aristotle's exact definition of science but my hopefully serviceable paraphrase.) By "scientific inquiry," then, I mean ***the in-practice habit of the intellectual virtue of science***.

Now, what are the parts of prudence? Aquinas distinguishes three types of parts to the virtue of prudence: subjective parts, quasi-integral parts, and potential parts. To say

prudence has subjective parts is Aquinas's terminology for the species of prudence: a politician's prudence as opposed to the prudence of a wise parent. The scientific parallels would be how scientific inquiry is found in slightly different ways in organic chemistry, say, than in paleobotany.

The quasi-integral parts of a virtue are like the integral parts that compose a new whole. "The things which need to concur for the perfect act of a virtue are called the parts of that virtue."[7] Just as the whole house is composed from its integral parts, there are virtues or habits that help constitute prudence as a new whole. Let us consider these "quasi-integral parts" of prudence first.

First, there is **memory**: "Intellectual virtue is engendered and fostered by experience and time,"[8] writes Aquinas, and so prudence must draw upon memory to do its work. If you have lived a short life or have a poor memory you cannot learn from your past. Your memory is limited to the whole of your life—at most!—and snippets of the lives of others. What is the parallel in scientific inquiry? It seems to be experiment and close observation, over time, of the natural order, while retaining what one has learned from nature, whether that retention is personal or communally shared. Perhaps Darwin was so successful simply because of his memory developed on long walks and patient observation. St. Albert the Great would spend hours watching animals in a field or conversing about nature with fishermen, farmers, and hunters. Scientific inquiry needs **a memory of nature**.[9]

Second, there is **understanding**. By this, Aquinas means "the right estimate about some final principle, which is taken as self-evident."[10] The prudent person sees the end-goal

[7] *ST*, IIa-IIae, q. 48, a. 1, c.
[8] *ST*, IIa-IIae, q. 49, a. 1, c.
[9] See Irven M. Resnick and Kenneth F. Kitchell, Jr., *Albertus Magnus and the World of Nature* (Reaktion Books, 2022).
[10] Ibid., a. 2, c.

clearly—this is the final principle—and then finds the good means to get there. Now, scientific inquiry as such is theoretical—it looks not so much to personal or collective end-goals as it does to fundamental principle and causes. The scientific analog to understanding seems to be **understanding of natural principles**. Such principles or definitions are discovered or taught and need experience to sink in—e.g., the principle of least action or the principle of the conservation of energy—but once they are grasped other natural phenomena are understood in their light. Is Le Chatlier's principle at work in this experiment? What is a buffer solution, and why is it good that blood is a buffer?

Third, there is **docility**. Prudence is about action in the concrete, and there is an indefinite array of details in such particulars. "Hence," Aquinas argues, "in matters of prudence man stands in very great need of being taught by others, especially by old folk who have acquired a sound understanding of the ends in practical matters."[11] This teachability is one's docility. The scientific parallel arises within the ethical community of scientists.[12] This community includes teachers and students, wherein habitual memory of the cosmos is handed down. Richard Feynman stresses this temporal chain in his lecture about the nature of science.[13] The learners must be teachable, **docile to what the natural order** has to teach them both in itself as well as through human teachers.

Fourth, there is **shrewdness**. What docility is with respect to learning from others, shrewdness or quickness of wit is for finding out for oneself. As Aquinas puts it, "Shrewdness is an easy and rapid conjecture in finding the [reason why]."[14] As far as practical concerns go, the one with this wit more quickly finds the apt solution to a

[11] Ibid., a. 3, c.
[12] I borrow this phrase from the work of Lee Smolin, but it arises in other places.
[13] See Richard Feynman's remarks about this in "What Is Science?" *The Physics Teacher* 7, no. 6 (1969): 313–20.
[14] *ST*, IIa-IIae, q. 49, a. 4, c.

practical issue. The scientific equivalent of this is Archimedes's famous "Eureka!" moment. Memory and a keen imagination aid intellectual quickness at ferreting out the explanation for some new or puzzling phenomenon. So, scientific inquiry needs **insightfulness**.

