Apis mellifera (The Honey Bee): A Teacher's Companion

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Abstract

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While people have an uneasy relationship with most insects today, honey bees have been revered in ancient belief and culture in India, southwest Asia, and throughout the Mediterranean world. After honey bees were introduced by the English to North America in the 1600's, they became integral to food production. Now they and other pollinators are imperiled.

Beekeepers surveyed for this paper revealed a desire for more people to appreciate honey bees and to not fear them. Waldorf teachers who were surveyed for this paper involve honey bees in their teaching primarily in grade five during botany, but a lack of applicable material prevented them from using them beyond the basic science blocks.

In addition to examining their views, this paper explores the sympathy and antipathy we collectively share about insects and encourages teachers to invite the honey bee as a muse for creative teaching. The text and appendices provide material -- poetry, music, fables, biographies, class projects, and further resources -- to draw *Apis mellifera* into the life of a teacher and a class.

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A Teacher's Companion

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Chapter I

Honey Bees and Us

"Insects teach us nothing short of what might be considered the highest understanding we can derive from nature (Berrevoets, 2009, p. 44)."

Apis mellifera, the European honey bee, is just one out of thousands of species of bees, wasps and other pollinating insects upon which the rest of the living world depends. Unlike those thousands of other organisms, however, honey bees have become part of human culture and have captured the imagination of human beings throughout time. The complexity of their social organization is part of our fascination, yet they are not the only social insects; ants and termites, for example, live in complex societies rearing young and constructing elaborate structures. Honey bees are not the only insects humans have domesticated; silk worms have a long history of cultivation and central role in history for Asian, African and European cultures.

Honey bees stimulate something more in us: a profound love and even reverence. Creation stories from Southeast Asia involve the honey bee; ancient religions from India, Egypt, Persia, Rome and Greece are filled with references to the honey bee. Medieval Christians in Europe not only saw the honey bee as symbol of purity, honey bees became vital to the workings of the church as a source of wax for candles which were central to religious practices and ceremony. As the feudal state evolved in France at the end of the Dark Ages in the 800's, Charlemagne built his power on taxes -- *l'abeillage* -- collected

in the form of honey (*abeille* is bee in French).

Today, even as honey has become part of a transaction economy, commercial beekeeping has become industrialized, and science has dissected nearly every cell and orifice of the honey bee, we can still find a sense of wonder in what is the whole of this being. A new beekeeper in Oregon summarizes the sentiment that many share, "I have enjoyed the spirit energy of the bees. It feels like I have a new member of the family. When our first swarm left the hive it was a huge emotional loss. When the next swarm moved in a few weeks later I was so happy it made me cry (Anonymous, Beekeepers Survey results, 2010)."

Despite the evidence of an enduring reverence for the honey bee, human beings have an uneasy relationship with most insects -- they and other invertebrates have been feared and reviled through the millennia. Even the most devoted teachers may not find much enthusiasm, let alone love, for the study of scorpions, tarantulas or fire ants. They are dangerous to human beings and are so utterly different than mammals, fish or birds. This antipathy is in marked contrast to the sympathy we hold for honey bees.

An obvious reason for this attraction (or at least the overcoming of an aversion) may be for the allure of honey the unique product of *Apis mellifera*, the honey bearer. The first recorded honey hunt is an 8,000 year old cave painting near Valencia, Spain, and as beekeeping evolved, it made it easier for people to access honey safely. But much more wonder remains for teachers who want to look beyond the biology of the individual bee, honey, the workings of the hive, or the bee in a larger ecological landscape.

Insects and Us

"In order to save the world, we must love it -- and in order to love it, we must become familiar with it again (Mary Oliver in Gordon, 2006, p. 348)."

Effective and enthusiastic teachers have an innate curiosity in what is emerging in the world around them and strive to bring material to their students in a way that stimulates children's imaginations and cultivates a love of the world. A teacher who can use natural science as a gateway to the humanities and worlds of willing, feeling and thinking find a rich array of ideas with which to work. Religion, myth, painting and poetry throughout the ages and many cultures are filled with references and homage to honey bees; the relationship between human beings and this unique animal is fascinating and ever evolving. In the first lectures to teachers of the first Waldorf school in Stuttgart Germany in 1919, Rudolf Steiner underscored the central significance of the study of nature as a way to understand the human being and the cosmos. "As teachers, you will need to make nature understandable to your pupils and, at the same time, guide them to a comprehension of spiritual life. Without being familiar, at least to a certain extent, with nature and without a relationship to spiritual life, people today cannot become part of social life (Steiner, 1996a, p. 65)." Steiner explains that what brings our senses into relationship with the outer world is not a thinking process, but a willing one (Ibid.).

"Human feeling stands right in the middle between thinking cognition and willing (Ibid., p. 99)." Sympathy, or attraction to something is most commonly an unconscious activity. To develop deeper sympathy for things or people outside of ourselves (or to develop the whole of our own beings), we will need to develop our capacity for conscious

choice, of will. And, if we are to fully develop ourselves, our thinking process should likewise move out of the purely conscious realm -- we must develop antipathy to instincts which separate us from our ability to make ethical and moral choices (Ibid.). "For those few things into which we bring real enthusiasm, devotion, and love, and not simply rationality, sympathy dominates so strongly in willing that it rises to our consciousness, saturating our will with sympathy; otherwise the will remains as an objective connection with our surroundings (Ibid., p. 98)."

Through a loving interest and sympathy, integrating honey bees into a Waldorf school curriculum is a real opportunity for the education of the will. It is not just the physical actions in the honey bee's hive and her work among flowering plants that inspire us. An effort to learn about and cultivate plants that will nurture insects, birds and other wildlife, and our work to plant them is an ethical act. Conscious choice and the conscious repetition of that choice builds our forces of will. Likewise, the unconscious repetition of activities or habits in our classroom, cultivates healthy feeling towards the world (Ibid., p. 92).

Steiner specifically advises teachers to be wary of the study of natural science that ignores human experience. "If we turn our thinking and ideas only toward nature, then we can comprehend only what is continuously dying there, (Steiner, 1967, p. 65)," as reflective thinking and reason is examination of what is still, in effect, dead. "What brings our senses into relationship with the outer world is not of a cognitive, but of a willing nature (Ibid)." And what brings us into contact with the world around us, brings us into closer relationship with our inner world, as articulated in this children's verse by

Dorothy Harrer.

> If I can clearly see the world around me,
> The creatures of the earth and of the sky,
> Then I can see as well what other people need.
> If I can hear the sounds and songs and voices
> In the world around me,
> Then I can hear as well what all words mean.
> For if I can know the outer world,
> I can also know the world within. (Harrer, 1973, p. 8).

For today's teacher, it is also appropriate to know that human impacts brought by our agricultural practices (pesticides, fertilizers, monocultures, genetic modification), our home landscaping, and the industrialization of beekeeping have had profound impacts on the honey bee. We have caused the natural rhythms to be so disrupted that honey bees and insects of all kinds are imperiled as never before. Their plight is like an alarm call to us from nature to wake up and strive to understand the honey bee and her insect cousins. Bees provide a moral imperative -- a choice, an exercise of the will -- for humans to take interest in the world of the seen and of the hidden.

Beekeepers have a unique position in the world -- they land somewhere between farmers and shepherds. Seeing that modernity has nearly eliminated both activities, at least near and in cities, most children today have little or only cursory experience in the rhythms and life cycles of animals. Very few people have any involvement in the life cycle of insects outside of the occasional unwelcome ant invasion or moth infestation.

In October 1922, in lectures about the younger generation, Rudolf Steiner spoke

about the evolution of thought and the advent of materialism as the predominant world-view. He cautioned that people have lost the ability to arouse a genuine interest in the world and how education must be active and alive. "Fundamentally, the Waldorf School does not want to educate, but to awaken. For an awakening is needed today. First of all, the teachers must be awakened, and then the teachers must awaken the children and the young people (Steiner 1967, Lecture II, paragraph 24)." If teaching is to be effective and meaningful, then teachers have a responsibility to ensure that students not only experience an awakening of their feeling life, but that they also ask if they have a 'living' experience of the subject and are able to perceive it's relevance to 'real' life. Part of this awakening is to understand our own potential biases and misunderstandings of the life we see around us.

Antipathy to Insects, to the Other

People with an appreciation of the inter-connectedness of life on earth may be able to equally embrace the beauty they see in a spider's web and reconcile that with the bloodthirsty actions of the spider itself; they may find the adapted perfection of the scorpion's sting as inspirational as the mystery of the hummingbird's uncanny ability to hover next to a flower before flitting away in a blur of wing beats. Few people, teachers included, can honestly confess an unabiding admiration or feeling of love toward the magnified image of a louse, a flea, or any number of less itch-inducing, disease-carrying insects, or other bugs and beings in our world. There is a good reason for our visceral aversion to rattle snakes -- they can be lethal! Honey bees can be lethal, too, a close-up of their heads and other body parts may cause discomfort or even revulsion. What more

could be behind this disgust or revulsion?

In short, insects represent the "Other" more than any other animal organism we can see. We have internal skeletons, they have exterior hard shells, to name just one obvious distinction. Early 20th century entomology started setting insects up as "bogeys", psychologically aligned to what was considered the savagery of the human unconscious. Scholars began to question if insects were proto-human or anti-human by nature. Karl Jung asked if insects represented the vestiges of animal psyche left in humans. Yet, it was not always revulsion that resulted. "Modern investigation of animal instinct, for example in insects, has brought together a rich field of empirical material which shows that if man sometimes acted as certain insects do, he would possess a higher intelligence than at present (Sleigh, 2006, pp 281- 285)."

Evidence of Western culture's antipathy to insects is found throughout myth, literature, psychology and religion. Insects were seen as representative of particular decay and pestilence in the 14th to 17th centuries when depictions of the Virgin Mary and the image of the one child were representative of what was whole and holy. This was in contrast to contemporaneous images of the devil releasing large amounts of spawn, just like hatched maggots. The images were compounded by the plagues in Europe, when people could see the visible decay of the body. This was abhorrent because also during this time people desired the body to remain whole after death. Insects were seen as preventing the wholeness of the human body from being maintained (Coutts 2006, pp. 298-311).

Succinctly put, perhaps modern people's deepest feeling is that "the insect does

not belong to our world... (it brings) something that does not seem to belong to the customs, the morale, the psychology of our globe. One would say that it comes from another planet, more monstrous, more dynamic, more insensate, more atrocious, more infernal than ours.... (There is a) profound inquietude inspired by these creatures so incomparably better armed, better equipped than ourselves, these compressions of energy and activity which are our most mysterious enemies, our rivals in these latter hours and perhaps our successors (E. L. Bouvier in Coutts, p. 298)."

Honey bees have inspired a different imagination, though. Indeed, from a spiritual point of view, they are revered by humans and the gods alike. Chapter II provides an outline of how honey bees through the millennia have transcended their "outsider" status when other insects have not.

Toward a Reunion with Insects: Nature Spirits, Wholeness and Love

For a person's survival, an antipathy for a lethal sting or an infestation of parasites seems clearly necessary: avoid them! More subtle is the healing power that a small amount of formic acid from a bee sting or ant bite can bring to an individual (Hauk, 2008). The complex relationship of agriculture, ecosystems and our food supply demands an entirely different view of insects on our part: we must work with them! A healthy ecological web depends on organisms we might individually find repugnant. How can human beings develop the sympathy, or affinity necessary for a more harmonious relationship to evolve? To begin to answer this, biophilia, or the love of life is a helpful world-view brought to the mainstream by contemporary biologist E.O. Wilson (Kellert

and Wilson, 1993). Deeper still, perhaps, are the forces of the spirit, our quest for wholeness, and love. Honey bees hold a special role in bringing human beings closer to these forces.

Nature Spirits

> *The luminous, wonderfully radiant, shimmering aura of bees, as they flit from flower to flower, is unusually difficult to explain. And why? It is because the bee is everywhere accompanied by a fire spirit* (Steiner 1991, p. 112).

Anthroposophy (anthropos = human being, sophia = wisdom) is a world-view first articulated by the Austrian scientist Rudolf Steiner in the early 20th century. Anthroposophy recognizes a reality of physical matter imbued with spiritual impulses, and understands the spiritual world as one comprised of beings which act through all life and matter. Nature spirits, also referred to as elemental beings, are the unseen forces which sustain life on earth and have helped bring it forth from the very beginning (Wieting 2009, p. 3). These forces interact with light, air, minerals, water, plants, animals and human beings; they are behind the evaporation of water, the constriction of blood vessels, the emergence of plants from the soil, and the pollination of flowers. To a scientist with an anthroposophical world-view, the existence of these forces does not negate the scientific method or legitimate findings of observation, hypothesis, and experiment. Rather, they strengthen the method while providing an imaginative way of understanding the processes behind phenomena and change. They can help us understand

the world as a living, evolving entity. In an anthroposophical world-view, bees and butterflies have a particular relationship to the physical world of nature and the forces in nature that distinguish them from other animals and insects.

Human beings have largely lost the sensory ability to perceive these nature spirits, but through creative thought and imaginative pictures, we can learn to experience them. Out of ancient belief systems threading through central European folkloric tradition and brought forward today through anthroposophy, these forces are recognized as spiritual beings. These beings are known as gnomes (ruling the earth element), undines (of the water element), sylphs (of the air), and salamanders (the fire element). The poetic and dynamic interplay among these elementals is what gives rise to natural phenomena and the pulse of all life. This is described in depth in the series of Steiner's lectures called *Man as Symphony of the Creative Word* (1991).

In describing the activity of the elementals that the ancients called gnomes, Steiner paints an imaginative picture:

> With the fundamental force of their being, they unceasingly thrust away from the earthly, and it is this thrust that determines the upward direction of plant growth; they forcefully take the plants along with them. The antipathy that the gnomes have to anything earthly causes the plant to have only its roots in the earth and then grow out of the earth; in fact, the gnomes force the plants out of their true, original form and make them grow upwards and out of the earth (Steiner, 1991, p. 106)."

Close to the soil there exist the undines or water beings:

> They live in the etheric element of water, swimming and floating in

> it...They dream their own existence, and in dreaming their own existence, they bind and release, they bind and separate the substances of the air, which in a mysterious way they introduce into the leaves...They are like chemists, hovering around what the gnomes have thrust upward. Undines wish to remain in a state of constant metamorphosis, of changeability (Ibid.).

In the air and light are sylphs, which hear the air currents as music. They are most at home where birds are creating currents. Where the gnomes experience life in a state of wakefulness, and undines live in a dream-like existence, sylphs experience existence in a state of sleep (Ibid., p. 107). A bird creates a feeling of ego for the sylph. Because the sylph gets this sense of ego from outside itself, it is the bearer of wishes of cosmic love from the universe. And, so it's great task in the world is to convey light to the plants. "With the help of up streaming substances worked on by the undines, the sylphs weave an ideal plant form out of the light (Ibid, p. 108)."

Finally, it is the fire spirits which gather up the warmth and deliver it to the flowers. Pollen is the physical manifestation of this warmth. Fertilization in the plant occurs when the seed formed in the flower is brought into the earth. "When the insects shimmer forth into cosmic space and attract the human being to descend again into physical incarnation, it is the fire spirits which inspire the insects into this activity. The fire spirits are active in promoting the out streaming of spiritualized matter into the cosmos (Ibid, p. 113)." Ancient Egyptians, Greeks and Romans believed bees called new human souls down to earth (Crane 1999, Mead 1907).

Everywhere fire spirits follow in the tracks of the insects as they

> flit from flower to flower. And so one really has the feeling when following the flight of insects, that each of these insects as it flits from flower to flower, has a quite special aura which cannot be entirely explained from the insect itself. Particularly the luminous, wonderfully radiant, shimmering aura of bees, as they flit from flower to flower, is unusually difficult to explain. And why? It is because the bee is everywhere accompanied by a fire spirit. The fire spirit does not only gain a feeling of its ego in the presence of the insect, but it wishes to be completely united with the insect (Steiner 1991, p. 112).

Taking elemental beings into account, we can gain an even deeper perspective at the crises in our environment, and connect them to our own self-development. "The inner state of human beings means a great deal to the world. The nature spirits have invisible bodies which exist on the level of our general state of vitality (what is "etheric" in us) or on the level of our feelings (what is "astral"). These invisible aspects of ourselves are real to them, and they can be affected by them. Any single human being or any group will have an effect on the whole surrounding area, depending on how they live their lives (Wieting 2009, p. 50)". "The nature spirits do not have an ego -- that is why they are vulnerable. Our human ego in part lives in the periphery -- it was once more firmly in the body. Now it lives in our interest, in our sense for our tasks, in our love and understanding, in our struggles to find the right path in the higher aspects of ourselves, in our relation to destiny (Ibid., p. 73)."

We require imaginative thinking to perceive these spirits in nature. We are helped greatly when we look and listen closely, when we seek to awaken to the forces behind their beauty. This symphony is the "World Word sounding forth from a countless

multitude of beings (Ibid., p. 141)."

Wholeness

Bien "can help humans to learn, to relearn, to remember the bigger picture of the underlying interconnectedness of everything (Michael Thiele in Korrow, 2008, p. 9).

