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Frost on the Apple

The apple has a long and colorful history in world folklore and literature. In the Old Testament story of Adam and Eve, the forbidden fruit of the tree of knowledge in the Garden of Eden is often depicted as an apple. In Greek legend, an ambiguously labeled golden apple tossed by a spiteful goddess into a roomful of vain beauties incites the Trojan War. In a related tale, the Eleventh Labor of Hercules is to retrieve golden apples from the Garden of the Hesperides, where lovely nymphs guard the tree. But these are ancient stories of the Old World with limited relevance to modern life.

More recently, and in the New World, there is the story of John Chapman, better known as Johnny Appleseed, who traveled around the American Middle West in the early part of the nineteenth century planting apple trees and spreading a philosophy of conservation, virtue, and self-sufficiency. He combined the American values of industriousness and wholesomeness with the equally American traits of restlessness and individualism.¹ The apple itself, which is by turn, hardy, diverse, versatile, sweet, beautiful, and intoxicating, manifests features that Americans see in themselves. And like the apple, most of the American people were transplants from the Old World who adapted and thrived here. In fact, by the twentieth century, the apple had assimilated so well that the phrase “American as apple pie” had become shorthand for a host of positive qualities Americans associated with their culture.

The virtues of the apple are not lost on the poet Robert Frost, who owned a series of apple farms during his lifetime and once told a friend that he hoped “to end his days” raising apples in New England (Untermeyer 287). Frost writes of apples often, including them in

seventeen of his published poems and plays. His apple poetry is perused with an authenticity born of experience: in the early 1900s, Frost supported his family on a small farm in New Hampshire growing apples and raising poultry.² Yet, to suggest that Frost's apple poems are simply artistic renderings of farm life would do them a disservice, because Frost's ability as a naturalist is widely acknowledged. His biographer, Jay Parini, writes that "Few poets in the English language have been so specific in their knowledge of plants or flowers, or filled their poetry with so much flora and fauna" (56). Likewise, Frost's general interest in science, which began early and extended throughout his lifetime, was recognized by his peers and professional scientists alike.³

It is not surprising, therefore, that both humanists and scientists are drawn to Frost's nature poetry for its blend of artistry and accuracy. Two such scholars brought together by Frost's work are John Elder and Glenn Adelson. Their 2006 article, "Robert Frost's Ecosystem of Meaning in 'Spring Pools,'" is a thorough and revealing exploration of how Frost embeds a deep understanding of natural processes into a lovely, layered poem about transience and permanence in a New England forest. Working together, Elder, a literary scholar and Adelson, a biologist, use their complementary skills and training to examine the scientific and literary aspects of the poem in great detail, providing an excellent model for productive interdisciplinary dialogue on ecocriticism in general, and Frost in particular.

In contrast, because I am a lone author, and a scientist, the present work has a predictably narrower focus, with limited literary analysis. As an experimentalist with an interest in both mechanism and causality, I will look closely at the scientific basis for the natural phenomena in Robert Frost's poems as well as pertinent biographical details of his life as a farmer and family man in rural New England. Although Frost refers to apples nearly forty times (*Concordance* 30), this article will focus on just three poems—"The Gold Hesperidee," "Good-by and Keep Cold," and "After Apple-Picking"—works of art that collectively reveal Frost's knowledge of plant and animal biology, the effects of climate and weather, and practical matters of orchard management.⁴

"The Gold Hesperidee," published in *A Further Range* in 1936, describes a season in the life of a special apple tree, from when it blossoms to when it bears fruit and the emotional investment a dedicated farmer—"Square Matthew Hale" (1)—makes in that tree as well as his fury when he realizes that his precious apples have been stolen. The title of the poem refers to the Greek myth in which Hercules must pick three golden apples from the tree of the Hesperides, nymphs who lived in the Arcadian Mountains, as one of his Twelve Labors. Although the poem itself is about the dangers of idolatry, Frost also gives a

scientifically accurate portrayal of the life cycle of an apple, from blossom to fruit.

In the first line we learn that the tree, of a fictional “Gold Hesperidee” variety, is a “grafted apple tree.” In fact, essentially all apple trees intended to produce a specific variety are formed by grafting a stem from the desired species onto the trunk or rootstock of a host tree. Only the branch that was grafted will produce the desired apples. This step is necessary because most apples, and other fruit trees, cannot reproduce “true” to a cultivar from a seed. That is, if you were to plant the seeds of a Red Delicious apple, you would get apples, but not Red Delicious ones.