Fifth, there is **reason**. Prudent people can give and receive good counsel or advice. But counsel requires "an inquiry proceeding from certain things to others," writes Aquinas, namely, from what one must do to how you ought to do it: "But this is the work of reason. Wherefore it is requisite for prudence that man should be an apt reasoner."[15] For the scientific inquirer, the reasoning that takes place is not from end-goals to personal decisions, but rather from known natural phenomena and known effects to their unknown causes. Galileo looked up at the same stars and planets as did his contemporaries—but he could see more in them despite his failing eyesight. So, **causal reasoning** is an integral part of scientific inquiry—a pattern of inquiry known to Aristotle, medieval scientists, the late scholastics who taught Galileo, and expressed by Isaac Newton in the *Preface to the Reader* in his *Principia*—the idea of reasoning from effect-to-cause and back again both to explain natural phenomena and predict further phenomena.

Sixth, there is **foresight**. Prudence is concerned with contingent affairs, things that could happen this way or that, whose outcome is uncertain. One does not deliberate about what could never change or what is beyond one's control. Thus, we direct our prudential judgment to events whose outcomes we can affect, and "these things is implied in the word foresight," writes Aquinas, "for [foresight] implies the notion of something distant, to which present affairs must be directed."[16] Now, scientific inquiry does work with contigent and mutable particular situations. However, in the concrete it

[15] Ibid., a. 5, c.
[16] Ibid., a. 6, c. (translation slightly modified).

still seeks what is universal. It seems that scientists must have not foresight but hindsight—the natural sciences require **interpretation of natural history**. Darwin, voyaging on the HMS *Beagle*, was reading about the geological principles enunciated by Charles Lyell and found that he saw rock formations "through Lyell's eyes." This interpretation of natural history is especially important for sciences founded upon archaeological or geological or astronomical data and correspondingly lengthy timescales. For example, such a skill was required of Hubble to interpret the redshift patterns of distant galaxies.

Seventh, there is **circumspection**. Since prudence is about particular choices, and those particular choices have many different possible combinations of circumstances, it might fall out that what is good to do in one circumstance is not good to do in another. One must "look around" first. That witty remark is all of a sudden in poor taste, or the party you had planned would now be unsuitable to the guest of honor who has suffered a sudden personal loss. "Hence," Aquinas writes, "the need of circumspection in prudence, namely, of comparing the means with the circumstances."[17] For the scientist, too, there are also **exceptional circumstances**. Analogous to practical situations, nature does not always warn you in advance about these exceptions to her rules. This also happens in undergraduate lab experiments—what do we do now that this reagent has run out? Well, we ask the professor what makes a good substitute.

Last among the quasi-integral parts of prudence is **caution**. Just as in matters of theory "false is found with the true," so too in matters of action "is evil mingled with good," writes St. Thomas, "on account of the great variety of these matters of action, wherein good is often hindered by evil, and evil has the appearance of good."[18] Scientific inquiry also requires **a theorist's caution**. The truth about atoms might be more hidden than

[17] Ibid., a. 7, c.
[18] Ibid., a. 8, c.

revealed by how we represent them. The reality of the part of the cosmos selected for study—what scientists call a system—might be obscured by our exaggerated attachment to our own abstractions, idealizations, statistical averages, or models of that part.

Now for the potential parts of prudence. These parts "are the virtues connected with [prudence] which are directed to certain secondary acts or matters, not having, as it were, the whole power of the principal virtue."[19] Just as the whole essence of the soul contains many powers as parts, so too the whole essence of prudence includes certain sub-virtues or acts.

Among these potential parts of prudence, the first is **counsel** (*eubolia*). The prudent person can both give good counsel or advice as well as seek and receive it well. Perhaps this is not in all matters, but only in a certain area (parenting, say, or business). In the sciences, this seems analogous to those sharing in the task of effect-to-cause reasoning, whether through **teaching or research**. Not all those who are called scientists are good teachers or good researchers, but those who are good at scientific inquiry are usually one or the other—but, it seems to me, more rarely both.