A legitimate criticism of the modern scientific method is the problem of reductionism, of slicing phenomena into ever smaller parts so that we lose sight of the whole or the meaning of what is happening around us. When we are not seeking to understand how the parts fit together, or attempt to understand the consequences of scientific discovery as it relates to life, we risk harming our world. The acceleration of industrialization, epitomized in the development of our capacity and use of nuclear warfare, is perhaps all of the illustration necessary. Our involvement with honey bees provides an antidote to this reductionism and tendency to value the individual parts over the whole.

> "Bien" is a term born around the time when, about 150 years ago, modern industrial beekeeping practices accelerated with the widespread use of the square box hives and movable frames -- the hive was being broken apart for the convenience of the beekeeper and the increased exploitation of bees for honey. Many people began to recognize a need to see the whole of the hive again. The notion of bien can be likened to what more recently biologists call the 'super organism.'
>
> "The concept of the bien reveals itself as an undividable entity. As something which is beyond the sum of its small and many parts...We see these tens of thousands of single bees, and we know, to some extent, what each of them do at different times in their life span. But then there is something which makes all

> 50,000 into one complex, huge being, which is far beyond each individual sub-unit. The bien is one whole being. Through the bien we can experience the miracle that life is. We may sense the communal, non-hierarchical form of life, an attitude without greed, hate and delusion. Deep within we may feel the extent of selfless serving to the whole -- like Steiner says: the hive is permeated with love. So the beauty of the concept of bien, is that it can open our minds and stretch our understanding, because it's not only what we can see with our eyes, it's something those 50,000 honeybees are creating together. It can help humans to learn, to relearn, to remember the bigger picture of the underlying interconnectedness of everything (Michael Thiele in Korrow 2008, pp. 8-9).

This recognition of interconnection is a healing force. Waldorf educators often speak of providing "food for the soul" for their students. They are speaking about the nourishment that comes from "an art of education that works creatively from (the student's) soul (Steiner 1991, p. 190)." As a reductionist, exploitative science and pervasively individualistic world-view has taken hold in the world today, it would be considered by Steiner as like a parasite that is embedded in humanity. Even when a spiritual impulse comes to such a substrate, it then is perceived as poison. To Steiner, Waldorf education is the therapy, the healing force to overcome that poison. During a child's years in education, "much is brought to him of a parasitic nature," that which does not "spring forth directly from his heart and his soul... The moment the art of education lies close to the human heart, the human soul, the spiritual can be brought to man without becoming poison (Ibid.)."

Steiner is emphatic about how honey and the honey bee is an aid for soul nourishment.

There is nothing better than for a human being than to add a little honey in the right quantity to food. In a wonderful way, the bees see to it that a person learns to work on the internal organs by means of this soul element. By means of the honey, the bee colony returns to humans the amount of effort the soul needs to expend in their bodies. That is why beekeeping can be a great aid to human culture; it makes human beings strong.

When you consider that bees are influenced most of all by cosmic forces, the you will also see that bees provide the detour for humans to take into their beings what is right and necessary. Whoever looks at a beehive should actually say with an exalted frame of mind, "Making this detour by way of the beehive, the entire cosmos can find its way into human beings and help to make them sound in mind and body (Steiner 1998, pp. 2-4).

Love

How each the Whole its substance gives,
each in the other works and lives!
See heavenly forces rising and descending,
their golden urns reciprocally lending:
on wings that winnow sweet blessing
from heaven through the earth they're pressing,
to fill the all with harmonies caressing.

-- *Johann Wolfgang von Goethe* (in Steiner 1996b, p. 57)

Ultimately, the self-lessness and sacrifice of honey bees remind us that love permeates all of life. In our present time we have such difficulty practicing compassion and love -- egotistical goals lead to exploitation of nature and her four kingdoms -- at the same time we stumble from one calamity to the other in attempting to create man-made

wisdom and beauty in all aspects of culture and agriculture (Hauk 2011, paragraph 10)."

Steiner discusses love and it's meaning in the world as a spiritual experience and evidence of the Christ being's physical and spiritual manifestation on earth. For Steiner, it is a mystery that is not relegated solely to the experience of people who identify themselves with contemporary Christianity, but with a stream of spiritual activity that connects the whole of the earth to the spiritual entities in the cosmos. Love is the creative force in the world -- on earth and in the cosmos. But what does love mean in relation to bees?

The Roman poet Virgil (70-19 BC) was eloquent about this in his work known as The Georgics: "if we may compare small things with great, an innate love of creation spurs the Attic bees on, each in its own way." (a portion of Virgil's Book IV is in Appendix A).

In Renaissance England, an expression of love meant that a beekeeper should treat his bees as he would like to be treated: "In a word thou must be chaste, cleanlie, sweet, sober, quiet, and familiar: so they will love thee, and know thee from all other (Charles Butler's *Feminine Monarchie* in Olbricht 2006, p. 236)." In ancient Ephesus it meant to honor Demeter's initiate Melissa (Greek for bee). In modern times it might mean protecting bees from agricultural poisons or over commercializing them.

In the December 17, 1912 lecture "Love and Its Meaning in the World," Steiner gives one of his most direct explanations that can help us understand bees and our profound attachment to them. Love, in a word, is self-less. In contrast to the notion of cause and effect, where acts of compassion lead toward an improved existence in the

future, "deeds of love do not look for compensation (Steiner, 1972, paragraph 3). " Instead, "by everything we do out of love, we pay off debts (Ibid., paragraph 4)" to others in the past. There is no compensation in the future for deeds of love. Steiner points out that this is something people know subconsciously, by and large, and why it seems there is so little love in the world. People act mostly out of self-interest. The impulse for love is not strong in humanity, but "our deep concern must be that an impulse for sound healthy development shall find its way into the affairs of humanity. To disseminate love over the earth in the greatest measure possible, to promote love on the earth -- that and that alone is wisdom (Ibid.)."

Two other powers in the world and at work in human individualism are strength, and wisdom. Wisdom and strength bring about egoism and independence; they are necessary forces for human beings to become free individuals (Ibid., paragraph 10). To balance these forces and to prevent humanity's ultimate descent into egoism and materialism, love was streamed to the earth. "Love mediated by way of the senses is the wellspring of creative power, of that which is coming into being. When we practice love, cultivate love, creative forces pour into the world (Ibid., paragraph 7)."

> You'll begin to understand the life of bees once you're clear about the fact that the bee lives as if it were in an atmosphere pervaded thoroughly by love. The thing that a bee profits from the most is that it derives its sustenance from the very parts of a plant that are pervaded by the plant's love life. The bee sucks its nourishment, which makes it into honey, from the parts of a plant that are steeped in love life. And the bee brings love life from the flowers into the beehive (Steiner, 1998, p. 2).

Understanding antipathy, embracing our search for wholeness, and cultivating love are all reasons why *Apis mellifera*, the honey bee, can be a muse for living and evolving in our time. Chief Dan George (2011), the Native Canadian poet provides a compelling picture of one way we might act to strengthen our conscious feeling toward the natural world and grow our wisdom to love what is there.

If you talk to the animals they will talk with you
and you will know each other.
If you do not talk to them you will not know them,
and what you do not know you will fear.
What one fears one destroys.

Chapter II

Honey Bees Through the Ages

When Ra weeps again, the water which flows from his eyes upon the ground turns into working bees. They work in flowers and trees of every kind and wax and honey come into being (Ransome 2004, p. 33).

An initial appreciation of the honey bee may begin with observing her in nature as she forages among the flowers, or tasting the fruits of her labor from a jar of honey. The initial interest may endure through repeated experiences of a fleeting nature, or that interest can deepen through a study of the life cycle of the bee and the hive. A still deeper interest can form when a person sees the honey bee as more than an organism living in nature, but as a symbol of our deeper humanity and a link to our spiritual origins. Long before the honey bee was manipulated toward ever greater honey production, she was seen as a messenger of the gods -- a divine being. Seeing her in this light brings the teacher a much richer experience and boundless sources of imagery to his task of nourishing the students in his care.

A note of caution: what follows is a very cursory overview of the role of honey bees in ancient civilizations to today. Evidence and commentary by archaeologists, historians and students of the mystic traditions is intriguing and would require volumes more research than this project will contain. Instead, what follows are examples from history that show the importance of honey bees in the formation of our deepest world-views.

One moving creation story involving the honey bee is from the San people of the Kalahari desert region in southern Africa, as told by entomologist and writer Stephen Buchmann in his book, *Letters from the Hive* (2005).

> A long, long time ago, Mantis asked Bee to carry him across the dark, turbulent waters of a flood-swollen river. Bee, known for his wisdom and reliability, agreed and told Mantis to climb on to his back. Buffeted by fierce, cold winds, Bee soon grew weary and searched for solid ground on which to deposit his burden. But the stormy waters seemed to stretch all the way to the farthest horizon. Exhausted and weighed down by the much larger Mantis, bee sank closer and closer to the lapping waters. But just as he was about to go under, he spied a great white flower, half open and floating on the water, awaiting the sun's first warming rays. Marshaling his remaining strength, Bee struggled toward the flower, laid Mantis down in its very heart, and planted within Mantis the seed of the first human being. Then, his task complete, poor Bee died. Later, when the sun had risen in the sky and warmed the white flower, Mantis awoke, and as he did so, the first San was born from the seed implanted by Bee (Buchmann 2005, p. 119).

Cave art by pre-historic San people in the Drakensburg mountains depict bees nests and honey hunters in association with abstract shapes believed to "represent sacred beliefs about potency and power (Buchmann, 2005, p. 17)" and cave art in India depicts honey hunting techniques still in use in rural India and Nepal today.

The Hindu creation story describes the "great god Vishnu, who in the form of Surya, the sun, created the world. Surya is depicted as a honey bee -- creator of its own ingenious world -- resting on a lotus flower, the symbol of life. To help populate the

newly created world, the love god Kama, was armed with a bow whose string was made of honey bees, the symbol of fertility. The arrows inflicted sweet pain, for while the honey produced by bees represents the sweetness of love, the bee's sting represents its pain (Ibid., p. 120)." Vishnu, Krishna, and Indra are called the Madhava, or the nectar-born ones. Their collective symbol is the bee. An old poem says "When the sun rises, the lotus flower opens and frees the bees from their prison (Ransome 2004, p. 44)." Vishnu is also closely related to the lion, and bees and lions wend their way together through the Hebrew, Greek and Persian mystery schools, especially Mithraism.

Language also reveals the roots of European honey harvesting in India; "the Sanskrit word for honey is *madhu,* which is etymologically identical with the Greek *methu* and the Anglo-Saxon *medu,* known as mead (the honey beverage) (Ibid.)."

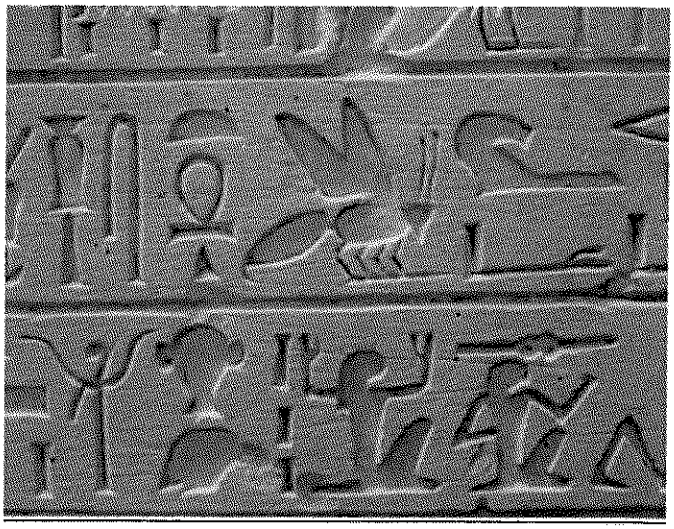
Beekeeping in India is thought to have begun about 4,000 years ago and honey played a major role in religious rituals, including marriage ceremonies, when the bride was anointed with honey as a way to ensure fertility. The purity of honey was so revered that wedding guests would be served honey to ward off evil spirits. Beekeeping and honey became much less important as sugarcane production and processing was developed by about 200 AD. The rise of Jainism, a strict form of Buddhism, discouraged the use of animals for human benefit and contributed to honey's reduced use (Buchmann, 2005, pp. 46-47).

The ancient Egyptians' relationship with the honey bee is perhaps even more defining to their identity. Bees symbolized royalty and the entire kingdom of Lower Egypt itself, as evidenced in hieroglyphs. The Egyptians often represented souls as birds,

and also that the soul could assume the form of the bee. In a ceremony performed during preparations for burial called the "Opening of the Mouth", the priests offered honey to a statue of the deceased so that he would be able to eat in the afterworld. One passage says "The bees, giving him protection, they make him to exist. (Ransome, 2004, p. 32)."

A particularly poetic explanation of the origin of bees is found in what is known as the Salt Magical Papyrus: "When Ra weeps again, the water which flows from his eyes upon the ground turns into working bees. They work in flowers and trees of every kind and wax and honey come into being (Ibid., p. 33)."

The center of beekeeping in the ancient world was in Egypt and temple paintings as old as 2400 BC "depict the harvesting, processing, and storing of honey (Buchmann, 2005, p. 49)." Honey has been found in the tombs of pharaohs and wax and honey was used as a preservative and in cosmetics throughout the Egyptian empires.



Egyptian hieroglyph (source Louvre Museum, Paris from Glenn Apiary website)

Greeks and Romans were influenced by the expertise of the Egyptians and became avid beekeepers and consumed large amounts of honey. Perhaps the earliest known bee poetry comes from the Roman poet Virgil in his works known as the *Georgics.* In addition to providing practical advice on beekeeping, such as where to place hives, how to maintain them, and how to control a swarm of bees, he "praised the communal values of honey bee society (Buchmann 2005, p. 50)."

> They alone hold children in common: own the roofs
> Of their city as one: and pass their life under the might of the law.
> They alone know a country and a settled home,
> And in summer, remembering the winter to come,
> Undergo labour, storing their gains for all.
> (Virgil in Buchmann 2005, p. 50)

The Greek philosophers, including Socrates used imagery of the honey bee frequently, and not always favorably to the people who are being called out. Plato's *Republic* is full of bee imagery -- industry and purity -- but in his criticism of corrupt leadership and debauchery in society, Socrates likens lazy people to drones in the beehive, thought at the time to be parasites, and taunts poets in society by calling them drones. A blatant (and ironic) misogyny is revealed by a leading contemporary poet, Hesiod, as he likens drones to women:

> As in the thatched hives bees feed the drones who are criminal partners -- all day long until the sun goes down the bees are busy laying the white combs, day after day, while the drones stay indoors in the covered hives and reap the toil of others into their own bellies -- so did Zeus who thunders on high make women to be an evil for mortal men,

grievous partners (Liebert 2010, p. 105).

Many more examples of bee metaphors are found in Greek and early Roman conquest literature. One of the most famous is in the *Aeneid*, when the poet Virgil describes the industrious Carthaginians at work building their city:

> Just as when labor occupies bees in the early summer through the floral countryside when they (the bees) raise the grown offspring of their race, or when they cram liquid honey and they swell their honeycombs with sweet nector, or they receive the freight of those arriving, or, with a battle-line formed, they ward off the drones, a lazy herd, from the hives; the operation bustles and fragrant honey is redolent with thyme (Aeneid 1.430-36 in Stipanovic 2006).

The era leading up to the time of the beginnings of Christianity and the first several hundred years A.D. is some of the most interesting. A great mixing of cultures and religions in southwest Asia (modern Syria, Israel, Turkey, Iraq, Iran) and the eastern Mediterranean (Greece, Cypress) was brought about during the Roman Empire. Out of Persian religious practices came a mystery cult based on the divinity of Mithra. In esoteric or gnostic schools of Christianity, Mithra is considered a protoype of the Archangel Michael. Mithra, the "Lord of Generation" was the sword bearer for the sun being Ahura Mazda. The Mithraic symbols are full of images of bees and its rites involved honey and beeswax as central components. These symbols and rites were frequently related to the worship of D'meter the Mother Goddess, whose priestesses were called bees. Priestesses robes were adorned with bees and coinage from Greece and Rome

depict her and bees. Oxen (cattle) and lions are also important esoteric symbols for the practitioners of Mithraism and the "solar heroes" Nimrod, Gilgamesh, and Hercules are all important actors in this mystery school, represented in association with the lion. Bees born out of the skulls of dead oxen were considered human souls coming into birth (Mead 1907).

Ephesus, in modern day Turkey, was a center for the Hittites and their worship of the Great Mother, D'meter (the predecessor of the Greek Demeter); her priestesses were called Melissa, Greek for bee. The Romans also revered her and she became known as Diana and in close association with the Greek goddess Artemis, Mistress of the Animals. The Essenes, a Jewish sect that flourished around the time of Christ revered Artemis and utilized honey and bees extensively (Ransome 2004, p. 47).

Greek coin from Ephesus, bronze, 295-280 B.C, with bee and stag symbols.

(Forum Ancient Coins)

Honey is also symbol of truth in various religions and cultural practices. For example, "the Hebrew word for bee is *dbure,* from the root, dbr, meaning 'word.' Honey signifies truth because it needs no treatment to transform it after it has been collected.