Next we learn that the tree is blooming for the first time at the age of five (2), which is not an unusual length of time for a tree to reach the minimum size needed to produce flowers. In general, the amount of time needed for a tree to be ready to bear depends on the type of rootstock and the proportion of scion (graft) to rootstock. For example, in a letter written in 1926, Frost mentions that his son Carol is growing apples on dwarf rootstock so that he can get them to market sooner (*Selected Letters* 328).

Next, the bees come by to pollinate (3). Because most apple trees cannot self-pollinate, an agent such as a bee must carry pollen (sperm) between compatible varieties to fertilize the ovum, which is accessed through a structure known as the stigma in the center of the blossom. Fertilization must occur in order for a flower to become an apple.

The concept of pollination was one that Frost examined, circled, and came back to many times in his published work, his letters, and his notebooks. In fact, Frost proposes that poetry itself could act as a pollination agent. He writes in a notebook entry dating to about 1920 that “Poetry brings pollen of one flower to another flower” (*Notebooks* 169). Throughout his life, especially when living abroad, Frost calls upon friends to act as messengers (or bees), spreading information about him to receptive parties (*Selected Letters* 124). Frost’s intention is clear that he wants to spread greetings and news of himself, but not indiscriminately. He only wants to be remembered to people who can and will use information about him in a productive way. A short poem, “March Maker,” that summarizes his thoughts on pollination appears in a notebook entry probably made in the early 1950s (*Notebooks* 82, cf. 602):

The bees and I are go between [sic]
 And as from this to that we go
 “Remember me to so and so”
 (With pollen dust the flower means.) (1–4)

The Frost children learned the facts of life early. Six-year-old Lesley records a conversation with her parents about flower fertilization (*New Hampshire's Child Book I* 25). When her father asks her why the flowers have different colors and scents, Lesley replies that it is for people to enjoy. Elinor then explains that the colors and aromas attract bees that will transfer pollen "off the pistil onto stamens." Either Lesley or her mother is a little confused here, since pollen is actually transferred *from* the stamen *to* the pistil, but the episode reveals how the Frosts encouraged their young daughter to embrace factual over fanciful explanations for natural phenomena. By the next spring, Lesley displays a better understanding of pollination when describing fertilization of cherry blossoms: in May of 1906, she explains that the pollen the bee carries on "his" wings from the stamen "goes down through the pistal [sic] into the seedpod" and that the blossom won't "grow into a cherry without pollin [sic]" (*Book III* 26).⁵ Writing on another spring day, Lesley displays not only a practical understanding of plant reproduction but also a commendable sense of restraint when she decides not to pick the strawberry and peach blossoms she finds along the roadside because she would rather eat the fruit in the summer (*Book I* 34).

Back on the apple tree, all but three of the flowers, and the small stems that supported them, have fallen off (4), meaning that fertilization was only successful in those three blossoms. The flowers that remain then "set," and the fertilized ovary is fed through the stem by which it is attached to the tree. The ripened ovary, containing individual ovules, or seeds, becomes the apple. In acknowledgment of how the fruit develops from a flower, farmers and botanists refer to the two ends of the apple as the stem-end and the blossom-end, what we might call the top and bottom, respectively. Frost used this terminology as well, in two poems—"After Apple-Picking" and "New Hampshire." In the final line of the first stanza, Frost refers to a "downy wax" on the growing apples (6). The wax is a natural coating that protects the fruit from various pathogens and ultraviolet radiation. It is important to protect the fruit from mutation-inducing UV radiation because the seeds contain the genetic material that will produce the next generation.

In the next stanza, we learn that each growing apple has turned from facing upward on its stem, as the lightweight ovary did when it was part of the flower, to hanging downward as the fruit becomes too heavy for the stem to support: "They had just given themselves a little twist/And turned from looking up and being kissed/To looking down and yet not being sad" (7–9). It is in this downward position that the fruit will continue to grow until it becomes ripe and eventually falls from the tree or is picked. In addition to turning downward, Frost

alludes to another change that accompanies ripening when the farmer tells his son that “what was green would by and by be gold” (17). Taken literally, the farmer is referring to the color change that occurs as an apple ripens; taken metaphorically, the farmer is anticipating the monetary value of his apples once ripened. The unripe, green color is due to the presence of the photosynthetic molecule chlorophyll and the pigment carotene (and related molecules called carotenoids) in the skin of the apple. It is the process of photosynthesis that converts sunlight, water, and carbon dioxide into glucose (sugar) and oxygen. Therefore, while the apple is growing and synthesizing sugars, it must continually replenish its chlorophyll, thus maintaining the green color. Carotene acts as an accessory to photosynthesis by collecting light energy and transferring it to a nearby chlorophyll molecule. At the end of the season, when photosynthesis stops, the chlorophyll decomposes and the characteristic green color disappears. When chlorophyll breaks down, its molecular components are returned to the plant through the stem where they will be stored over the winter and reassembled to make more chlorophyll the next year. It is especially important for the plant to recycle chlorophyll because it is rich in nitrogen, an element that is hard for the tree to obtain from the soil. Though nearly 80% of our atmosphere is nitrogen gas (N_2), plants cannot use nitrogen in this form.