The second potential part of prudence is **judgment** (*synesis*). Counsel and judgment are distinct. Someone might be good at giving advice—providing various possible ways to navigate a tricky situation—but good judgment allows you to see which situation is ***here and now*** true and thus which course of action is best: "Right judgment consists in the cognitive power apprehending a thing just as it is in reality,"[20] argues Aquinas. Judgment sees how abstract rules apply to ***this specific*** **scenario**. The scientific inquirer too, must have this skill. It is akin to those eureka moments, but is rather a type of

[19] Ibid., q. 48, a. 1, c.
[20] Ibid., q. 51, a. 3, ad 1.

habitual ability to recognize—the scientist with **good scientific judgment** can incorporate new instances under a known, general rule. Newton had the insightfulness, but a Laplace or Lagrange or Euler helped to expand it towards a more complete mechanics.

The third potential part of prudence is **good sense** (*gnome*). What happens when the "common rule" fails? What if you come across some exceptional or unusual situation? "[Good judgment] judges rightly about all actions that are covered by the common rules," Aquinas notes, "but certain things have to be judged beside these common rules."[21] For scientific inquiry, such situations arise when a theory or model exceeds its domain of applicability or is found inadequate to new data. A new discovery is made—say, the moons of Jupiter—and the current theory and its models come crashing to the ground. Here, scientific inquiry requires a sense of judgment deeper than scientific judgment: it needs **good philosophical sense**. It needs a philosophy of nature, as even contemporary scientists such as Carlo Rovelli, George Ellis, or Lee Smolin argue.

The parts of scientific inquiry, then, are these: memory of nature, understanding of natural principles, docility to nature, insightfulness, causal reasoning, interpretation of natural history, attention to nature's exceptions, a theorist's caution, thoughtful teaching and research, good scientific judgment, and philosophical sense. Perhaps these are all brought to a point in the intellectual habit of mind which St. John Henry Newman calls ***the illative sense*, that right reasoning about things to be assented to because they are true**.

(3)

[21] Ibid., a. 4, ad 1.

We now need to apply our explorations of the principle of holism and scientific inquiry to the good life. I would prefer to do so by surveying passages from C. S. Lewis, Wendell Berry, Romano Guardini, Walker Percy, Christopher Dawson, St. John Henry Newman, Hans Jonas, Charles De Koninck, Remi Brague, and many more. For the sake of time, I will select a few passages from Wendell Berry's book *Life Is A Miracle*, in which Berry—farmer, poet, writer, English teacher, and conservationist—passes judgment on the scientific world-view paradigmatically proposed by the biologist E. O. Wilson. While doing so, I will also address a lacuna in the foregoing comparison of scientific inquiry to prudence, for scientific inquiry might seem to have much more in common with what Aristotle calls *techne*—art or technical skill.

The connection between science and technology seems obvious to us. One cause of our taking this connection for granted is that many people proposed hundreds of years ago to bend theoretic and philosophical pursuits towards more practical ends: we should use our scientific knowledge of the forces and powers of nature "to render ourselves, as it were, the masters and possessors of nature."[22] These famous words of René Descartes capture something of the characteristics of modern STEM studies. Yet scientific inquiry employs other skills apart from its technological uses or fruits. How are your fractional distillation techniques? Can you titrate this acidic solution to a neutral point? How about finding the best fit line for the data in this experiment? However, the technical skills that form integral parts of scientific inquiry—from the ability to synthesize an ester to the ability to find a derivative—are not for their own sake. They are ordered to a higher theoretic ends.

Let's return to Wendell Berry. His book, published in 2001, has the full title *Life Is a Miracle: An Essay Against Modern Superstition*. It has a twofold critical target:

[22] René Descartes, *Discourse*, VI.

scientifically enhanced technological imperialism and its corresponding conception of the good life. Our modern compartmentalization of subdomains of expertise compound an endemic human limitation that our every act must be taken within an ambit of ignorance. As the radius of our knowledge grows, so does the circumference of our ignorance. Prudence, being the proper measure of our lives and actions, guides us to propriety of action: propriety with ourselves, within our families, within communities, and within our environment, the terrestrial places in which we live.