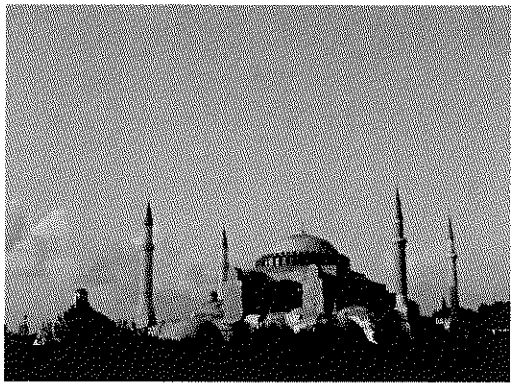
Truth was thought to be passed on by bees through their honey so that the elect could express it in their scholarship and poetry (Buchmann 2005, p. 129)."

Early Christians venerated the honey bee as well. Bees were thought to be pure as evidenced by their apparent lack of sexual reproduction. Their honey became an important means of supporting the later church and their wax was a crucial part of candle making for ritual. One of the most intriguing aspects of the marvelous building, the Hagia Sophia, the Church of Divine Wisdom in Istanbul is a legend relating to the hexagonal honeycomb. The Hagia Sophia was the enormous cathedral completed by the Byzantine emperor Justinian in 537 A.D. As Islam grew later in the millennium, the cathedral was so inspiring, it became the model for the great Islamic mosques. The Hagia Sophia itself was converted to a mosque in 1453, and is now a secular museum.

> The Church was dedicated to the *Logos*, the second person of the Holy Trinity, its dedication feast taking place on December 25, 537 the anniversary of the incarnation of the Logos in Christ. Famous in particular for its massive dome, it is considered the epitome of Byzantine architecture and is said to have changed the subsequent history of architecture. It was the largest cathedral in the world for nearly a thousand years and was designed by the Greek scientists Isidore of Miletus, a physicist, and Anthemius of Tralles, a mathematician (Wikipedia 2011, Hagia Sophia).

According to a legend, when Justinian was attending mass in the church at the site prior to the Hagia Sophia's construction, he accidentally dropped a communion wafer. Before he could retrieve it, a bee flew into the church and took the bread. Justinian sent

messages to beekeepers around the empire, and offered a reward to anyone who could return the wafer. Soon after, a beekeeper came to the palace with honeycomb that had been constructed around the wafer. Justinian is thought to have built the basilica in the shape of a six-sided honeycomb cell in honor of this event (Buchmann 2005, p. 128).



Hagia Sophia, Istanbul (photo by Claire Johnson)

In western and central Europe in the early and high Middle Ages, beekeeping grew in importance for its contribution of honey and wax for candle making. St. Ambrose of Milan is perhaps the saint most associated with honey bees in the Roman Catholic Church. He lived in the fourth century and was known for his preaching and teaching and is attributed with converting some of the church's significant leaders. The title *Honey Tongued Doctor* was initially bestowed on Ambrose because of these abilities. This led to the use of a beehive and bees in his iconography, symbols also used to convey wisdom.

There are other saints associated with bees and beekeeping, including Bernard of Clairvaux and Valentine. Saint Gobnait of Ireland is a patron saint of beekeepers. She was a 5th century nun and healer who used honey in the treatment of illness. Her name is

anglicized to Abigail and also Deborah (the Hebrew meaning of "Deborah" is "bee"). One of the miracles attributed to Gobnait was that she protected a parish by unleashing a swarm of bees (a brief biography is found in Appendix E).

St. Gobnait of Ireland stands upon a beehive.

Detail at base of statue in Ballyvourney.

(photos downloaded from www.catholicireland/net)

Europe's Renaissance brought about a wide innovation in beekeeping and organization of bees in commerce. The earliest manuals in English emphasize how to profit from bees and were written to encourage payment of the tithe of honey and wax to the church. In 1593, Edmund Southerne's A Treatise Concerning the Right Use and Ordering of Bees demonstrated the central role that bees began to play in the economy (Olbricht 2006, p. 226).

Scientists, too, were increasingly intrigued by honey bees and the appearance of Charles Butler's *Feminine Monarchie* in 1609 indicated a more sophisticated understanding of bee biology (including the potent fact that most honey bees were female

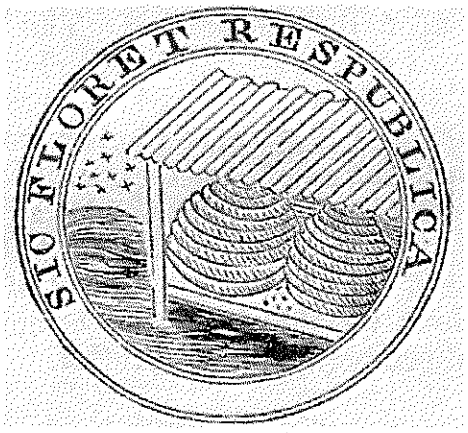
and were "reigned" by a queen instead of a king). The virtues recognized by people of earlier centuries and millennia, however, remained largely intact and provided a helpful model to cultivate a more demure demeanor for English country folk in the early 1600's, after the reign of Elizabeth I.

> If thou wilt have the favour of the Bees that they sting thee not, thou must not be 1) unchaste or 2) uncleanly: for impurity and sluttish ness (themselves being most chast and neate,) that utterly abhorre: thou must not come among them 3) smelling of sweat, or having a stinking breath caused either through eating of leekes, onions, garleeke, and the like; or by any other meanes: the noisomnes whereof is corrected with a cup of beere: and therefore it is not good to come among them before you have drunk: thou must not be given to 4) surfeiting and drunkennes: thou must not come 5) puffing and blowing or sweating unto them, nether hastily stirre among them, nor violently defend they selfe when they seeme to threaten thee; but softlye moving they hand, before thy face gently put them by, and lastlie though must be 6) no stranger unto them. In a word thou must be chaste, cleanlie, sweet, sober, quiet, and familiar: so they will love thee, and know thee from all other (Charles Butler in Olbricht 2006, p. 236).

The earliest recorded introduction of honey bees to North America was on the Island of Bermuda in 1617 when a letter from a groundskeeper said, "The bees that you sent doe prosper very well. They stand as yett in the Governors garden but I am purposed

toward Michel mace (Michaelmas) to remove them when I have builded a convenit place for them. (Crane 1999, p. 303). Bees are also recorded to have come with settlers in Virginia in 1622. Early records are spotty, but by 1638, settlers in New England reported that honey bees were "thriving exceedingly" in the woodlands which were abundant with tree cavities for hives to establish themselves. Beekeeping became an important part of most farmsteads in the following century in the colonies and were so important to the founding fathers that a $45 bill was printed by the Continental Congress with the engraving of a beehive on it (Ibid., p. 304).

Material to produce coins was precious and scarce in the new country and the creation of paper currency was a milestone in the United States' early history. The series of bills carried the virtues, warnings or encouragement the founders sought to convey. "On the 45-dollar bill, issued on the 14th of January, 1779, is represented an apiary in which two beehives are visible, and bees are seen swarming about. The motto is — SIC FLORET REPUBLICA — *"Thus flourishes the Republic."* It conveys the simple lesson that by industry and frugality the Republic would prosper (Lossing 1863)."



The $45 bill issued in 1779 by the Continental Congress (Lossing 1863).

Later, too, the new Mormon religion, and especially as it was established in Utah in the mid 1800's, identified deeply with the honey bee (or Deseret) and the territorial symbol signified organization, unity and productivity (Ellis 2004, p. 128).

Through the ages, hives took on a wide array of styles and forms -- it is an interesting study all on its own, and beyond the scope of this paper. But no conversation on bees and beekeeping in the United States or Europe can neglect the modern bee world's arguably most significant event: the advent of the Langstroth hive in the 1851. "A good hive must fill two requirements: 1) it must be a good home for the bees and 2) it must be so constructed as to be convenient to perform the various operations required by modern beekeeping (Root 1959, p. 334)," and the innovation that Lorenzo Lorraine Langstroth made allowed for these two requirements as never before. His discovery of "bee space" and the movable frames he developed on which bees could construct the comb inside the hive boxes earned him the recognition as the father of modern beekeeping (Buchmann 2005, p. 74). Bee space is the distance between combs in a hive -- or the amount of wiggle room that bees need to move around the confines of the hive. It is about ¼ of an inch and is the same whether it is in a man-made hive or a hive of the bees' own construction in the wild. The vast majority of the hives in commercial and small-scale backyard operations are the stacked-box Langstroth hives. Appendix H has a biography of the Reverend L.L. Langstroth.

Today, there is good news and sobering news about honey bees and our relationship to them in the United States. In the mainstream, honey bees seem

appreciated primarily for the pollination services they provide to mega-crops like almonds in California and are shipped great distances from across the U.S., woken up prematurely from their winter clusters and put to work in the otherwise sterile orchards of the Sacramento Valley in February. Queen bees are bred for short term benefit of hive organization and honey production rather than for carrying forward healthy descendents that will split to form new swarms (Siegel and Betz 2010). Bees are also interesting to laboratory scientists for their perceptive and communication abilities. They are used as research subjects to detect land mines and chemical traces left by warfare (Kosek 2010, p. 651). Chillingly, they are also used in interrogations of prisoners of the 'war on terror' as a way to intimidate and cause fear (Ibid. p. 653). The use of honey bees in warfare is not a recent phenomena. As far back as the Romans and Greeks, records show bee hives being hurled into enemy range to cause havoc and pain and St. Gobnait of Ireland herself is believed to have used her bees to fend off enemies (Duffy 2011). "The word bombard comes from bombos (another Greek word for bee, or buzzing), making an association between the threatening hum of an angry swarm and incoming projectiles. In World War I the bee became central to the war machine not as a projectile but as a source of beeswax that was used to coat almost all ammunition (Kosek 2010, p. 654)."

Even for people who do not work with the honey bee in such a stark utilitarian way, we still have a dilemma in North America where the honey bee is not a native species. On the one hand, most ecologists and environmentally-oriented people recognize the need to support bio-diversity and ecological communities of native plants and native pollinators. European honey bees have in some ways been competitors for native species

in North America. There is some dispute about the European honey bee's original geographic spread. While the current breeds or races of *Apis mellifera* are thought to have originated in the Old World, that is to say, various parts of Central Europe, Russia, Western Asia, and Africa, scientists are now finding a wider diversity of origins for related bees from the geologic past, with evidence of *Apis* ancestors found in North America (Hepburn and Radloff 2011, p. 16).

On the other hand, we have cultivated a domestic animal that is now in tune with an ecology of human design -- our food crops and ornamental gardens; over one third of food crops depend on honey bee pollination. We may have over-domesticated them, as evidenced by the phenomenon of Colony Collapse Disorder (CCD). In 2006 it was reported that there was a 40% drop in colony numbers, 2.4 million beehive colonies existed in the United States, less than half of the amount in 1950. That drop "eclipsed all previous mass mortality in the bee world, making it the worst recorded crisis in the multi-millennial history of beekeeping. There is still no consensus about the reason for this decline (Kosek 2010, p. 650)."

Organic and biodynamic beekeepers and around the world are active in the search for understanding CCD and are actively networking and researching ways to combat pests, parasites, agricultural chemicals, and other environmental hazards to the honey bee. The solution lies also with non-beekeepers -- consumers, land owners, gardeners, industry, and teachers -- for "every human being should show the greatest interest in this subject, because, much more than you can imagine, our lives depend upon beekeeping (Steiner, 1998, p. 5)."

Chapter III

Honey Bees Through the Year

The lifecycle of a hive is fascinating and brings to mind diverse and many pictures from which teachers can draw. Likewise, the story of transformation from egg to foraging adult bee can be awe-inspiring and a source of vivid imagination. The story of the individual is woven through the whole in this tour through the year in a honey bee colony. First, to help orient, below is some very basic honey bee biology. Three are three kinds of honey bees: workers, drones and queens.

Workers

Workers make the vast majority (95% to 98%) of honey bees in a colony. They are all female, do not mate and carry out all of the work of the hive except laying eggs. They pass through various adult stages after emerging from the honeycomb cell where they were reared through their larval pre-adult stage. After chewing through the wax cap that was put in place when they were in their cocoons, the new adult sets to her first job of cleaning cells. Michael Weiler's *Bees and Honey From Flower to Jar* provides a helpful description of the life that follows:

> A newly hatched bee is first fed via its proboscis by other bees. It moves over the honeycomb unassisted. It almost staggers. Its hair appears grey, matted and ruffled. With hesitant movements at first the downy grey young bee cleans itself and smoothes out its still crumpled wings. It looks

like a little, helpless child, but soon seems steadier and more resolved. After several feeds it begins to slip into recently vacated brood cells (where baby bees are reared) in its immediate vicinity and licks them with its proboscis. In doing so it is apparently secreting something with which it polishes the cell wall until it looks smooth and shiny. This gets the cells ready again, either for the queen to lay in or to receive stores of nectar or pollen.

The young bees now feed from the cells of stores, especially on pollen. Yet they remain close to where they hatched. By shivering movements of their wing musculature, which also has the effect of training it, they produce heat and thus help to maintain the brood nest temperature and maintain a constant 35 degrees centigrade (95 degrees F).

Bees between two and three days old begin to feed the older larvae of the bee brood with a mixture of honey, pollen and royal jelly. Over and over again they stick their heads in the brood cells and do something there for a few seconds and then move on to the next. In between they collect food from the store cells.

After a further two or three days the bees devote themselves to cells with younger and younger brood, busying themselves in caring for it, feeding it or inspecting it. At his stage they also possibly join the bees that surround the laying queen for a time. The body of the mother of the hive is always being touched and licked. Bees are constantly offering her their proboscises so that she can take food from them.

In the period of life between the fifth, and ninth or tenth day of development, it is also possible to see lots of bees taking on small reconstruction jobs on the cells or participating in capping them.

In the normal course of development, individual bees leave the hive for the first time around the ninth or tenth day. The young bees take their first flight to orientate themselves in the immediate surroundings of

the hive.

In the ensuing days we can observe the young bees taking the nectar from the incoming foragers and traveling to where the stores are being deposited. Hour after hour the fresh nectar, which at first is a watery liquid, is tended and thickened. To do this the bees take it up and expose it to the air of the hive. Over and over again it is sucked up and expelled. Each time a part of the water is evaporated in the warm, dry air of the hive. Then the honey is deposited in a storage cell to ripen further. At another time the bees "stamp" with their heads into the cells in which the pollen has been deposited. The pollen is compressed and stuck together with saliva and nectar. As a result it undergoes a lactic acid fermentation which breaks down its protein components and preserved it. Finally it is covered by a layer of honey.

Subsequently, the bees may join a comb-building cluster and there participate in exuding was and moulding it into comb.

At about the eighteenth day of life, they may leave the building cluster and take part in cleaning and clearing out activities. They start 'guard duty' at the hive entrance, that is, they monitor incoming bees and try to drive away foreign insects. These can be strange bees from another colony, flies, moths, bumblebees or wasps... Another job at the entrance is ventilation. The bees hold on tight with their feet, many standing in formation one behind he other, and move their wings powerfully thus blowing a steady flow of air out of the hive...

The bees stay a further two or three days round the hive entrance until they are about 20 or 21 days old. Then they become foragers. When at the height of summer, the development of the colony is still in progress they remain as flying bees for between 10 and 20 days more until they die somewhere in the surroundings (Weiler: 53-55).

Drones

The drone bee is male and fertile. He emerges from a slightly larger cell and is distinctly larger than the worker females. Conventional beekeeping views the drone as very nearly parasitic to the hive, or at least giving nothing. Biodynamic beekeepers may see them differently. While the drones do not actively work within the hive, they may serve helpful functions of regulating temperature when they are in the hive and of sensing the wider environment when they are on their scouting forays preparing to mate with a queen. They are mature enough to mate 10 to 14 days after hatching.

Queen

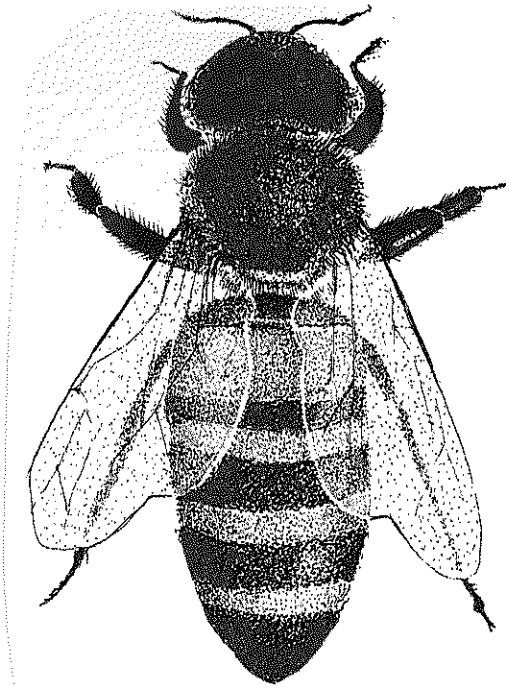
The queen is the largest bee in the hive and a colony tolerates only one queen at a time. She is the generator of new life in the hive by laying thousands of eggs each day and workers' lives are in constant sensing with the queen's movement around the comb. The queen's life cycle is altogether different from that of the workers and drones and it is described in fuller detail below.