Carotene, on the other hand, which gives carrots and squash their yellow color, is composed entirely of carbon and hydrogen atoms and contains no nitrogen. Because carbon, provided by carbon dioxide (CO_2) in the air and hydrogen, provided by water (H_2O), are both plentiful, there is no advantage in breaking down carotene into its elemental forms. In fact, there would be a disadvantage in breaking down carotene because it also serves as a sunscreen to prevent UV damage to the seeds within the apple. (Apples that turn red have an additional pigment that acts as a UV-protectant after the chlorophyll breaks down.)

Even at this point, it is not certain that the apples will grow to maturity because two of its natural enemies, the “codlin moth” (28) and the “rusty parasite” (28) are lurking. The codlin, or codling, moth is the adult form of the widespread pest, the apple maggot. Although the larval maggot does the damage, it is the adult moth that lays eggs on leaves and the surface of fruit. After hatching, the larvae eat their way into the fruit, heading for the protein-rich seeds at the center, remaining in the apple for about three weeks. When the larvae are ready to pupate, that is, undergo metamorphosis, they leave the apple and move back onto the limbs of the tree, where they will spend the winter, emerging from a thick, silken cocoon in spring as a moth. If the apple

falls to the ground while the maggot is still in it, the maggot will crawl back to the tree it fell from, or one nearby, in order to pupate. Knowing this, farmers of Frost's time would often paint the lower region of the tree trunk with a band of sticky plant tar that would trap the maggots and interrupt the life cycle. Frost's poem "The Black Cottage," describes "tar-banded ancient cherry trees" (3), a likely reference to this pest management practice that prevents wingless insects from crawling up into fruit trees to pupate or lay eggs.

"Rusty parasite" refers to cedar apple rust, a fungal parasite that must live on both junipers (or Eastern red cedars) and apple trees at specific times in a two-year life cycle in order to reproduce. The fungal spores are carried by the wind from the juniper tree to the apple tree and back again. If untreated, the rust fungus can infect both the fruit of the apple tree and its leaves, rendering the fruit inedible and leading to extensive defoliation. For this reason, farmers avoid planting apple trees near cedars.

In addition to the apple maggot and cedar apple rust, common enemies of the orchard are aphids, mites, scale insects, and powdery mildew. These pests were effectively treated during Frost's time by the practice of dormant spraying. In the spring, trees were sprayed with a lightweight mineral oil, sometimes called horticultural oil, which would seep into crevices and smother fungal spores and the eggs of overwintering insects. Timing of the spray depended on the weather and the tree's development—preferably the overnight temperature would not go below 50°F and the buds on the tree should not have begun to swell. We know from letters written by Frost to his son in 1936 (*Family Letters* 186) and 1938 (197), that dormant spraying was performed on Carol's farm in southern Vermont in early to mid-April.

Finally, in autumn on "the verge of frost" (31), the apples are almost ripe; this detail reveals that the Gold Hesperidee is a variety that bears its fruit late in the apple season, which can stretch between summer and early winter. But Matthew Hale never gets to taste the fruit of his labors: on his way to church one fall morning, he discovers that the tree has been looted for its gold and the beautiful apples are gone. After throwing an angry fit, Hale reflects on his misplaced adoration and vows to restrain his "wrath" (60) in the future.

Hale's passion for his fictional apple tree makes us wonder if Frost had a real variety in mind. Is it possible to use the clues in the poem to identify such an apple? Frost's favorite yellow apples were known to be the Golden Delicious, a popular eating apple, and the Yellow Transparent, a sweet, juicy apple best suited for applesauce and pies.⁶ Several details point to the Golden Delicious as the likelier inspiration for the poem: first, it is a late variety, typically bearing fruit in late

autumn or early winter; second, it is highly susceptible to both cedar apple rust and the apple maggot; and finally, the Golden Delicious is one of the varieties (along with Macintosh and Northern Spy) that Frost said he would like to end his days growing (Untermeyer 287). Conversely, the Yellow Transparent ripens in July in New England, rather than late autumn, and unlike the Gold Hesperidee, is naturally resistant to cedar apple rust. Together, these facts suggest that, if indeed the Gold Hesperidee is based on a real type of apple, which it need not be, it is probably the Golden Delicious.