This stands in stark contrast, Berry argues, with the individualist attitude of "the presently dominant system of thought" which is not properly called science "but 'science-technology-and-industry.'"[23] This attitude sees in the natural world a sort of "virgin land and the future lineaments of empire."[24] Yet Berry sees in this project of the mastery and possession of nature a limited and fallible human system—a man-made whole that cannot measure to totality of nature.

> *Synthesis, [Wilson] says, is "holism." He does not acknowledge that the synthesis he is talking about is neither whole nor holy, but rather an artifact made of parts that we have isolated and in our fashion understand and put together again in a way we understand.*
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> *The fallibility of a human system of thought is always the result of incompleteness. In order to include some things, we invariably exclude others. We can't include everything because we don't know everything; we can't comprehend what comprehends us.*[25]

The aim of such synthesis and integration is not knowledge, but problem solving, whether for medicine, engineering, or genetically enhanced conservation efforts.

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[23] Wendell Berry, *Life Is a Miracle: An Essay Against Modern Superstition* (Counterpoint Press, 2003), 33.
[24] Ibid., 31.
[25] Ibid., 34. See also ibid., 40: "The synthesizing and integrating scientist is only ordering and making sense of as much as he knows. He is not making whole that which he has taken apart, and he should not claim credit for putting together what was already together."

Nature's order is no longer a mystery to be contemplated but rather something that is "not yet" known. "This 'not yet'," writes Berry, "forthrightly appropriates mystery as future knowledge. . . . As soon as a mystery is scheduled for solution, it is not longer a mystery; it is a problem."[26] What is more, "If we lack the cultural means to keep incomplete knowledge from becoming the basis of arrogant and dangerous behavior, then the intellectual disciplines themselves become dangerous."[27] The incompleteness of our knowledge—the need for caution and circumspection and a vigilant docility—also inspires Feynman's remark that "science is the belief in the ignorance of experts" since "it is worthwhile rechecking by new direct experience, and not necessarily trusting the human race's experience from the past."[28]

So much for Berry's assessment of Wilson's scientism. What about Wilson's view of the good life? Among the many points Berry makes, two are salient for our purposes.

Here is the first lesson. In E. O. Wilson's scientific world-view the one carrying out the scientific inquiry becomes a non-entity; the view is, therefore, self-refuting. Wilson holds to "a theoretical materialism so strictly principled" that it "is inescapably deterministic."[29] On the one hand, Berry notes of Wilson, this "illusion of free will" is supposed to provide "an evolutionary advantage in illusion. The proposition that our ancestors survived because they were foolish enough to believe an illusion is certainly optimistic, but it does not seem very probable." On the other hand, Berry notes that Wilson, also a conservationist, "affirms the Enlightenment belief that we can 'choose wisely.' How a wise choice can be made on the basis of an illusory freedom of will is impossible to conceive, and Mr. Wilson wisely chooses not to try to conceive it."[30] In

[26] Ibid., 36.
[27] Ibid., 12.
[28] Feynman, "What Is Science?"
[29] Ibid., 26.
[30] Ibid.

other words, the very terms of inquiry are founded upon "explaining the origin of things" including such things as ourselves, "whose authentic existence is denied by the terms of the proposed investigation."[31] The "I," much less any "we," is not a whole above and beyond its parts.

A second lesson from Berry is that Wilson's approach to scientific inquiry makes it an inhuman part of the good life. One might think, muses Berry, that he and Wilson should find common ground in their common home for higher learning, the university. But Berry sees in the modern university a collection without "a common purpose, a common standard, and a common language."[32] The modern university is no longer a true whole, but a heap of things apart from what once made them whole. True, Berry admits, E. O. Wilson's project aims at providing these parts of knowledge with a new home and thus a new whole. Berry objects to this intellectual project in view of its self-defeating reductionism. The sort of human life that members of such a university must pursue is the difficulty here. I quote Berry at length:

> *"Over the years," Mr. Wilson writes, "I have been presumptuous enough to counsel new Ph.D.'s in biology as follows: If you choose an academic career you will need forty hours a week to perform teaching and administrative duties, another twenty hours on top of that to conduct respectable research, and still another twenty hours to accomplish really important research" . . . Mr. Wilson is thus prescribing to the young a normative work week of eighty hours. Since he mentions no days off, let us assume that he is speaking of seven workdays of about 11½ hours each, lasting, say, from eight o'clock in the morning until 7:30 at night, or until eight at night if we allow half an hour for lunch. There are 168 hours in a seven-day week. Eighty from 168 leaves 88 hours. If the young Ph.D. sleeps eight hours a night, that takes another 56 hours, leaving 32 hours, or about 4½*

[31] Ibid., 51.
[32] Ibid., 60.

> *hours per day. In that 4½ hours he or she must eat, keep clean, shop, do domestic chores, commute, read, care for his or her (unfortunate) children, etc. The time left over may presumably be used for amusement and for taking part in family and community life.*
>
> *I suppose we ought to yield a certain admiration to such a dedicated life of work and sacrifice. It is certain that all of us have benefited from such effort on the part of some people. But it is just as certain that we have been damaged and are threatened by similar effort on the part of other people. In fact, most people can be driven to such an extent only by a kind of professional or careerist panic.*

Berry argues that it is the modern university that serves as the quasi-whole enforcing this regimen of dedication:

> *The modern university thus enforces obedience, not to the academic ideal of learning and teaching what is true, as a community of teachers and scholars passing on to the young the knowledge of the old, but obedience rather to the industrial economic ideals of high productivity and constant innovation. The problem here is not that we should object to hard work and exacting study, which any school might appropriately expect, but that we certainly can find reason to object to turning schools into factories, and to making originality or innovation the exclusive goal and measure of so much effort.*[33]

What has happened here, according to Berry? What has happened is a failure of propriety, a failure of proper and prudent action in our own places in the wholes which contain and nurture and measure us. The practitioners of scientific inquiry are no longer ordered to a community animated by the tradition of discovering the truth as much as they are beholden to the ends of "industrial economic ideals of high productivity and constant innovation" which will surely make someone rich. What has happened is that

[33] Ibid., 61–62, 63.

the virtues of scientific inquiry have been displaced from their proper whole, within the range of human virtues, including the prudence to aim at a fully human and well-lived life.

Conclusion

A few words in conclusion. First, Aristotle's principle of holism would have us attend to and contemplate the wholes that constellate the cosmos. This sort of science would be and is more adequate to the reality of things. Second, virtues such as prudence or scientific inquiry are themselves wholes, and they have certain parts required for their excellence. In one sense, we have used prudence (along with its parts) as model for finding things out about the virtue of scientific inquiry and its parts. However, we have also found that the virtuous integral parts that contribute to prudence as a whole are also those that aid scientific inquiry, while scientific inquiry as a virtue possesses potential parts analogous to prudence. This analogy between prudence and scientific inquiry should not surprise us, as both are ultimately concerned with knowing the truth about concrete reality. In this, we have sought to imitate Newman's insight that prudence is one part of a common illative sense able to assent to the truth in things. Finally, scientific inquiry itself must serve as a part within a broader array of human virtues, coordinated to the proper end of the good life. Following Wendell Berry, we have suggested that every use of science for industrial or technological ends can be no more morally neutral that any act of technical skill. Prudence itself—especially in the sense of propriety strong enough to be culturally shared—guides our part in a greater whole. Our human pursuit of the ends of science and the ends of technology ought not transform the whole of life into mere parts of a life that could have been well lived—such hypertrophy prevents us from taking a more prudent and wiser view of the whole, even in activities of teaching or research. Whether the modern university can

inculcate and incorporate such insights is unclear, to say the least, so dedicated is that form of institution to practices and pursuits that disintegrate human attention to wholes and to higher common goods. If these ideas from Aristotle and Wendell Berry are sound, scientific inquiry is a part of a good human life. However, it is a part that, like any good part, must be properly ordered to its whole.