Hives and Comb

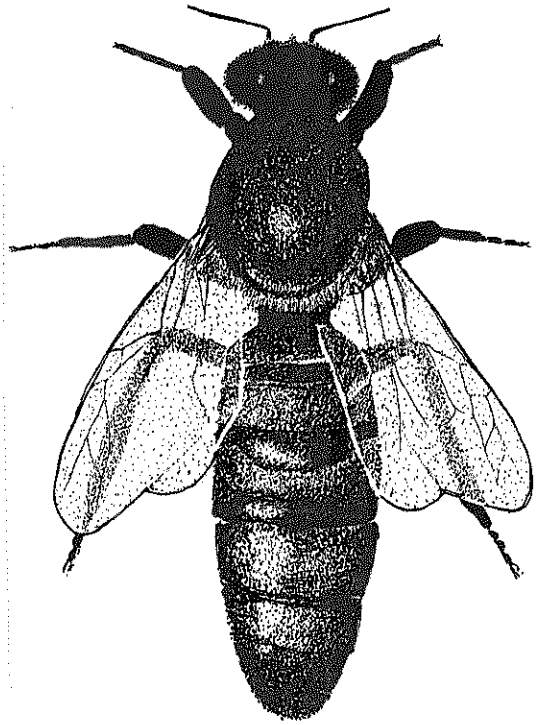
In places where it is warm all year, honey bee colonies can make their homes in the branches of trees and fairly open rock crevices. In temperate places, they need to find homes where they can be protected from the cold in the winter months. Honey bees can make their homes in basically any dry cavity -- rock walls, tree trunks, or even the walls

Three types of honey bee

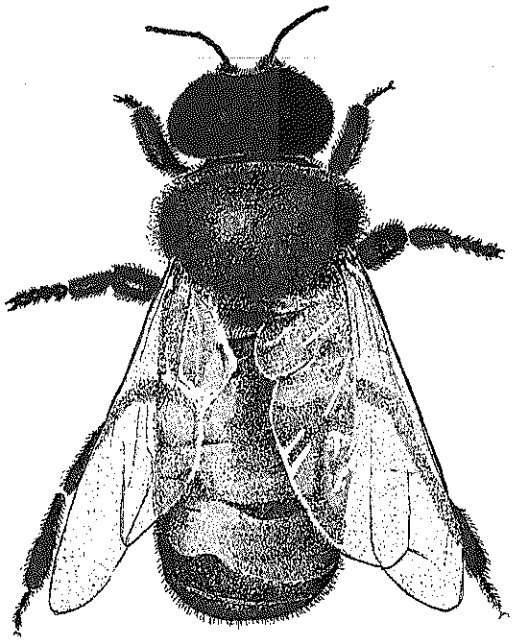
(source: Sammataro 1998, pp 12-15)



Adult Worker Bee



Adult Queen Bee



Adult Drone Bee

of houses and barns. As human beings developed ever closer relationship with bees, they created homes where bees could carry out their activities (Hauk 2008, pp. 14-20). In the past several hundred years, hives have taken on form that is increasingly designed for the benefit of the beekeeper. The basic box form of the Langstroth hive is now the standard for commercial beekeepers throughout the world, though hive forms are experiencing a new phase of innovation as many small-scale beekeepers seek to work in closer harmony with the honey bees' natural tendencies. These include "top bar" hives in wide use in Kenya and many backyards, the "Warre" hive, and even hives with sacred geometry in mind (Reed 2010; Breland 2010).

Three Langstroth hives in a Portland back yard (photo by Lauren Johnson)

Within the hive, bees create the miraculous comb out of wax that they make out of the substance of their bodies. To Rudolf Steiner, this was part of the evidence of the way bees social organization is a prototype of what human beings will be in the distant future.

"Within the activity of a beehive, you will experience something that does not exist anywhere else on this Earth (Steiner 1998, p. 170)" and it is beyond our current capacity to fully comprehend. "The consciousness of a beehive, not the individual bees, is of a very high nature. Humankind will not attain the wisdom of such consciousness until the next major evolutionary phase -- that of Venus -- which will come when the evolution of the Earth stage has finished. Then human beings will possess the consciousness necessary to construct things with a material they create within themselves (Ibid.)." The consciousness Steiner explains has to do with a renunciation of the "sexual element," as there is just one queen in a colony given over to reproduction and the rest of the workers devote themselves to support the whole of the organism.

In the meantime, we can marvel at the forms that are made by bees out of their own bodies. Sliver-thin wax discs are exuded out of the abdomens of worker bees and molded by the thousands to create the round cells for brood rearing, honey making, and pollen and honey storage.

Sneak peek of a new hive box with fresh comb (photo by Lauren Johnson)

The first hives made by humans were round -- reflecting, perhaps, early people's intuitive attunement with the nature of the bee. "One way to understand the importance of a round form for the bee is to realize that almost all of its significant life experiences and expression manifest in 'roundness', for example:

- The six-sided cells of the workers and drones are the most economical way of placing a lot of round cells close to each other in a given space so that no empty spaces remain
- The queen lays eggs in circles, moving from comb to comb
- The queen cell is sack-like
- The comb itself takes on a heart shape which is the result of a round structure under the influence of gravity (the law of hanging chains give this form)
- The winter cluster, the flight of the swarm, and the rotation of the larvae spinning its cocoon all take place in roundness or at least an approximation of roundness...

Roundness represents warmth, health, productivity, radiance and an overall energetic resonance with life. It promotes harmony and facilitates fertility and abundance in both the nature of its shape and the energetic emanation of the shape (Hauk 2008, pp. 14-15)."

Ninety percent of a bee's life is spent building and moving about on the comb in the hive. Wax comb is the biggest inner organ of the "Bien", or super organism. "The comb is home, womb, pantry, (external) skeleton, sense organ, nerve system, memory organ and immune system. The 'comb-wide-web' provides a means of communication on multiple levels: dance, vibration, chemical marking. Therefore, it is essential to allow bees to build their own natural comb and to give them the freedom to express their instinctual life forces. Natural comb is essential when we want to support the bees in a

time of ecological challenges. It is their birthright (Melissa Garden, holistic beekeeping page)."

Forager on May crabapple blossoms, Portland Oregon
(photo by Lauren Johnson)

Honey Bees Through the Year

As a teacher moves the year with his or her students, lessons and material reflect what is happening in the seasons. The life of the hive is full of active images from which a teacher can draw and bring into short vignettes for math stories in younger grades, for example, or more complex calculations in the middle years.

The frenetic activity of spring and early summer is epitomized by the worker bee gathering nectar and pollen to bring back to the hive. The height of spring can be found in the drama of a bee swarm; it is like no other image in nature as the super-organism of the hive reproduces itself. As the autumn months of the Michaelmas season draw the earth's

forces inward, and the quietude of mid-winter inspires us to cultivate our inner light, the activity of the hive provides another way for a teacher to tap into these seasons of inwardness.

WINTER

"In winter.....there is this great 'collecting', 'gathering', its inwardness resting on the absence of outer activity." (Hauk, 2011, paragraph 1)

In midwinter when nectar flows have ceased and the air is cold, the hive is at its quietest. In a typical hive, the number of bees dwindles down to under 5,000 individuals (from a height of 50,000 or 60,000 in peak months). These remaining bees live circumscribed within a small cluster near their honey stores in the hive and perhaps some brood cells, though egg laying is at its slowest rate of the year. The cluster pulsates around the queen, with workers circulating from the center to periphery to regulate warmth. Sunny days might bring warmth in from the exterior and an occasional opportunity to excrete waste. Workers in winter live longer to sustain the hive -- up to three or four months instead of the typical six-week lifespan of a worker bee in the height of summer. In the contracted cluster time of deep winter, the queen lays very few eggs and little or no new brood is raised.

Beekeepers are often most anxious during this time in cold climates as this is the time of the year when the hive is most vulnerable to starvation and weakness. If there is enough honey and the bees have not been weakened by parasites or disease, all should be

well for the colony. A successful winter will mostly depend on a healthy and productive summer. In the coldest weeks and months, beginning in November and December, depending on local climate, the bees are in a state of torpor and they move very little. On a sunny day, some bees may leave the hive to eliminate waste and an observant beekeeper may see flecks of golden brown excrement on top of new fallen snow.

It is a dangerous time for a hive. Excess moisture, extreme cold, lack of ventilation, the death of the queen, and diseases are major risks, but the lack of food or a hive that has stored its honey and pollen in a way that is not easily accessible to the cluster of bees is a primary reason for hives to fail in winter time. While good beekeepers take great care in the late fall to leave enough honey (or, even better, not harvest honey at all in late summer), reduce the entrance sizes of the hive boxes, and seal any external cracks or leaks. Moisture is a big enemy of the winter hive, yet the bees also need adequate ventilation and air flow (Root 1956; Organic Beekeepers, 2010-2011; Sammataro 1998).

Supplemental feeding in the winter is a much discussed topic among beekeepers. Hives should never be opened in the wintertime, for risk of disturbing the fragile interior climate. Beekeepers gauge the amount of honey stores by the weight of the hive boxes. It is an inexact science, but standard manuals recommend leaving at least 60 pounds of honey in a single hive box. Knowing the weight of the empty box is important! A standard box should therefore weigh a total of about 130 pounds -- honey, comb, and all (Root 1956, p. 680).

Bees are cold blooded animals -- they depend on the external environment for the

temperature of their bodies -- and form a tight cluster within the winter hive to regulate their collective body temperature. Bees can live with individual body temperatures ranging from around 94 degrees Fahrenheit in the summer peak brood rearing time to around 43 degrees Fahrenheit when they are at the periphery of their winter cluster. Over the past 100 years, beekeepers have experimented with many ways of wrapping or storing hives in the winter. Local climate plays the largest role in determining how much or whether to insulate a hive. And again, healthy summer colonies can become hearty winter clusters.

These winter clusters inspire beekeepers during these quiet months. One example is the following essay by Gunther Hauk, founder of Spikenard Farm and Bee Sanctuary in Floyd, Virginia.

Winter Dreams

"When icicles hang by the wall
And Dick the shepherd blows his nails..."

- Shakespeare, sonnet

...then the honeybee colony is cuddled in a tight cluster, metabolic processes at 'low flame'.
These bees are not as cold and stiff as the bumblebee or wasp queens which go through the winter months solitarily, unmovable and without food in a protected tight space. Slowly the honeybee colony moves along the honey stores-the gift of last year's sun--giving them light in the time of darkness and warmth during winter's cold.

For us this is the time to go inward, to study, reflect and contemplate,

deepening our understanding of the Earth's wonders and our mission on it. This inwardness, trained and practiced at mid-winter's beckoning, will show its harvest in the months to come, when outward activity challenges our strengthened will, our heightened understanding.

This polarity of life, guided by the earth's rhythms, can also be witnessed in two evolutionary streams. The inwardness, which the Buddha had attained in his long development as a Bodhisattva, was gifted to mankind in his teachings of love and compassion. These virtues are accomplishments of the heart, are a transformation of the Self for the good of humanity.

The other stream is one of transformation of matter, of the Earth, for the good of all the beings living on this beloved planet. It is a stream that has to do with the transformation of nature into culture. Agri-culture led the way on this path, followed by the arts and sciences. The stone, earth or wood are transformed into dwellings, the clay into pottery, the metallic ore into implements and jewelry. An incredible training of human faculties are the gifts gleaned from these activities.

This stream was initiated approximately 10,000 years ago by the great Zarathustra in ancient Persia, modern-day Iran, Iraq and Afghanistan. We can find these polarities, necessary for evolution, symbolized by Cain and Abel. The latter tread softly on the earth as a shepherd, only taking from nature what she readily offers, giving in return offerings in a sacral state of purity and gratitude. Cain, on the other hand, destroys the given wisdom and beauty of nature in order to learn how to create man-made wisdom and beauty, become a co-creator. As we know, we are still in this learning process, especially in modern times when the motive of bottom-line has

supplanted that of beauty and wisdom.

But we did make progress, did not fumble all the time; think of the beautiful cathedrals, the beauty of the Persian hanging gardens or the medieval cloister gardens.

It is clear that we cannot do without either one of these streams, since one feeds and stimulates the other one.

We can find a being, in which these polarities are united naturally in superb wisdom and beauty: it is the honeybee. In winter, as I mentioned, there is this great 'collecting', 'gathering', its inwardness resting on the absence of outer activity. It seems to me like a state of meditation, when strength is summoned in extreme quiet and stillness, strength that is released in an incredible feat of diligent work, all focused on sustaining and invigorating nature and our lives.

In our present time we have such a difficulty practicing compassion and love--egotistical goals lead to exploitation of nature and her four kingdoms-- and at the same time we stumble from one calamity to the other in attempting to create man-made wisdom and beauty in all aspects of culture and agriculture.

Is it any wonder that the beings in whom these two sides of our existence come together in such a harmonious way, that the honeybees are our mirror for our failures. At the same time they are an example, and inspiration for how we can solve the problems facing them and us.

At the present it is the heart-warmed love and compassion that inspires so

> many all over the world to adopt sustainable beekeeping methods, tending the colonies with ever-deepening understanding and care. And we are so happy and grateful that we can be part of this. (Gunther Hauk, Spikenard Farm Winter 2011 Newsletter)

SPRING

The Bee buzzed up in the heat.
"I am faint for your honey, my sweet."
The flower said, "Take it, my dear;
For now is the spring of the year.
So, come, come!
"Hum!"
And the bee buzzed down from the heat.

-- From The Bee and the Flower, Alfred Lord Tennyson (1809-1892)

As the season shifts to spring, stirrings in the hive begin with the workers who are busy cleaning comb cells to prepare for the laying of new eggs and raising new brood. On sunny days in late February and early March where nectar may already be flowing in warmer states, forager bees who have over-wintered may make some of their last flights and contributions to the hive. Most of the early brood will be fed by the royal jelly of the adults and from stores of honey and pollen that have been kept through the dark months. (A basic glossary of bee terms can be found in Appendix J.)

Brood -- the Baby Bees

It is a wonder to examine the early stages of bee development. Because their gestation is so hidden from view, contrary to what we can see in moths and butterflies, whose caterpillars chomp their solitary way through the tender leaves of springtime and

then build their cocoons attached in places an observant child can discover, it surprises some to learn about the honey bee's unique development from egg to adult.

Insects are all born out of eggs and pass through various types of development before becoming adults who then can be part of the reproductive cycle. What emerges from an insect egg may have one of three forms. There are what are considered primitive insects, like silverfish, who hatch out of eggs as small-scale versions of the adults. They grow to adult size by molting, or shedding their outer skin when it becomes too tight.

Other insects pass through a growth pattern with a special nymph stage between egg and adult. A nymph resembles the adults in many respects, but has certain differences, such as a lack of wings. Dragonfly nymphs have no wings and live in water; they undergo a series of moltings, eventually emerging in their last molt with wings to begin their adult lives. They go through what is known as incomplete metamorphosis.

The third pattern of transformation is complete metamorphosis where the larva that emerge from eggs are always markedly different from the adults. They may have more legs, or none at all; lack eyes, or have mouths that chew instead of pierce or siphon food. Larvae from flies are known as maggots, beetle and bee larvae are known as grubs, butterfly and moth larvae are caterpillars. Before they become adult insects, they pass through an intermediate stage as pupae (Farb 1962, pp. 57-58).

> It is the pupal stage that sees the dramatic return of all the wormlike forms to their ancestral appearance. The word "pupa" derived from the Latin for "doll" was used to describe this stage because many insect pupae resemble a doll or infant wrapped in swaddling clothes. The pupal stage is commonly called a resting stage, but this is a misnomer.

> Although most pupae appear lifeless and mummy like, sweeping changes are in progress beneath the still surface. During this period of fierce biological activity, the ancestral insect form is reconstructed -- complete with mouth parts, legs and wings. When the larva completes its growth, it stops feeding. It may spin a silken covering, such as the cocoon of a moth, inside which it is apparently immobile, or it may reorganize while protected by nothing but its naked outer skin, such as the chrysalis of a butterfly (Ibid. p. 58).

These fascinating developments become even more interesting when the role of hormones and shaping forces is brought into play. Soon after the cells of a newly laid egg begins to divide, from a place in the egg where the future thorax will develop, there is what is called a "wave of determinism" that spreads over the embryo. "Like a stage director, this wave arrays certain cells for the specific roles they will play in the life of the larva. Shortly thereafter, a second wave assigns still other cells to the roles they will play in the insect's pupal and adult stages: the clusters of adult cells that result are known as imaginal buds (Farb 1962, p. 59)." Thus, a forming larva has within it two separate growth patterns: the one that it uses to continue its growth into a larva, and another which is held in storage and which will come into play when the time comes for it to turn into a bee. The cells for each of these two distinct phases of development for the insect are completely separate -- almost as if there are two organisms in one. The larva grows in a way that is fundamentally different than that of embryos in other organisms. Instead of growing by the process of cell division and differentiation, the larva grows larger by making its cells larger. It essentially has the same number of cells when it emerges from

the egg as when it begins its pupal stage.