Regardless of the type of apple tree it is, Farmer Hale has the luxury of lavishing his attention on just one tree. Of course, most farmers have an entire orchard to care for and cannot fret about the fortunes of any single tree. This is not to say, however, that he cannot dote on the orchard as if it were a single tree: in reality, an orchard is an ecosystem that can be thought of as a living entity with its own needs and possibilities, depending on its age, location, type of tree, and season.

Frost's poetry includes many references to orchards, mostly apple orchards, which he depicts as fragile entities that need humans to take care of them much like domesticated animals or children. Despite its fragility, however, Frost endows an orchard with the ability to impose order on men through constant demands for care. In "Good-by and Keep Cold," published in *New Hampshire* in 1923, Frost provides lessons on orchard management as he describes those things that can endanger young fruit trees. He begins by addressing the perils a young fruit tree might face as it spends the winter in a remote hillside orchard (4). Frost refers to sharp-toothed mice and rabbits nibbling away the bark of the tree, moving around the trunk to make a band that girdles the tree (6). Up higher on the trunk, a hungry deer might eat bark during a lean winter (8) then feast on the tender green leaves as the tree emerges from dormancy. The grouse would not be a problem until spring (8) when the birds will fly from branch to branch eating the nutritious buds before they have a chance to bloom.

Wild animals also have a taste for mature apples, not just the leaves and bark. A letter Frost was writing on August 30, 1926 ends abruptly when he hears a noise overhead: "Just at this moment (1.30 A.M.) I am interrupted by the bang of an apple on the roof. Another porcupine is up and at it. To arms! Duty and honor call. With hurried best wishes to you both" (*Selected Letters* 335). At this point, Frost presumably rushed outside to chase off the quilled thief, who was eating apples to fatten up for the harsh northern New Hampshire winter. Like the porcupine, Frost was a nocturnal creature and would frequently stay up to the small hours writing or talking with friends. While this might be normal behavior for a poet, it is rather unusual for a farmer. Consequently, on

Frost's farm in Franconia the cows had to adjust to giving milk at noon and midnight instead of the more common early morning and late afternoon times (Morrison 30).

Animals that sleep through the winter also have a taste for fruit that man has planted for himself. In "The Bear," published in 1928 in the collection *West-Running Brook*, the title character pulls down a tree to reach the chokecherries:

The bear puts both arms around the tree above her
And draws it down as if it were a lover
And its choke cherries lips to kiss good-by,
Then lets it snap back upright in the sky. (1–4)

This image may have been inspired by an incident in late summer of 1925 that Frost relates in a letter to Louis Untermeyer from his home in Sugar Hill, NH. Frost writes of a bear infestation that was "as thick as caterpillars in a pest year" and reports that "A mother and two cubs went up the road by our house the other evening tearing down the small cherry trees along the wall. You could see where one of the cubs had wiped his bottom on a large stone and left traces of a diet of choke cherries and blueberries" (Untermeyer 176).

Frost proposes to discourage the hungry creatures by calling them to the stone wall around the orchard before winter begins and waving a stick at them, hoping they might think it is a gun (9–11). Besides the obvious attempt to scare the animals away, it is likely that Frost is alluding here to the custom of "wassailing" the apple trees, which has been practiced in parts of England from medieval times. In order to ensure a good crop for the next spring, the members of a village gather in the orchard on Christmas Eve, or on Twelfth Night, to pour wassail on the roots of the tree to summon good spirits, then shoot their firearms into the branches to scare away the evil spirits. The Frost family lived in England from 1912 through 1915, including a year in rural Herefordshire, part of the apple-growing West Country. The Frost home was adjacent to a large orchard of apple, pear, and plum trees, and it is possible that the Frosts had opportunity to observe a wassailing of the orchard during the holiday season of 1914–1915.