For honey bees and their complex social structure, this becomes particularly intriguing. The vast majority of eggs laid by the queen will develop into female worker bees. The comb cells are specifically sized and molded by the house bees to instruct the queen to deposit a fertilized egg into that cell. Ever since the queen originally mated upon her emergence from the hive (this is described more fully in the following section on summer), she has been carrying in her body all of the sperm from that encounter in a special holding sac. The eggs are held separately until the time one needs to be laid into a cell. The mature egg descends through the queen's body and is brought together with a sperm cell for fertilization. The fertilized egg is deposited by the queen into the bottom of the cell. It is about the size of the a comma on this page, white and semi translucent. It seems to stand up in the cell, parallel to the sides of the cell. Three days later, the egg hatches and the larva emerges.

Nurse bees bring a whitish liquid to the larva as its first food, royal jelly, which is secreted by the nurse bees from the hypopharangeal glands in their heads. It is comprised of easy-to-digest carbohydrates and protein and is larval food for only the first few days. After that, the larva is fed a combination of honey, pollen (called bee bread) and royal jelly. The larva is curled at the bottom of the cell and beekeepers call this round larva. After about a week, the larva has grown to nearly fill the cell and is standing upright with its head at the opening. It has gone through five moltings of its outer skin by this time. Nine days after hatching from its egg, the larva's cell is capped with wax by the worker bees and the larva begins to spin its cocoon. For the next 12 days, the larva pupates and

undergoes the miraculous metamorphosis to become an adult bee. When the bee emerges from its cocoon, it uses its new mandibles to poke its way through the wax cap of its cell and it is greeted by a nurse bee and fed honey.

In Rudolf Steiner's lectures on bees and beekeeping to the workers of the Goetheanum in 1923, we can read about the significance of the varying shapes and sizes of the comb cells into which the queen lays her eggs and in which the larvae are nurtured.

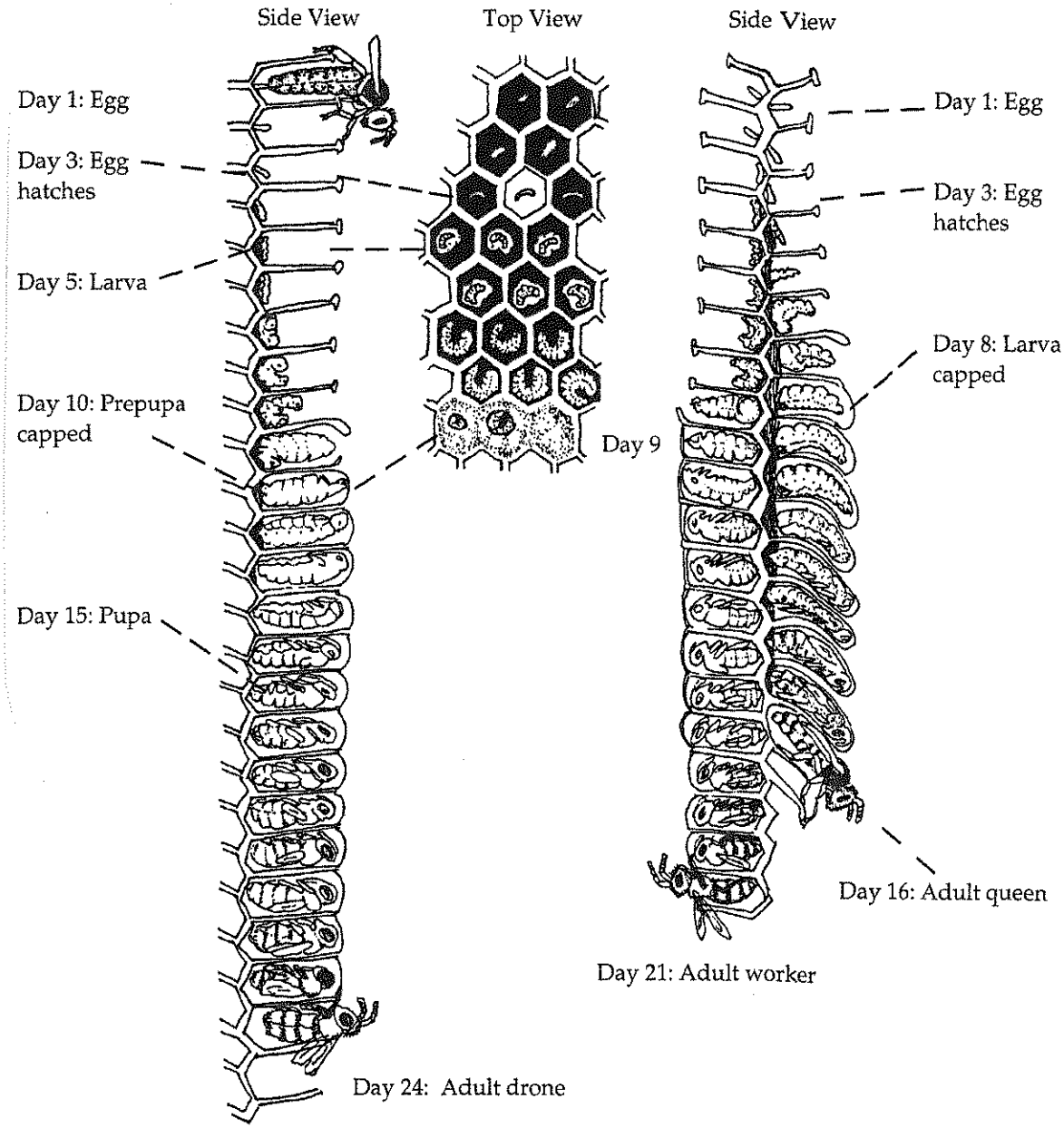
It takes 21 days for a worker egg to become an adult bee. For three days, it remains an egg, then for 6 days it is a larva, then for 12 days it is a pupa (3 + 6 + 12 = 21). Twenty-one is the amount of time that the sun takes to rotate on its axis (21 earth days = 1 sun day). The "worker bee has experienced every different effect the Sun can have on it, and all of these effects are now in the bee -- the bee is a creature more directly affected by the sun than other animals, it is a "Sun" creature (Steiner 1998, p. 103)."

What, then, exactly is the effect of the sun on the larval imaginal cells? Conventional biology has yet to examine this closely, but philosophy and religious and spiritual imagery of the ancient world may help pique the inquiry.

If, in her movement through the "nursery" or brood cells of the hive, the queen encounters a comb cell that is larger than the others, she will lay an egg that she does not fertilize with a sperm. That egg will develop in that larger cell and become a male honey bee, or drone. The workers in the hive, therefore, guard the proportions of the population of the hive and, in fact, will also sense when a new queen may need to be developed. The

Developmental Stages of Honey Bees

Source: Sammataro 1998, p. 11)



drones pass through the same progression of stages from egg to larva to pupa, but with significant differences in gestation time. The cell is capped after 10 days and is a pupa (in its cocoon) for 14 days, making the drone development last 24 days total. The sun cycle of 21 days, is, therefore, surpassed in the drone's development, exposing the developing drone to more of the earth's forces, according to Steiner.

There is a wide range of belief about the purpose of drones in the colony. They do not appear to do any work in the hive, they do not forage; their only apparent role is to mate with a queen during her fertilization or "marriage flight." Some might observe though, that the drone might have sensing capacities that can communicate aspects of the wider environment to the hive, especially when a colony is preparing to swarm. They are perhaps a sort of "knowledge worker" in the hive (Berrevoets 2009, p. 40). They may also support the cooling of a hive during hot weather. Conventional beekeepers who are seeking to maximize honey harvest, and who do not rely on naturally fertilizing their queens, however, seem to see the drone as very nearly parasitic. A typical honey bee colony is comprised of anywhere from 5 to 10% drones, making for a significant number -- 2,500 to 5,000 bees in a 50,000 bee colony. Without understanding any clear benefit, it can seem to make sense for the commercial beekeeper to seek and destroy the drones or put in the hive a uniform wax foundation that prevents drone cell formation. For the observant scientist or beekeeper who may understand that nature and the organism of the hive may have more subtle complexities and its own wisdom to regulate itself, it might seem shortsighted at best, and outright harmful at worst, to manipulate the hive in this way.

Worker bees will create yet even larger cells, in an elongated, rounded, not hexagonal shape. These cells or "queen cups" look a little bit like a peanut shell, about three centimeters long and are generally built out of worker cells as the queen larva grows. The larva in a queen cell will be fed almost exclusively royal jelly. In the last two days of the larval stage, she is also fed honey and the cell is capped after only 8 days (instead of 9 or 10 for a worker larva). Queen bees develop out of this shift to honey and the higher sugar content of royal jelly. In addition, the queen is given a juvenile hormone from the nurse bees. The pupal (cocoon) stage lasts only 8 days, so the adult queen emerges after only 16 days total of development, less than one full rotation of the sun on its axis. This was significant to Steiner, as these bees would be only influenced by forces coming from the sun, and not be influenced at all by forces of the earth.

Three conditions will trigger a hive to start rearing a new queen: "1) the colony is making preparations for swarming, 2) the queen's physiological and behavioral activities are substandard, and 3) the queen is lost or dies. In each case, the purpose is to replace the existing queen (Sammataro 1998, p. 13)."

The queen is longer than all of the other bees in the hive and she usually does not have color bands on her abdomen as the others do. Queen bees will live much longer than any of the other bees in the hive -- up to about three years or so for a healthy queen. The artificial breeding of queen bees is one of the most important deleterious aspects of beekeeping today and was a key topic in Rudolf Steiner's lectures to beekeepers in 1923 (Steiner, 1998).

A honey bee hive without a queen will die. This is one of the core realities for the

life of a colony and why modern beekeeping, with its commercial emphasis on honey production, has attempted to control nature through the breeding and artificial rearing of queens.

Swarming -- Rite of Spring

The timing of an old queen's departure and a new queen's emergence is generally in the spring, when the colony is "in a swarming mood. Frequently, between one and two dozen larva are developed into young queens. As these new queen cells are capped, a group of 10,000 or 20,000 workers and the older queen may leave the hive on a sunny day near noon and head in a direction that has been scouted out in the previous days. In the old hive, the first young queen to emerge will either prepare to swarm with another group, or seek out the other queen cells and destroy the pupating queens (Weiler 2006, p. 70)."

To witness a honey bee swarm on the move is one of the most stirring natural events a person can witness. When a hive has grown so large within its confines -- a beekeeper's box, or the hollow of a tree -- when brood and young bees and honey and pollen stores are at their peak, workers in a colony will begin to make preparations to move. Exactly what happens inside the hive is still a mystery, what tells the bees when and where to move is not entirely known, but beekeepers have a sense of it.

"The term "swarming" is applied to the act of a family of bees leaving their home to establish a new home elsewhere... The term "swarming out" is applied to the migration of the entire colony as in the case of a lack of food (hunger swarms), recently hived swarms that are dissatisfied, and small nuclei (nucs, or a group of workers and a

queen) that leave when a young queen has taken her marriage flight... In a strict sense the term swarm only applies during migration. As soon as a swarm establishes itself in its new home it is called a colony (Root 1956, p. 605)."

A witness to a hive swarming may describe the event this way:

> It is close to noon, the sun is at its zenith. For some time there has been a certain amount of disturbance at one of the hives. Lots of drones have been flying in and out. The orientation flight has just finished, but quite a lot of bees are scurrying around the hive entrance, going in and out or rocking backwards and forwards as if scrubbing ('washboard movement'). Suddenly the busy foraging flight is replaced by a new activity. Masses of bees are pouring out of the hive entrance almost like a stream of water, tripping over and bumping into one another and immediately rising into the air, which is soon filled with a loud buzzing. While the outflow has still not finished, the bees that have taken off fly high into the sky. They do not head purposefully to some point like the foragers, but instead fly round in large lemniscate loops near to, or further away from, the apiary; some quickly, like streaks lighting in the sunshine, others slowly and peacefully. It seems as if there is no spot in the whole surroundings that is not visited or flown throught by a bee. They alight on the grass, bushes and trees; crawl around briefly and take off again. A lot of bees even approach the astonished, almost shocked, onlookers and crawl around on them as if looking for something -- a little dreamily almost, even going into their nose and ears, tickling peaceably -- and then slowly going away again.
>
> Meanwhile the flow from the entrance of the hive has dried up. At the moment there is almost no more activity there. Instead the observor notices a small collection of bees busy on a tree a few meters from the hive. On cautiously approaching -- there are still bees crawling around on

> the grass -- he notices that more and more bees are landing there. He may even notice that a bee with gleaming red legs, which seems longer and more slender than the rest, is being covered by the new arrivals. By now a cluster of bees about the size of a pear is hanging on the branch. On the outside of it are quite a number of bees with their abdomens pointing upwards into the air and the tip bent downwards somewhat...they are fanning their wings powerfully without flying away...the bees with their bottoms in the air are 'scenting' by blowing a current of scent out into the air. This attracts the bees still flying around to the cluster (Weiler 2006, pp. 21-22).

After a day or two or three, the cluster of bees, often as large as a good-sized watermelon, will either be collected by a beekeeper, or find a hollow tree, abandoned house or other dry place to set up a new home. The foragers have brought enough nectar and pollen with them to survive up to three days and will need to begin building wax comb and making honey and new brood in the new hive very soon. High summer is fast approaching.

Swarm ball photographed in May 2011
in Portland, Oregon (by Kathryn Foubister)

SUMMER

How doth the little busy bee
Improve each shining hour,
And gather honey all the day
From every opening flower!

How skillfully she builds her cell!
How neat she spreads the wax!
And labours hard to store it well
With the sweet food she makes.

In works of labour or of skill
I would be busy too:
For Satan finds some mischief still
For idle hands to do.
--Isaac Watts (1674-1748)

In the heights of sunny summer, when bees are working diligently in their hives making honey, foraging bees are abundant in meadows and gardens, and the reigning monarch is secure in her role, many of our classic images of the harmonious hive are born. The Roman poet Virgil famously drew from the organization and industry of summer bees to describe the martial power of Aeneas' Troy.

> Just as when labor occupies bees in the early summer through the floral countryside when they (the bees) raise the grown offspring of their race, or when they cram liquid honey and they swell their honeycombs with sweet nectar, or they receive the freight of those arriving, or, with a battle-line formed, they ward off the drones, a lazy herd, from the hives; the operation bustles and fragrant honey is redolent with thyme (*Aeneid* 1.430-36 in Stipanovic, 2006).

As Chapter II described, human understanding of honey bees organization evolved through the ages, but vestiges of masculine martial metaphors remain in the midst of

more feminine or domestic images. Bee bread, pollen baskets and waggle dances are but three of the terms that epitomize the abundance of the summer hive.

Dancing

To find their new home, and also to communicate the location of good forage honey bees perform a fascinating movement known as the waggle dance. This bee-to-bee communication was discovered by Karl von Frisch through a long series of experiments in the mid 20th century (his biography is in Appendix H). Again, Michael Weiler (2006) provides a vivid picture of what an observer might witness.

> The house bees are busy everywhere, but some of them are noticeable for their special behavior. They move round the comb in a pattern that always returns to the same point. They waggle their abdomens rapidly from side to side as they move in a short straight line then return to the starting point in a semicircle only to repeat the wag-tail along the straight line, this time completing the other half of the circle on the return, and so on.
>
> There are quite a lot of bees showing this behavior, especially in the lower part of the comb. Many are carrying pollen baskets, others not. Some are walking vertically downwards on the comb, others upwards, many horizontally to the left or right and some diagonally upwards or downwards. But all of them keep to their own direction and exhibit this waggling movement of the abdomen as they walk along the straight line. Some trace out the patterns more vigorously, quicker and more frequently; others more deliberately, slower and less frequently. The 'dancers' often repeat their figure eight for several minutes without a break.
>
> Quite a lot of bees on the comb are paying attention to them with

their antennae, following them briefly and then going away (Weiler, 2006, pp. 59-60).

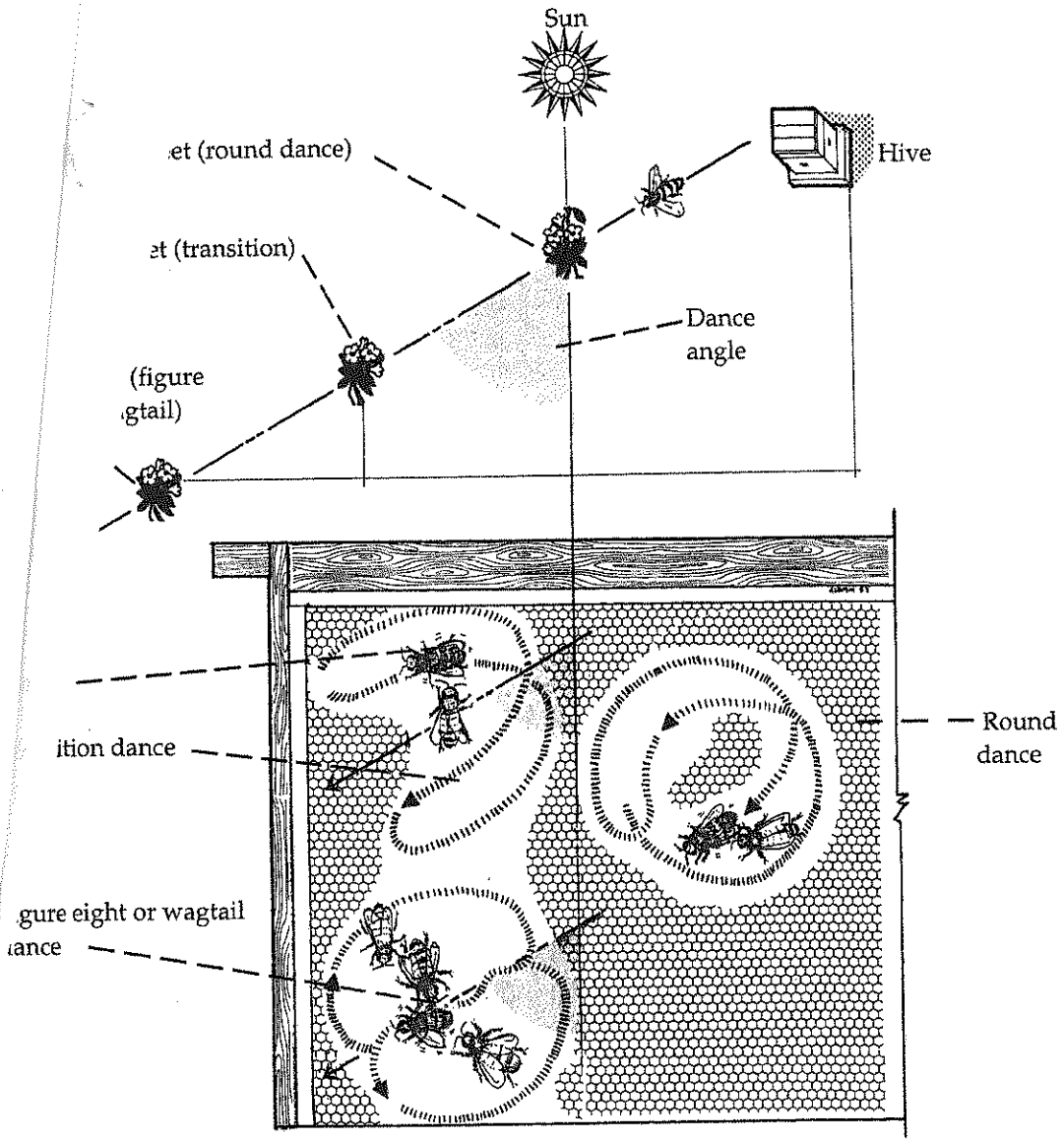
Von Frisch, in his experiments, discovered that the bees were communicating about the location and quality of forage -- nectar and pollen that the bees could bring back to the hive. The bees use the location of the sun to orient the axis of the dance. To direct her sisters to the source of forage, she might put the axis of the dance vertically on the comb, and waggle when climbing upward, indicating that they should fly upwards and toward the sun; when the dance is done vertically but downward, the bees would be instructed to fly away from the sun when outside. Bee eyes can sense the direction of the sun's rays even when they can't see the sun itself, and allows them to navigate to the coded dance. Angled dances will indicate to what angle of the sun the forager bees should orient (Weiler, 2006, p. 60).

Bread

At a 2010 workshop on Friendly Haven Farm in southwestern Washington, the home of farmer and beekeeper Jacqueline Freeman, eager participants held out their open palms to receive a large dark brown pellet called bee bread that came from her bees. The pellets had been removed from the wax comb and stored in a jar in the pantry. To the tasters, (who may also have felt like a little bit like supplicants), it was far different than any bread they've tasted. It was chewy and tasted strongly of fermentation and is known to be packed with protein.

Dance Language of Honey Bees

(source: Sammataro 1998, p. 22)



> Bees gather four different substances from the surroundings: sweetish liquid nectar; floury pollen; sticky, bitter bud resin, and water. The process of gathering pollen by the bees is more visible than that of nectar and can be observed with the naked eye. Whereas pollen gatherers work more superficially on the flowers, nectar gatherers often have to force their way deeply inside the flowers in order to be able to reach the nectaries with their tongues, during which they are also dusted with pollen. They frequently have to burrow, roll, dance right into the chalice of the flower as they maneuver, rip open and shake out the anthers with their mandibles and forelegs. The whole bee body is engaged in filling the pollen baskes and we soon notice the pollen remaining caught all over the hairs on the head, thorax and abdomen. At the same time, the free pollen in constantly wetted with fluid from the proboscis, for which purpose the bee has brought honey with her in her crop or uses nectar out of the flower. This sticks the pollen together somewhat (Weiler 2006, p. 121).

Bee bread is made from the pollen bees collect during their foraging, described above. The pollen is carried in specially-designed baskets on the rear legs of foragers and brought to the hive entrance where house bees then remove it and carry the pollen to comb for packing and storage. It is vital food for young bees and hives without adequate bee bread stores have been observed to weaken and die (Ibid., p. 122).

Honey

It is beyond the scope of this paper to go into the sweet depths that a full discussion of honey can inspire. Therefore, just the most basic physical properties of honey is presented here. Even with a limited discussion, honey is fascinating and

provides year-round inspiration for the creative teacher.

Apis mellifera (literally honey-bearer) will make honey as long as the nectar is flowing in flowers around the hive. Forager bees collect the nectar from flowers using their straw-like proboscis (tongue) and carry it in their crop in their abdomens to the hive. Honey bees, unlike many other insects who also pollinate flowers, are known to forage in the same flower species at a given time. That is, they will not hop from a lavender flower and then to an aster in one trip from the hive. A group of bees will usually work an area, loyal to that species, visiting just that species. It is for this reason that honey bees are valued for their efficiency in pollinating food crops, especially in landscapes with a diversity of crops.

"In the course of the year, the foraging zone of a particular colony changes. Whereas the flight radius remains rather short in the spring, at the availability in the area of main nectar sources…it can increase to 1500 meters or even 3000 meters (or 7 to 30 square kilometers -- that is about 2.7 to over 10 square miles). The flight radius is dependent on the strength of the colony, weather conditions, and the attractiveness of a particular source of forage (Weiler 2006, p. 111)."

The nectar is comprised of sugars and water. Back in the hive, the nectar from the foragers is transferred to "house bees, who release small portions of the liquid onto the base of their proboscis. By stretching out their proboscis, the liquid comes in contact with air movements in the colony. This helps enhance the evaporation of water from the nectar. Then, small amounts of the nectar are placed in the cells, where further evaporation and ripening takes place. As warm air circulates in the hive, fanned by other

house bees, the evaporation rate of the nectar increases. Nectar generally consists of 60 percent water and 30 to 35% sucrose, or table sugar. There are minute amounts of other substances, as well and the sucrose is altered by the action of a bee enzyme called invertase. Invertase breaks down the sucrose into two simpler sugars, glucose and fructose. In addition to invertase, honey is also created by the action of another enzyme, glucose oxidase, which converts glucose to gluconic acid and hydrogen peroxide. The factors that endow honey with antibacterial properties include the hydrogen peroxide, the high sugar content (80%), and high acidity (Sammataro 1998, p. 113).

Once a comb cell is full of liquid that has about 20% water content, bees cap the cell with more wax for storage. This capped cell becomes part of the store for the long winter months and early spring or the harvest for the beekeeper. Some beekeepers will harvest in early fall, others will wait until a sunny warm spring day. Local conditions the strength of the hive, and a beekeepers' philosophy will dictate.

FALL

Auto-da-fe
And judgment
Are nothing to the bee;
His separation from his rose
To him seems misery.
--Emily Dickinson

As the summer season progresses, bees can experience a forage "hole" between the height of spring foliage and the surge of late summer or early fall flowers such as asters or yarrow. People hoping to support bee populations will take care to plant

flowering bushes and perennials that can flower well into the fall.

As the foraging starts to fall off, so, too, do bee numbers in the hive. The queen will have begun to taper off her egg laying and the amount of brood will be adjusted to cluster in a central area of the hive in order to be nurtured and kept warm in the winter months. Most bees born in the late fall will over winter and become the first foragers in the early spring. Bees born in the spring and early will have finished their life cycle and if they have not died outside the hive, will start to die in greater numbers in or near the entrance of the hive. Workers will remove the dead bees and a host of other scavenger or carnivorous insects, often aggressive yellow jacket wasps, can be seen feasting on them on the ground around the hive.

Protecting the hives from invaders is an important activity for the bees in the months of October and November. A weaker hive may be susceptible to invasion by wasps and beekeepers are often anxious at this time of the year as they help their bees fend off these would-be invaders. The wax moth is perhaps the most ubiquitous unwelcome inhabitant in a hive. Eggs deposited by adult moths will hatch into larva that eat through brood comb for the shed exoskeletons of bee larvae and decimate pollen stores. When they fasten themselves to the interior walls of a hive to spin their cocoon, they can eat into the wood sides and damage the hives. Moth infestation can destroy a hive in one season (Sammataro 1998, p. 143).

Underneath the hive, beekeepers may also be more intensively monitoring the "bottom boards," placed there to collect the castings off the bees such as mites. Bees will groom each other to remove these parasites, and an increased number on the bottom

board will show that perhaps an infestation that risks weakening the bees beyond recovery. Beekeepers using natural or holistic methods may treat them by offering a feeding dish with a thymol or formic acid treatment (Hauk 2008, pp. 50-63 provides a good overview of disease and treatments).

The way holistic beekeepers respond to bee diseases and pests is perhaps their strongest defining characteristic. Conventional beekeeping as espoused through the majority of beekeeping clubs and associations via university extension services and the US Department of Agriculture advise a host of fixes around keeping bee colonies alive, including pesticides to kill mites, anti-biotics, and a higher rate of supplemental feeding of sugar solutions. The diseases and parasites can indeed be devastating and few (if any) experienced beekeepers, holistic and conventional alike can claim that they have never lost a hive to one or another.

Diseases to a holistic beekeeper are viewed not unlike disease in our own bodies. The best prevention is a balanced life and a healthy immune system. Mites and the devastating hive disease called foulbrood can be seen as a consequence of an imbalance -- the whole context of a hive and its environment is taken into account, it is not a strict cause and effect phenomenon (Hauk 2008, p. 55). Much of the preventative care is actually given in late winter or early spring with homeopathic doses of herbs fed to bees coming out of their winter cluster. An herbal tea made of chamomile, thyme, peppermint, and nettle sweetened with a bit of honey and given to the bees is one way of stimulating their natural immunity and metabolic systems (Ibid).

The fall hive activity, then, is primarily one of physical fortification. Sealing any

crevices and making the hive entrance smaller is accomplished by the bees by a liberal application of propolis -- a sticky substance they collect from the surrounding environment that serves as mortar. They use the propolis, too, to entomb invaders such as moths and mice. As these animals are often too large for the bees to remove and decomposition would invite further problems, they are safely mummified within the propolis used by the bees. Propolis is a resinous substance derived from a semi-liquid material exuded by trees and buds. Foragers bring the liquid material back to the hive in their pollen collecting structures. House bees remove it from them and mix it with wax and another, still-unknown substance to make propolis. Studies have documented that propolis is anti microbial and helps keep the hive clean (Sammataro 1998, p. 122).

The year again cycles back to winter and the hive clusters tightly around the brood. Inside is a semi-torpid group of workers and their queen. The attentive beekeeper keeps an eye out for disturbances and on sunny days in February, the stirrings of a new year.

Chapter IV

Working With Honey Bees: Perspectives of Beekeepers and Teachers

In two surveys administered in the fall of 2010, 177 small-scale beekeepers and 75 Waldorf teachers shared perspectives about their work and the value of teaching children about honey bees. The survey questions are found in Appendix I and a list of resources offered for teachers by teachers is found in Appendix K.

Beekeepers Survey Results

"Observation. I now look at and think of things differently. I have a greater interest in insects in general. Beekeeping is just another way to find wonder in the world."

(Beekeepers Survey 2010, New beekeeper, Suburban Oregon)

The objective of survey was to obtain qualitative data about the experience of beekeeping in the US. The survey was accessed by a link to the on-line survey tool Survey Monkey and invitations to participate were disseminated by email to individuals and beekeeping associations around the country. 177 responses were received from 36 states and provinces in a four week period in November and December 2010.

- The group is relatively new to beekeeping: 35% reported having less than one year of beekeeping and 26% had 2-3 years, though 18% of responses had over 15 years of beekeeping experience.
- Even split for the location of hives: rural (30%), semi-rural (29%), suburban (29%); urban was just 12% of responses

- Beekeepers were fairly mature in age: 67% of respondents were between 36 and 65 years old.

- There were a variety of reasons for being inspired to start beekeeping. 40% inspired by something they watched on television or the internet, and 16% had direct inspiration from a family member.

- Most people had highly personal rather than economic motivations to keep bees. 21% wanted honey for personal use, 20% reported a spiritual interest, and 37% were seeking to enhance a garden or local ecology.

- Most beekeepers were self-educated rather than educated through formal classes or exposed to beekeeping in school. Nearly 50% get most of their information from books, manuals or websites. Many cite insect societies, beekeeping groups, and mentors were very important to many.

- 80% of respondents uses Langstroth hives, 20% use top bar hives or some version of Langstroth.

- Most common breeds or races of bees -- 54% raise Italian, 25% Carniolan, 12% Russian, 25% of respondents don't know the breed, or they were some sort of combination as a result of collecting a feral hive.

- 63% of respondents have lost a hive for a wide variety of reasons: due to taking too much honey/starvation, some from CCD, some from loss of the queen, cold, varroa mite, wax moth, beetles, bears, nosema, American foulbrood, even a tornado.

It was inspiring to read beekeepers' comments from around the country. Beyond all of the worry about caring for these animals and the expense that can arise without clear or guaranteed compensation, beekeepers enjoy what they do. Here are some of the comments from new and experienced beekeepers living in cities, suburbia and rural areas alike.

> Working directly with nature, to support and help them flourish, while supporting the environment, ecology and ecosystems through pollination, and all the while producing remarkable artisan food and beverage - it's the most remarkable activity, truly. (Experienced beekeeper, San Francisco, California)

I watch the life of the super-organism --- the bee society, coordination of tasks, extraordinary pollen and honey, seeing the transformation of the larvae to bee. And of course the wonderful harvest! (Suburban California)

Learning from the bees while connecting with 'wild" nature in an intimate way. (New beekeeper, rural Virginia)

Biophilia. And a passion for Hymenoptera. Falling in love with any type of animal, be it a zebra or a bee, you feel an overpowering pull towards that animal. Biophilia. (New beekeeper, urban Oregon)

Just knowing they are alive and so am I. Watching them -- if people lived with each other like bees do all with one accord, what a wonderful peaceful life. All working together for the better of the Queen? (New beekeeper, rural Colorado)

I 'see' bees far differently than before. I used to simply view them as annoying buzzing things that might sting me or my family. Now I see them as individuals, curious & friendly, almost never harmful, and a joy to be around. (New beekeeper, suburban Arizona)

Observing my bees, watching what they do and how each one has a different job to do - they all work together to ensure each other's survival - if they didn't help each other, they would not survive on their own. (New beekeeper, suburban upstate NY)

The idea that I'm evolving and constantly learning something new every day. (New beekeeper, urban Illinois)

I am still amazed that the little critters can "make" wax and honey just from the liquid a flower produces. (Over 15 years of beekeeping, rural California)

Beekeepers in the survey were almost universally emphatic that the biggest problem for honey bees is that the general public considers them dangerous. This is likely the biggest barrier to the wider scale adoption of honey bees in school curricula and backyard beekeeping. In early 2011, some of the dialogue on the on-line discussion group OrganicBeekeepers@yahoo.com involved inquiries into insurance rules and

procedures for a school in Arizona to bring hives to their suburban school site. There was not a clear consensus on how to accomplish it, as local ordinances and attitudes of parents and teachers about how to regulate risk to bee stings varies widely. Below are some responses from the survey relating to this issue.

> Most people share an expectation that bees are aggressive killers. I think many people around my area confuse bees with aggressive wasps but are even more afraid of bees because of the "swarm". They expect the worst of Africanized bees in all bees. They also do not have a basic understanding of bee biology and hive behavior. (New beekeeper, rural Virginia)

> My hives are right next to a school but I am reluctant to offer the school the opportunity to experience the hives. It seems that our society is leaning to reducing risk (in this case, of a sting) to the point where they will force me to remove my bees on the chance that someone has a problem with them. Just discussing the issue with the neighbors was hard enough. Even Doctors around here tell folks that if they get stung they MAY develop a fatal allergy to bees, so everyone is scared of them (this happened to my neighbor). And adding to the problem is the news media frenzy about Africanized Honey Bees. How can I counter that? So I just keep my mouth shut and place my hives were they are hard to see from outside the yard. (Experienced beekeeper, suburban CA)

> Some people are allergic. You may need to have all teachers trained to use an EpiPen if anyone has an allergic reaction. If you place the bees strategically so no one will walk across their flight path and so no kids can throw anything at the hives (fence it off), and a good distance from the school buildings, that will be safe. Another thing, if there will be any lights on at night near the hive, bees will eventually find their way there. The bees should be in the dark at night without lit areas nearby. (Experienced beekeeper, suburban California)

Beekeepers shared a wide array of opinions about what they thought were the biggest threats to bees in the environment. This may be locality dependent or have other correlations relating to other attitudes, but these are speculations beyond the scope of this paper. One thorough overview of the threats to bees is articulated in the documentary

film *Queen of the Sun* (in limited release in spring and summer 2011, more information available at www.queenofthesun.com).