Pests are a problem that a farmer can address, even if he only uses idle threats and rituals, but he can do little to mitigate the harm imposed by harsh weather. Over the years, Frost's letters to friends reveal that the weather was a constant concern, both for his own farm and later for his son Carol's. In June of 1918, Frost writes about a cold snap in Franconia, NH that killed their seeds, causing the loss of a month's growth. He reports that those with large farms set fires and sprayed water to keep the crops warm overnight but the small farmers resorted

to wrapping up garden plants in their own clothing, sheets, and blankets. Frost laments that he lost his favorite tomato plant which “froze right in my heavy winter overcoat” (*Selected Letters* 231). In 1920, he tells a friend that Franconia’s climate which could frost gardens in July and August was a major reason the family decided to move to southern Vermont (*Selected Letters* 254).

Although mild frosts can kill seedlings and plants in spring and summer, continuous cold in winter is a good thing for an orchard. Frost explores the paradox that although warmth might be something parents would want for their young children or farmers would want for newborn animals, untimely warmth will destroy a fruit crop. In “Good-by and Keep Cold,” the farmer provides advice about the perils of warm winter weather, ending with the line “Dread fifty above more than fifty below” (19).

Trees can tolerate very cold temperatures (although -50°F is extreme) because they undergo a process called winter hardening as they transition to dormancy, a state of minimal metabolic function. Plant tissues consist of cells with rigid, but permeable, walls and spaces between the cells. The *intracellular* fluid (cytoplasm) contains relatively high concentrations of dissolved materials such as sugars, salts, and proteins, which serve as antifreeze to lower the freezing point of the entire solution. The *intercellular* space is mostly water, which means that it will freeze first when the temperature drops. Once the water between the cells is frozen, osmotic pressure forces additional water out of the cells to balance the amount of water on each side of the cell wall. As the volume of water inside the cell decreases, the cytoplasm becomes more concentrated, further depressing the freezing point. Additionally, the process of freezing actually releases heat which also raises the temperature in the tissue. (This is why spraying crops with water before a hard freeze can be protective.) Once winter hardening is complete, the tree should be protected against a range of freezing, even subzero, temperatures depending on other factors such as the presence of an insulating snowpack and mechanical damage that ruptures cells. In the spring, a sustained thaw will reverse the hardening process and the tree will emerge safely from dormancy to prepare for a new season of growth and reproduction. If the tree develops buds before the last cold snap, the cells in the soft leaf and flower buds will freeze, causing the water inside the cells to expand, rupturing the cell walls and destroying the tissue. An entire season of growth could be lost, making it harder for the tree to survive the next winter. So Frost did not take much, if any, poetic license when warning of the dangers of warming.

Although it is not possible to control the weather, a farmer can minimize the risk of premature thaw by careful selection of the orchard site:

"I don't want it stirred by the heat of the sun./ (We made it secure against being, I hope,/ By setting it out on a northerly slope.)" (12–14). Apple orchards should be planted on a gentle (4–8°) slope in order to ensure good drainage. A slope facing north will heat up more slowly than one facing south because, in the northern hemisphere, the sun travels across the southern portion of the sky. A crop planted on a northerly slope will bloom and bear later than one on a southerly slope, but will also be better protected against untimely thaws.

When *New Hampshire* was published in 1923, the Frosts were living on an 80-acre farm in South Shaftsbury, VT with an apple orchard on a north-facing hillside, like the one described in the poem (*Selected Letters* 353). In November of that year, Robert and Elinor gave the farm to their son Carol and his bride Lillian LaBatt as a wedding present and moved to a smaller farm nearby. Carol grew several apple varieties on his farm and drew inspiration as his father had years before in Derry. In a 1935 letter to his son, Frost provides a critique of a poem Carol had sent him: "We both liked the apple-crating poem for the genuine satisfaction it takes in the life you are living. It has a great deal more of the feeling of real work and country business than anything of mine could ever pretend or hope to have" (*Family Letters* 183). Sadly, Carol never did become a commercial success as a poet and destroyed all written copies of his work. Failure as an artist fueled the depression that eventually led to his suicide in the farm house in South Shaftsbury in 1940 (Parini 332).

The final poem I will consider concerns the end of a season, after a farmer has brought his orchard past the dangers of weather, predators, and pests, only to become a victim of his own success. In contrast to poor Matthew Hale who ends up with no apples, the farmer in "After Apple-Picking" is overwhelmed by his bounty. In this poem, which was published in *North of Boston* in 1914, Frost paints a detailed portrait of harvest time in an apple orchard, describing not only the physical and mental weariness that descends after a day of picking, but also documenting the farming practices of his time.

With its emphasis on manual labor and farming tasks, "After Apple-Picking" has the strongest georgic character of the three poems discussed in this essay. Frost's place in the georgic tradition was first recognized by fellow American Ezra Pound when he reviewed *North of Boston* for *Poetry* magazine in 1914. Pound declares the poems to be "modern georgics" in which Frost consciously puts "New England rural life into verse" (Pound 127). The poem also fits a more recent characterization of the American georgic tradition by Timothy Sweet as one that describes man's relationship with the land, not just in terms of work, but also in terms of the economic value to be extracted from the land. As someone who was never able to support his family by farming

alone, Frost was acutely aware of the harsh economic realities of farming.

In keeping with the georgic flavor, the poem is filled with practical details: we learn that the time is late autumn because the overnight temperature is cold enough to freeze solid the top layer of the animals' drinking trough (10–11) and there is frost covering the ground (12). We learn that, like Matthew Hale, the farmer in this poem is harvesting a late-bearing apple. Furthermore, a reference to stubble (line 34) reveals that the apple trees are near a hay field that has already been cut. The "rumbling sound" (24) from the cellar bin of "load on load of apples" (26) indicates that the trees are near the farm house.⁷

The methods and tools of picking apples are also described: the farmer stands on a long open-ended ladder (1) which has round rungs (22), rather than flat treads; we discover that the ladder is not free-standing and must be supported by the branches he is picking from because of the way it causes the bough to sway (24). As he picks apples, the farmer notes "each russet fleck" (20). Russet is a patch or streak of rough brown skin that can be caused by a virus, fungus, bacteria, wetness, or frost. Apples, including Golden Delicious, can also have a genetic susceptibility to russetting. But, unlike the popular russet potato, with its rough, dirt-colored jacket, and russet pear varieties, such as the Asian and D'Anjou pears, there is no longer a widespread taste for russeted apples. Instead, the "russet flecks" are seen as flaws and russeted apples rarely make it to modern supermarkets, despite the sweet, nutty taste the russet adds.

Once he picks the apples, he lowers them down carefully (31), presumably using a basket, then transfers the apples to a barrel, repeating the process until it is filled (3). The activities described in the poem are similar to Lesley's journal account of helping her father pick apples in 1906 (*New Hampshire's Child* Book IV 66–67). The barrels are then emptied into bins in the root cellar (24), where they will be held in cold storage. The apples apparently stayed tasty throughout the winter, based on a charming entry in Lesley's journal from late January of 1907. On that day, four-year-old Carol, who normally ate two apples a day, unsuccessfully lobbied his mother and sisters for the right to have a third. After baby Marjorie babbled "apple apple" in response to his earnest request, Carol "stamp'd his foot" and went off to play, grumpy but resigned (Book III 83–84). The Frost farm in Derry, where they lived at that time, had a cellar beneath the farmhouse and Lesley describes being sent on scary trips down there to retrieve items for dinner (Book VI 64–65).

Any apple that falls to the ground must be diverted to the cider-apple heap, even if it looks undamaged (35–36) because of the "one

bad apple” phenomenon. As part of the natural ripening process, apples release the gaseous hormone molecule ethylene, which triggers various chemical reactions, including those that produce a color change and convert starch to sugar. When apples are packed together closely, as in a cellar bin or a barrel, the release of ethylene from a damaged apple will cause nearby apples to begin ripening, which will cause additional release of ethylene and can quickly lead to rotting of the entire lot. Therefore, in order to preserve the apples, and other stored foods such as potatoes, only the firmest apples with unbroken skin are placed in cold storage.

Luckily, damaged apples are just fine for making cider. Cider is produced by pressing apples to squeeze out the juices, including various dissolved solids. The pulpy material that remains after pressing, pomace, is often used as an animal feed during the winter. Cider is served unfiltered and unsweetened and is tangy, due to carbon dioxide produced by low levels of natural fermentation. Although cider is non-alcoholic when consumed fresh, it can be fermented to produce an alcoholic cider, which is typically 6–8% alcohol (ethanol) by volume. Cider can also be converted to apple cider vinegar by the intentional, or unintentional, introduction of bacteria to convert ethanol to acetic acid, the active ingredient in vinegar.

Frost’s short poem “In a Glass of Cider,” published in 1962, uses the action taking place in a glass of cider as a metaphor for the ups-and-downs of his life:

It seemed I was a mite of sediment
That waited for the bottom to ferment
So I could catch a bubble in ascent.
I rode up on one till the bubble burst
And when that left me to sink back reversed
I was no worse off than I was at first.
I’d catch another bubble if I waited.
The thing was to get now and then elated. (1–8)

The unfiltered solids naturally settle to the bottom, but fermentation produces bubbles of carbon dioxide that rise to the top until they reach the surface and burst. Having lived in “cider country” (*Selected Letters* 122) in England, where he felt compelled to keep a barrel of cider by the front door for guests, Frost was undoubtedly familiar with the behavior of bubbles in cider glasses as well as the effects of cider on people.