> The biggest problem in this area is that most people do not realize that the "flower feed" they use during the spring and summer has insecticides in them." (Experienced, semi rural California)
>
> Stop treating lawns for weeds. The spring dandelions, henbit and later the clover, are important forage for bees. Stop pesticide use in the home and garden. Appreciate all life, all pollinators, the entire food web.. not just honey bees. (rural Oklahoma)
>
> I have come to believe that very little is truly known about bees, and that many different beekeepers have many different opinions that go in many different directions. (New beekeeper, suburban British Columbia)

Beekeepers in the survey were not generally connected to schools or teaching about bees. Nevertheless, many did have helpful advice for people seeking to connect beekeeping to school communities.

> The bees are a messenger from the future. Their ability to live lives of service in a condition of pure selflessness and renunciation points the way to the social condition that we human beings need to achieve. Children (and adults) need to be exposed to the bees with this picture in mind. (Experienced beekeeper, suburban New York)
>
> Maintaining an observation hive in a school is the most important thing you can do for children. Having the bees as a constant companion reminds kids of how important bees are to us. Once a hive is established, maintenance is fairly minimal and something older kids can even help with. (Suburban California)
>
> Since bees are the primary pollinator for many plants we eat, maybe there should be some sort of additional curriculum in the schools that relates this and what they should and should not do in order to maintain good bee health." (Experienced rural California)
>
> Most important over any words or academic work: glass fronted demo hives permanent in the classroom - so kids watch them every day and see

changes every day. Period. Let the kids observe, and their fascination grow, rarely teach, rarely talk, just let them watch." (Experienced, rural Minnesota)

Just be honest about the Bees, don't glorify the raising of Bees and most of all teach respect to a most delicate creature on this earth that works so very hard for the Human existence! (New beekeeper, suburban Texas)

Teachers Survey Results

"Life in it's myriad forms is at the core of all our lessons. Sometimes the smallest and the humblest provide powerful lessons and insight. We must encourage a thorough understanding of the biosphere, the delicate balance of life, and the forces at work in nature. Clearly, insects are a part of our world and we must strive to embrace and comprehend the mysteries which are in plain sight."

(Teachers Survey 2010, Waldorf Teacher, North Carolina)

The object of the survey was to gauge the amount of interest and success in involving honey bees in the Waldorf elementary school curriculum. Questions were largely related to the attitude or relative importance of connecting to insects or honey bees through the eight years. Seventy-five teachers responded to the survey disseminated to Waldorf schools in North America during three weeks in November and December 2010. An email and link to the on-line survey on Survey Monkey was forwarded to individuals and administrative offices. As in the Beekeepers' Survey, a wide geography was represented in the results in schools found in the Association of Waldorf Schools of North America (AWSNA) director. Teachers from 24 states around the United States

responded to the survey. Because the subset of possible respondents was small and also, perhaps a busier group of people was being polled, the number of responses was smaller, though still significant.

- The group of teachers who responded was particularly experienced: 55% of respondents had more than 9 years of teaching in a Waldorf setting.
- There was a variety of class and subject teachers represented: 62% of respondents are currently class teachers and 38% are subject teachers, including woodworking, art, language, middle school science, kindergarten, movement, gardening, music, and handwork.
- Some of them had bee experience at their schools: 18% of respondents say their schools have bees on site. However, that doesn't take into account a situation where multiple teachers from one school responded. A different survey would need to be conducted to get a better picture of how many Waldorf schools have bees or have close access to beehives.
- There was mixed recognition of importance of involving bees or insects in the curriculum:

> It comes up from time to time and I actually have had several main lesson nature stories in grades 1 and 2 about insects, but that is because they are cool stories with a moral point I would want (plus spiders have 8 legs for 8's table), rather than any goal. Upper grades, of course big bee thing and butterflies a bit. (Pennsylvania)
>
> I don't teach about honeybees every year but I read a book on the bees this year at quiet time and we visited the farm that has honeybees several times this fall. I think it's important that when you talk about plants and flowers you talk about insects. (Ohio)
>
> We are in a botany block and insects play a major role. Other than a Botany block, insects are rarely a part. (California)
>
> I would love to work with someone who knew about bees and keeping bees would be part of an ideal setting for our school, but we are an urban school, and I don't see it happening. (Pennsylvania)

- While there was some recognition of the value of teaching about bees, teachers were frequently too busy to pull appropriate materials together or, see how bees would fit outside of the science blocks. Some of the comments included:

> Facts that are more useful for bee keepers haven't been as useful in the classroom." (Oregon)
>
> It is hard to find on short notice materials that have easy-to access information appropriate to an elementary setting. (Minnesota)
>
> I just couldn't pull stuff together fast enough to fit it in -- main lesson blocks have to hit the ground running and be wrapped up in 3-4 weeks. A Waldorf-oriented lesson plan (2-3 days worth, with activities and writing/artistic suggestions, even poems/songs) would be great. (California)
>
> It is a lot of work to take facts or information regarding the life of bees and make it relevant for children in real ways. (Vermont)

On the whole, teachers were most focused on how bees might relate to science blocks in 3rd grade (farming), 4th grade (man and animal), and 5th grade (botany). For several respondents, a major barrier for keeping bees on site or actively engaging with beehives is fear of allergic reactions to bee stings.

The responses indicated clearly that ecology and botany lessons are areas where insects are involved and even integral to lesson planning for class teachers. Some subject teachers involve insects when it is a practical matter -- say worms in wood or maybe learning about the origins of silk and silkworms. What is absent is an appreciation of our culture and the humanities as it relates to honey bees. Not one person mentioned the potential for 5th grade humanities -- honey and bees in India, Egypt, or Persia. Language arts in the upper grades could involve metaphors and word origins of honeymoon, sweetness and love, all kinds of possible connections to bees. One teacher in California mentioned her work with middle schoolers: "I use models from the natural world a lot

when I teach geometry in 6th, 7th and 8th grades -- in 7th grade, insects are part of conversations ranging from chemistry to discoverers exploring of new ecosystems--part of the natural environment that's the backdrop for most of the content in one way or another."

Leading Thoughts

Perhaps the best summation for teachers and anyone interested in bringing honey bees closer to the life of a Waldorf school -- or any elementary school classroom -- is this encouragement from an experienced beekeeper in California: "Be ready for when the bees choose you! Get involved in your community beekeeper association … remember it's an art and a science. The best advice given to me: ask three beekeepers a question and get four answers. A lot of this you learn and develop yourself."

Beekeepers and teachers are not necessarily mutually exclusive; a small subset of respondents were both. And enlivening an elementary Waldorf curriculum with the bee as a muse is best done in a collaboration between school communities and local beekeepers. Hives in schools can present potentially insurmountable challenges, regular field trips to local hives can be a next-best solution. As one beekeeper aptly stated, observation is the best way.

A busy Waldorf teacher would likely agree, but he or she might find that the challenge of addressing the whole of the curriculum surpasses his or her ability to keep bees in mind beyond the obvious connections to botany and pollination. That teacher might bring to mind Steiner's lectures on "Soul Economy" where he states

> The aim of Waldorf education is to arrange all of the teaching so

Chapter V

Honey Bees in School: Practical Ideas

By no means are the suggestions below intended to serve as a complete honey bee curriculum. However, a next step could be to create a 3-day plan or even an entire main lesson block out of the material and a bit of further research. The hope of these suggestions is to pique the interest of a grades teacher to invite the honey bee into their lessons in as many ways possible -- through music, speech, movement, painting, etc. -- all modes of learning.

The caution and encouragement I offer is for the reason Martyn Rawson and Brian Masters state here.

> Any curriculum requires that we do our own thinking. Something written down cannot do more than state the content it would be good to teach, and make suggestions as to how this might best be done. Behind every content, however, stands the educational aim it is intended to achieve. The content is intended to school and develop the soul of the child. It is not the content of what is taught that is important...but the soul forces that can develop when the children work with that content... the curriculum in a Steiner (Waldorf) school is conceived on the basis of what the children need rather than what material has to be covered. Teachers who regard a Waldorf curriculum as a collection of subjects are in danger of getting stuck in the material and failing to observe the transformation that takes place in the children that this material is intended to bring about.

> Alternatively, there might be teachers who strive to realize Steiner education in all its "purity" and are thus in danger of turning away from the material altogether, wanting only to become immersed in the psychological and social processes as such. Such teachers would fail to notice that by not giving the children the content suitable for their age would be denying them the very nourishment needed by their souls (Rawson and Masters, 1997, pp. 2-3).

What follows are thoughts on Waldorf education's pedagogical goals as it relates to child development, the content of the over-arching curriculum in each grade, and practical matters relating to teaching through the eight grades of elementary school. The content of this paper in the previous chapters provide raw material for a teacher to digest and incorporate. As an outreach and education project, a school group or individual could even go so far as to sponsor a local "tour de hive" as the author did in 2010, or encourage a honey bee awareness week (Appendix L has examples of both). The Appendices contain ready-made material that can readily be used in a number of grade levels, some of which is called out specifically in the text below. The hope is that this work can help the teacher to bring vivid pictures to the children they teach and activities that bring those pictures to earth through our deeds.

The following is inspired by and organized in a way similar to the book *Toward Creative Teaching* (Rawson and Masters) and with Steiner's *Practical Advice to Teachers* in mind. Rather than break apart activities grade-by-grade, the ideas below are given in reflection of the three main periods of the seven year cycle between the ages of seven and 14: Grades 1-3, Grades 4-5, and Grades 6-8. The arts of painting and form

drawing, speech, writing, reading and mathematics are all well-described in various Waldorf texts by Steiner (1996a, 1997, 2000) and other sources (Andersen, Schuberth, Rawson and Masters, Lievegoed). I also draw on the advice of experienced Waldorf teachers (Auer, Finser, Monk Finser, Motter), taken into account in these suggestions.

> Living in and with pictures is the key to the world of the whole seven-year period" (ages 7 to 14)... in the first period, ages 7, 8, 9, "we have pictures of fairy tales, legends and fables, the world and the picture are one and the same; the myth is the reality the child experiences. From the 9th to 12th year, the children find pictures as satisfying complement to reality because they want to immerse themselves in the essence of things living behind their manifestation"...From 13 to 14, "a clear schism occurs between the picture and the world, but the soul can express itself in pictures, so truths can be expressed in pictures of which the young person will have to work hard to discover the meaning. Such pictures belonging to the seven-year period can, and indeed should, contain images of great truths that may dip down into the soul where they may slumber for many years to come (Rawson and Masters 1997, p. 5).

Grades One, Two, Three

As teachers, we are encouraged to "surround ourselves by a mood of fairy tale and legend, enveloping our class in warmth of soul.. And cultivate imaginative pictures with the children using a language that is devoid of any scholarly dryness (Rawson and Masters 1997, p. 5)." The children love movement, rhythm and rhyme and have a highly receptive memory. Memory is strengthened if the material given is accompanied by "love

for all that is true, beautiful and good, and with abhorrence of all that is ugly, false and evil (Ibid.). This allows their souls to breath in and out in a healthy way.

"To the children, being usually still at one with their surroundings and with nature, it is perfectly obvious to them that animals, flowers and clouds talk to one another in fairy tales and 'nature stories' and reveal their inner natures (Ibid., p. 13)." It should be noted, too, that at no stage should pure invention or sentimentality enter the children's souls. They should hear what is accurate and true, whether this be expressed in the imaginative pictures of mythology, in an artistic or in a scientific form. As the children progress through school, the kernel of truth in their souls will grow richer and stronger as a result of this variety (Ibid, p. 31).

The Child in First Grade (Ages 6-7)

- Not yet able to have abstract ideas, still in the realm of naming things in the world and making associations.
- "Stage of creative imagination, when the world is still covered with the merciful veil of his own imagination (Lievegoed: 83)"
- Drives of the will still closely related to physical needs.

In the early part of first grade, the teacher might find that the instinct to imitate is still strong and they have a sense of reverence for what is true and good. They are asking the teacher two fundamental questions: Do you know who I am? Can you help me encounter the world? (Auer).

Their observations of the world call to mind this passage from A.A. Milne's *Winnie the Pooh and the Honey Tree.*

First of all he said to himself: "That buzzing-noise means something. You don't

get a buzzing-noise like that, just buzzing and buzzing, without its meaning something. If there's a buzzing-noise, somebody's making a buzzing-noise, and the only reason for making a buzzing-noise that I know of is because you're a bee."

This is about as "scientific" as it should be at this age. Honey bees should be introduced in relation to things a child can see (or hear, as the case may be) -- abstract descriptions of bee biology or ecology should be left alone. Rhyming verse and rhythmic movement in circle can easily be incorporated into the morning. The first two stanzas of the Isaac Watts poem are a good example (the latter two are better left for later years, see Appendix A).

How doth the little busy bee
Improve each shining hour,
And gather honey all the day
From every opening flower!

How skillfully she builds her cell!
How neat she spreads the wax!
And labours hard to store it well
With the sweet food she makes.

This is a good example because the bee in this poem is doing something the children can picture and imitate themselves. The images are very amenable to moving in space in ways that encourage the crossing of the medial lines -- up and down, left to right. We can easily be enchanted with the goodness of her work. Above all, it is rhythmic and memorable.

Oneness and wholeness are two related concepts the first grade teacher keeps in mind at all times. The song "One for the Golden Sun" by Peter Oram is particularly

whole-some and has the six sided honeycomb in it's stanza on six. This is helpful for children during their early counting lessons or through the year as a movement circle. Music and words are in Appendix B. Beeswax modeling in this grade can be introduced with a recollection of the busy bee who made the wax and of course, the Queen Bee fairy tale from the Brothers Grimm can be a favorite for the year (Appendix C). (Thank you to Kathleen Taylor, Grade 1 teacher at Portland Waldorf School for introducing this song and The Queen Bee to the author).

The form of the swarm as a spiral can be used in a story prior to a form drawing lesson or circle movement for a spiral. The bees circle out from their hive, keeping their queen safe (or following their queen who is leading them -- again, the biology is not the important image here).

In addition to the usefulness of the honeycomb cell in lessons about the number six, twenty-one is a number teachers can keep strongly in mind through the years. It is the number of days the sun takes to revolve around the earth and the number of days it takes for a worker bee to grow from egg to adult. Queen bees develop in 16 days, drones in 24, and these are intriguing mysteries teachers can keep in mind.

The Child in Second Grade (Ages 7-8)

- Developing ability to develop own images, evolving from perception to concepts. Images are not sharply defined, they are fluid, mobile, active -- day-dreamy (Lievegoed 2005, p.85).
- Beginnings of wall between inner world and outside. "He wishes the world and its purpose and direction to be recounted and painted in words (Ibid., p.86)
- Moral sense developing strongly, rules (Auer)

In second grade the children begin to show stronger feelings of empathy, and also

differences. They are starting to band together in groups of us and them and teachers often report more mischief among their students, especially later in the year. A story created with honey bees in mind could be therapeutic to a divided class -- the image of the Bien and also the evolving roles that worker bees play (from nurse bee to guard to forager) could be applied to the changing roles that clean up helpers (or jump rope carriers, etc.) have through the year.

Many of the ideas for first grade can also be applied for second grade. Because the emphasis is on fables and stories of heroes and saints, then stories involving bees can easily be incorporated. The Thai fable in Appendix D might be helpful, with its interesting setting and the metamorphosis of its protagonists, the elephants and bees. Aesop's fable, The Bee and Jupiter would be a strong one for children who are finding it difficult to understand the way their wishes might cause harm (Appendix D).

As form drawing in second grade emphasizes symmetry, it would be simple enough (and challenging enough) to use the hexagon in various ways on the page. A companion story for a week could be that of the Irish nun, St. Gobnait, the patron saint of bees and beekeeping, who traveled around Ireland until the vision of nine white deer appeared to her (Appendix E).

By this time the students will likely be proficient enough in their pentatonic flutes to try the songs offered in Appendix B The songs are not so challenging rhythmically (owing to the author' relative inexperience writing music), but the intervals and note range are more appropriate for children who are already somewhat proficient on the pentatonic flute.

As painting color stories evolve out of the second grade and become somewhat more representational, it would be interesting to use the seasonal moods and colors related to the seasonal flute songs.

Finally, the summer between second and third grades can provide an opportunity to encourage the Great Sunflower Count. A project of the Xerces Society for Invertebrate Conservation, it is a way for families, individuals and classes to connect to the wider environment in service to the pollinators (www.greatsunflower.org).