Humans are not the only ones with a desire to get “elated” now and then. In “The Cow in Apple Time,” Frost introduces us to a cow which has developed a taste for cider: “. . . face is flecked with pomace and

she drools/A cider syrup. Having tasted fruit/She scorns a pasture withering to the root" (4–6). In the poem, the cow has jumped over a wall to get into an orchard where fallen apples are lying on the ground. She made pomace herself from the windfall apples that have not only "sweetened" (7) but have apparently fermented as well, based on her drunken, unladylike behavior. Apples that fall to the ground will get sweeter as they dehydrate as a consequence of no longer being attached to the tree's circulatory system that provides water. As water evaporates, the sugars become concentrated. The fermentation step, however, is more complicated than simple evaporation, because it requires the presence of a microorganism to carry out the chemical reactions that convert sugar to ethanol. This organism is *Saccharomyces cerevisiae*, more commonly known as yeast. Although we think of yeast as a highly purified product purchased in small foil packets, it is actually all around us in the environment. And because yeast requires sugar for energy, the single-celled microorganisms are attracted to the surfaces of apples, grapes, and other rich sources of sugar. Various species of yeast are found in the soil and travel easily because they are light enough to be carried through the air. Therefore, it is not surprising that many apples that fall to the ground and decompose eventually also ferment to produce ethanol, with carbon dioxide as a byproduct.

The bovine taste for apples, especially fermented ones, is well known and farmers do their best to prevent episodes such as the one described. Frost's daughter Lesley recalls in her journal of 1905 that the family cow on the Derry Farm would frequently go wandering, requiring a family member to fetch her (*New Hampshire's Child Book I* 14–15). In "Mending Wall," the narrator alludes to the problem of cows eating windfall apples when he wonders why it is necessary to maintain the fence between the two properties: "He is all pine and I am all apple orchard./My apple trees will never get across/And eat the cones under his pines, I tell him" (26–28). To make his point clear, the narrator continues: "'Why do they make good neighbors?' Isn't it/Where there are cows?/But here there are no cows" (32–33).

As a side note, although stone walls in Kingsbarns, Scotland reportedly served as the visual inspiration for "Mending Wall," the action, dialogue, and setting were based on experiences from the Frost family farm in Derry, NH (Newman 68). The Frosts' apple orchard was separated from their neighbor's grove of white pines by a stone wall. White pines do not carry the cedar rust that infects apple trees; however, they can carry white pine blister rust, a fungus that infects currants and gooseberries as part of its life cycle.

Although Robert Frost did not need to farm the land after leaving Derry in 1912, he never lost the desire. He was thrilled when his son

became a farmer and his letters glowed with pride, and a bit of envy, as he described the year-round cycle of activities on Carol's farm in Vermont (*Selected Letters* 345, Untermeyer 208). Once he became a successful poet, Frost owned a series of farms with orchards in New Hampshire and Vermont, the last of which was the Homer Noble Farm in Ripton, VT, which he bought in 1939 (Morrison 23). The farm was near the site of the Breadloaf Writers Conference, which was held each August and led by Harvard University faculty member Ted Morrison, whose wife Kay was Frost's personal secretary. With the help of the Morrison family and tenant farmers, he kept chickens, cows, horses, and pigs; he also raised vegetables and maintained maple and apple orchards. In fact, at the time of Frost's death, an orchard of young MacIntosh apple trees stood on the northern edge of the farm waiting to be grafted with limbs from several old New England varieties of apple, including Sweet Bough, Cole's Quince, Lowland Raspberry, and Porter apples (Morrison 45).⁸

Throughout this essay, I have acted as a tour guide, pointing out scientific facts hidden among the verses, like so many rare birds or ferns. Implicit in the analogy is the notion that humanists are curious about and can benefit from knowing the scientific underpinnings of poetry. Is the reverse also true? Does the scientist have anything to learn from the poet? I would suggest that poetry, as an embodiment of a humanist, integrative outlook, serves as a useful antidote to the reductionist approach that has otherwise proven very successful at explaining the workings of the natural world. Rather than breaking nature into its component parts to be separately analyzed and only imperfectly reassembled, poetry describes the intricate ways in which human beings are tied to and fit into their environment.

In the poems described above, Frost reveals how poetry can be used to define man's place in nature and reveal the extent of his influence. For example, in "The Gold Hesperidee," Farmer Hale—who thinks he is in control of his apple tree—must accept the fact that he is nothing more than a caretaker, and not a particularly good one at that. In "Good-by and Keep Cold," the narrator similarly recognizes that there is a limit to what he can do to ensure a successful harvest because he is at the mercy of the weather, disease, and a variety of self-interested predators. Finally, in "After Apple-Picking," the narrator is reduced to the role of servant to the orchard, forced to work through his fatigue on a schedule determined for him by nature. Frost makes it clear that the farmer will not get to sleep until the sleep of winter descends on his orchard as well.

In each poem, Frost portrays the farmer as a mortal entity enmeshed within a larger landscape, not a god suspended above it.

In contrast, a scientist necessarily places herself outside of nature, employing the useful fiction that she is a neutral party whose presence does not influence the outcome of an experiment or observation. When the illusion of separateness escapes from the laboratory like an unruly virus, however, poetry—and Frost—are here to remind us that humans are a *part* of nature and cannot be considered *apart* from it.

NOTES

1. Biographical information about John Chapman is based on Robert Price's 1954 biography, *Johnny Appleseed: Man and Myth*. The reader is also directed to Michael Pollan's *The Botany of Desire*, which devotes the first chapter, that is, one-fourth of the book, to the apple, with a focus on John Chapman's role in establishing the place of the apple in American culture. An interesting side note is that Chapman was born in eastern Massachusetts, the region that the Frost family was from, and that he was a missionary for the Swedenborgian church, which was the chosen religion of Robert Frost's mother, Belle. In fact, Frost and his wife Elinor were married in the Swedenborgian chapel in Cambridge, MA. Frost credits much of his philosophical outlook, and open-mindedness toward science to the influence of Swedenborgian principles.

2. Biographical information on Robert Frost contained in this article is based on *Robert Frost: The Early Years, 1874-1915*, by Lawrance Thompson and *Robert Frost: A Life*, by Jay Parini. Descriptions of his life in Derry, NH may be found in Chapters 24 through 27 of the Thompson book and Chapters 5 and 6 of the Parini book. Where appropriate, specific page numbers are provided.

3. Detailed descriptions of Frost's early interest and training in science can be found in the 1974 article "Robert Frost's Early Education in Science," by Kathryn G. Harris in *The South Carolina Review* and in Chapter 9 of Thompson's *Robert Frost: The Early Years, 1874-1915*. Frost was famously autodidactic and kept up with the latest scientific discoveries through reading and by cultivating friendships with scientists. By all accounts, Frost had a genuine understanding of even complex subjects, such as relativity and modern physics. Peter Stanlis, who had been a friend of Frost, writes that "the Harvard physicist Harvey Brooks told me that from his conversations with Frost he believed that the poet understood Einstein's general theory more profoundly than many of his scientific colleagues in physics did" (143). Frost's scientific acumen entitled him to some skepticism as well, especially in the areas of quantum mechanics and the theory of evolution. The curious reader is pointed to two excellent books on the subject of Frost's skepticism: Robert Hass's *Going By Contraries: Robert Frost's Conflict with Science* and Robert Faggen's *Robert Frost and the Challenge of Darwin*.

4. Except for the poem, "March Maker," which appears only in his Frost's *Notebooks*, all references to lines of poetry are from the poems as they appear in *Collected Poems, Prose, & Plays*.

5. By referring to the bee using a masculine pronoun, Lesley appears to assume that the bee is a male, when, in fact, worker bees are all sterile females. Whether she is ignorant of the gender of worker bees or guilty of sloppy writing is not known. However, either is forgivable in a seven-year-old child.

6. Personal communication from A.M. Smythe.

7. Based on later descriptions of how the apples are carefully selected, picked, and lowered from the tree, it seems odd that apples would be carelessly tossed into a large common bin in the cellar. Instead, it is possible that the rumbling refers to apples that will be used for cider and need not be handled carefully. Alternatively, "rumbling" may refer the sound of filled barrels of apples being rolled down a ramp into the cellar. One hundred years after the poem was published, I am hesitant to speculate on what Frost means here.

8. A maple orchard is sometimes referred to as a "sugar bush," especially in New England. In fact, Frost himself uses this term at least once in recorded correspondence to Louis Untermeyer (Untermeyer 195). However, Frost never uses the phrase "sugar bush" in his poetry, opting instead for the term "sugar orchard," which appears in the title of "Evening in a Sugar Orchard," in New Hampshire.

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