The Child in Third Grade (Ages 8-9)

Emphasis on 9-year change

- Critical of adults, enjoy solving riddles, mastery of numbers
- "A complete change seems to have come over his feelings as though he has lost the protection of the imaginative world projected outside himself, as though, he suddenly, seeing its worst side, experiences the world as a hostile place (Lievegoed 2005, p. 91)." Fear of the dark, other "irrational" fears.
- More will-full -- "I" can do it! (Auer, 2009) Seeking people in the environment to place respect (Lievegoed 2005, p. 94)

The continuum of the first three years and its emphasis on wholeness shifts in grade three as children increasingly feel themselves separate from their surroundings. The Grade 3 curriculum involving farming, house building, professions and the stories from the Old Testament support their struggle to find worthy models for their ideals and give them things to DO. Honey bees can be a wonderful support to a teacher now, and beyond the powerful moral and work ethic examples honey bees provide, lessons abound in visits to farms and in work in the garden. Seek farm visits where bees are integral to their operations and take care to visit farms where insects of all kinds are nurtured. Biodynamic and other organic farms should have hedgerows or insectaries where the "good bugs" can thrive and the idea of balance rather than conquest is central to a farmer's outlook.

Back at school, a class could consider planting some good pollinator plants -- resources for gardens of any size are in Appendix F -- even just a few well-placed planter pots can serve well.

Finally, baking or other cooking with honey is another idea to keep honey bees in a classroom's consciousness during third grade (and sometimes, too in the 7th grade

physiology lessons when nutrition might be covered). A sample recipe for gingerbread is included in Appendix K, and recipes abound on websites and often in other resources about beekeeping.

Grades Four and Five

At age ten, children are moving quickly away from early childhood and see the world around them "from the vantage point of greater ego-awareness... Prior to "the Rubicon" of the 9-year change, "the whole Waldorf curriculum in Grade 3 can be regarded as leading up to this, and that of Grade 4 as a confirmation, encouragement and completion of this step (Rawson and Masters 1997, p. 29)." The focus for the teacher in Grades 4 and 5 moves from that of warmth and wholeness into a focus on nature and what is archetypal in the world around us. Old crafts and professions, a living understanding of plants and animals and personalities of important people are involved in the teaching in these two years. Children see imaginative pictures at this stage that they now understand may not be "real" but that provide the essence of things behind their manifestation. Honey bees provide ample support for all of these things.

The Child in Fourth Grade (9-10)

- More critical and analytical, memory capacity fading
- An attitude of dualism of self to the world -- ambivalent (Lievegoed, 2005 p. 93)
- Attracted to physical challenge, seek people (adults, public figures) to respect

In addition to the powerful lessons of the Edda and the Norse myths, the study of nature in Grade 4 is central. "Nature studies and related subjects, local geography, and

new crafts are introduced. The common element in these subjects is that they require the children to confront something without getting too deeply immersed in it...they must get a sense of being separate from the thing with which they are occupied (Rawson and Masters 1997, p. 31)." The blocks on human beings and animals might include some mention of insects, they, too, have a three-fold body structure. An anthroposophical study of how the physical bodies of insects or honey bees are alike or differ from that of human beings -- or lions, eagles or cows -- is beyond the scope of this paper, but would be interesting. A good start is with Karl Konig's *Earth and Man* (1982) and Steiner's *Symphony of the Creative Word* (1991) where it is recognized that insects, and butterflies and bees in particular, are more evolutionarily related to plants. As botany is part of the Grade 5 curriculum, it makes sense that the most in depth honey bee study in Waldorf schools would occur there.

Yet, in Grade 4, the honey bee can be introduced beautifully through painting, for students at this age are well-served by finding beauty in nature. The following page shows a painting developed for that purpose. It is not particularly anatomically precise, but rather attempts to draw out the golden sun qualities of the honey bee and its association with flowers.

Grade 4 might be a good time to see if they could create their own "waggle dance" communicating something to each other in the local geography -- many amusing variations could result. See the Karl Von Frisch biography in Appendix H for more about bee perception and the dances. Chapter III provides an illustration, too.

Fourth graders can also learn about insect metamorphosis by raising mealworms as a classroom project (even if you have a school beehive, this is a great activity). A sample project is provided in Appendix G.

Finally, fourth graders might be interested to know that the term "honeymoon" may come from the land of the Norse myths (the Celts have a claim, too):

> "In the far north of Europe, fierce pagan gods once ruled strapping warriors who plundered the world -- and plundered bees nests as well. For as bloody-minded as the Norsemen were, they had a sweet tooth. They also had a sweet sense of the romantic. Not only did they harvest honey and turn it into wine, they conceived the idea of the very first honeymoon (or so their descendents, the modern Scandinavians, claim) (Buchmann 2005, p. 133)."

The Child in Fifth Grade (10-11)

- Balanced: thinking, feeling and willing moving more harmoniously together (Rawson and Masters 1997).

- Seeking to know about interconnections (etheric-based thinking) (Auer 2009)

"A special kind of harmony, mobility, and enjoyment of life is characteristic for both inner and outer activities. In the way they walk, think, paint, sing, experience events and situations and join in with enthusiasm, the children express the unique gift of this age group (Rawson and Masters 1997, p. 30)."

As in Grade 4, nature study continues in Grade 5, but with a focus on botany. Here, the traditional Waldorf curriculum most closely brings the honey bee into action and teachers should not neglect to read Steiner's *Symphony of the Creative Word* in their preparations for Grades 4 and 5. There is also a rich trove of story, myth and history that can be introduced through the stories of India, Egypt, Persia and Greece that are the hallmark of this year. Chapter II of this paper provides an overview of some of the highlights a teacher can draw from that should not crowd an already full array of material. Including a beekeeper or goddess clad in bee iconography can be a nice addition to a class play.

Grades Six, Seven, Eight

"As physical maturity approaches, powers of feeling and will get stronger and tend to dominate the (students). Passionate acceptance or rejection color their reactions to life in general, as well as their work in school, and lead to the turbulence so familiar to teachers (Rawson and Masters 1997, p. 48)." At this broad stage, teachers need to express themselves with particular equilibrium and objective clarity. They need to connect

students with the practical world and recognize that students are working out of a sense of cause and effect. Students now experience a schism between inner pictures they may have and the reality they see in the world around them; their inner world is one still of pictures, because the soul still expresses itself in pictures.

The Child in Sixth Grade (11-12)

- Limbs are lengthening -- growth spurts
- Abstraction in thinking begins, discernment
- Feeling starting to go inward while will is increasingly activated to bring ego to face the world -- demanding rules and order

The Roman conquest gives ample opportunity for tapping into the poetry of Virgil and his admiration for order and industry on the part of the bees (see Appendix A). The recipe using honey in Appendix K dates back to medieval times and was used into the Renaissance. Both France and England used honey and wax as part of their tax system in the Middle Ages, generally as part of the tithing system to the Roman Catholic Church. Sixth grade geometry and mineralogy can tie to the hexagonal once again, but at a level where students can really begin to marvel at its properties.

Perhaps the most engrossing aspect of honey bee involvement in sixth grade would be in the arena of math. Limitless calculation with very large numbers, percent work and business math can be inspired by the life of the honey bee hive (See Appendix J for a start).

A business project could be created with an active hive or set of hives with a willing beekeeper. Calculating the cost of time and materials for tending a hive,

harvesting honey from a hive, jarring the honey, setting its price and marketing the honey could take place in the course of a year-long project for this grade. This is also an opportunity to introduce the beneficial social aspects of an environmentally sustainable enterprise and how one works ethically with animals. Finally, Heifer International allows individuals and groups to donate money to buy bees and equipment for people in developing countries.

The Student in Seventh Grade (12-13)

- Early adolescence in full swing, body changes
- Intolerant of flaws in others, especially adults, seeking ideals
- Confrontation as means of finding self

Seventh grade brings the Renaissance, exploration and world geography -- discoveries abound -- and Steiner considered the era to be discussed in Class 7 to be the most important of all. 'to show as clearly as possible the new kind of life that began in the fifteenth century, covering the whole of European life up to about the beginning of the seventeenth century. This is the most important period of time' (Rudolf Steiner in Rawson and Masters 1997, p. 56)." People began to rely on their own thinking, and students this age are doing the same.

Honey bees can be carried into the life of the class through poetry and descriptive history of the introduction of the *Apis mellifera* to North America to help new settlers with their crops. Honey had lost the economic role it held in the Middle Ages as sugarcane started to supplant honey as a sweetener. Honey was not a commodity, as sugar came to be; sugar took a pivotal role in the establishment of plantations in the New

World, and the beginning of the horror of the slave trade.

Honey could take a role in the physiology block and human nutrition -- it provides a good illustration of the ways complex and simple sugars (carbohydrates) relate and students at this age will appreciate the marvel of the chemical changes that bees can effect on nectar to make honey. Rather than use bees in the unit on sexuality, a teacher could consider the fascinating progression of gland development that bees undertake as they move through their adult roles as nurse, comb builder, guard, and forager. Michael Weiler's *Bees and Honey from Flower to Jar* (2006) provides a helpful guide for that.

The Student in Eighth Grade (13-14)

- "Birth" of the astral body -- moral, cognitive and aesthetic judgment will become available
- Thirst for new experiences, finding identity begins
- Ideals start to take root

There are three strong ways of bringing bees to the students of an eighth grade: powerful metaphor in literature, biographies of pivotal people in beekeeping, and construction of hives. Any of these activities could be something carried into the ninth grade, as well. The Emily Dickinson poems in particular in Appendix A could provide material for lessons on metaphor in literature and three others provide rich depths to explore: "Last Night" (Machado, in both Spanish and English), "The Bee Meeting" (Plath) and "The Honey Tree" (Oliver). At the very least, a teacher might enjoy savoring each of them, even if other material takes precedent.

Two biographies are included in Appendix H, L.L. Langstroth, an 19th century

Von Frisch, a 20th century Austrian zoologist who did groundbreaking research on the perceptive abilities of bees, including the discovery of the waggle dance as the means by which bees communicate about the world outside the hive. Other relevant 19th and 20th century biographies might include Emily Dickinson, Charles Dadant, Henri Fabre, Abbe Warre and Ehrenfried Pfeiffer.

Closing Thoughts

What started as an enthusiasm for joining together two passions -- the rich Waldorf curriculum with its approach to child development on the one hand and the beauty of the honey bee on the other -- became a year-long journey of discovery. Rather than reaching a destination or closure at the close of this paper, the reader will most likely find more questions to ask and new paths to explore. The hope is that the work presented here will support the ongoing journeys -- to know the outer world and perhaps also the world within.

If I can clearly see the world around me,
The creatures of the earth and of the sky,
Then I can see as well what other people need.
If I can hear the sounds and songs and voices
In the world around me,
Then I can hear as well what all words mean.
For if I can know the outer world,
I can also know the world within (Harrer 1973, p. 8).

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Appendices

A. Poetry selections for teachers and students

B. Four Seasonal Songs for Pentatonic Flute and "One For the Golden Sun"

C. Queen Bee by the Brothers Grimm

D. Four Fables

E. St. Gobnait of Ireland and a Scottish Folktale

F. Pollinator Gardening Resources

G. Class Project -- Raising Mealworms

H. Two Biographies

I. Beekeepers and Teachers Survey Questions

J. Honey Bee Facts and Figures

K. Recipe for Gingerbread using Honey

L. Further Resources

M. Project Presentation Form and Evaluations

Appendix A -- Poetry

Below is a sample of honey bee-inspired poetry from Roman times to the late 20th century.

The Georgics, Book IV

By Virgil (70-19 BC)
Verses 149 to 227, likely written in 29 BC
Translated by A. S. Kline, 2002

Come now and I'll impart the qualities Jupiter himself
gave bees, for which reward they followed after
the melodious sounds and clashing bronze of the Curetes,
and fed Heaven's king in the Dictean cave.

They alone hold children in common: own the roofs
of their city as one: and pass their life under the might of the law.
They alone know a country, and a settled home,
and in summer, remembering the winter to come,
undergo labour, storing their gains for all.

For some supervise the gathering of food, and work
in the fields to an agreed rule: some, walled in their homes,
lay the first foundations of the comb, with drops of gum
taken from narcissi, and sticky glue from tree-bark,
then hang the clinging wax: others lead the mature young,
their nation's hope, others pack purest honey together,
and swell the cells with liquid nectar:
there are those whose lot is to guard the gates,
and in turn they watch out for rain and clouds in the sky,
or accept the incoming loads, or, forming ranks,
they keep the idle crowd of drones away from the hive.

The work glows, and the fragrant honey is sweet with thyme.
And like the Cyclopes when they forge lightning bolts
quickly, from tough ore, and some make the air come and go
with ox-hide bellows, others dip hissing bronze
in the water: Etna groans with the anvils set on her:
and they lift their arms together with great and measured force,
and turn the metal with tenacious tongs:
so, if we may compare small things with great,
an innate love of creation spurs the Attic bees on,
each in its own way.

The older ones take care of the hive,
and building the comb, and the cleverly fashioned cells.
But at night the weary young carry back sacs filled with thyme:
they graze far and wide on the blossom of strawberry-trees,
and pale-grey willows, and rosemary and bright saffron,
on rich lime-trees and on purple hyacinths.

All have one rest from work: all have one labour:
they rush from the gates at dawn: no delay: when the evening star
has warned them to leave their grazing in the fields again,
then they seek the hive, then they refresh their bodies:
there's a buzzing, a hum around the entrances and thresholds.

Then when they've settled to rest in their cells, there's silence
in the night, and sleep seizes their weary limbs.
If rain's threatening they don't go far from their hives,
or trust the sky when Easterlies are nearing,
but fetch water from nearby, in the safety of their city wall,
and try brief flights, and often lift little stones,
as unstable ships take up ballast in a choppy sea,
and balance themselves with these in the vaporous clouds.

And you'll wonder at this habit that pleases the bees,
that they don't indulge in sexual union, or lazily relax
their bodies in love, or produce young in labour,
but collect their children in their mouths themselves from leaves,
and sweet herbs, provide a new leader and tiny citizens themselves,
and remake their palaces and waxen kingdoms.

Often too as they wander among harsh flints they bruise
their wings, and breathe their lives away beneath their burden.
so great is their love of flowers, and glory in creating honey.
And though the end of a brief life awaits the bees themselves
(since it never extends beyond the seventh summer)
the species remains immortal, and the fortune of the hive
is good for many years, and grandfathers' grandfathers are counted.

Besides, Egypt and mighty Lydia and the Parthian tribes,
and the Median Hydaspes do not pay such homage to their leader.
With the leader safe all are of the same mind:
if the leader's lost they break faith, and tear down the honey
they've made, themselves, and dissolve the latticed combs.
The leader is the guardian of their labours: to the leader
they do reverence, and all sit round the leader in a noisy throng,
and crowd round in large numbers, and often
they lift the leader on their shoulders and expose their bodies
in war, and, among wounds, seek a glorious death.

Noting these tokens and examples some have said
that a share of divine intelligence is in bees,
and a draught of *aether*: since there is a god in everything,
earth and the expanse of sea and the sky's depths:
from this source the flocks and herds, men, and every species
of creature, each derive their little life, at birth:
to it surely all then return, and dissolved, are remade,
and there is no room for death, but still living
they fly to the ranks of the stars, and climb the high heavens.

Medieval England

Anon.

Sit down, sit down, bee!
St. Mary commanded thee!
Thou shalt not have leave,
Thou shalt not fly to the wood.
Thou shalt not escape me.
Nor go away from me.
Sit very still,
Wait God's will.

From Henry V

William Shakespeare (1564-1616)

They have a king, and officers of sorts,
Where some, like magistrates, correct at home;
Others, like merchants, venter trade abroad;
Others, like soldiers, armed in their stings,
Make boot upon the summer's velvet buds,
Which pillage they with merry march bring home
To the tent-royal of their emperor,
Who busied in his majesty surveys
The singing masons building roofs of gold.

How Doth the Little Bee

Isaac Watts (1648-1748)

How doth the little busy bee
Improve each shining hour,
And gather honey all the day
From every opening flower!

How skillfully she builds her cell!
How neat she spreads the wax!
And labours hard to store it well
With the sweet food she makes.

In works of labour or of skill
I would be busy too:
For Satan finds some mischief still
For idle hands to do.

In Books, or Work, or healthful Play
Let my first Years be past,
That I may give for every Day
Some good Account at last.

The Gift from the Bees

German Folk Tradition
adapted by Chris Slade

We work together all the day.
We work for others, not for pay;
So copy us, if learn you will.
The sacred light from votive spill
Came from our crushed and melted comb.
So think of this in your own home.
It should be said with great respect:
There is no work that we neglect.
The wax from off our abdomen
Perfumes the homes of bees and men.
We fashion cells in hanging tower,
Six-sided like the lily flower,
And store therein our flowing forage
That serves as bacon, eggs and porridge.
Their honey strengthens them and me:
So God, look kindly on the bee!

The Bee and the Flower

Alfred Lord Tennyson (1809-1892)

The Bee buzzed up in the heat.
"I am faint for your honey, my sweet."
The flower said, "Take it, my dear;
For now is the spring of the year.
So, come, come!
"Hum!"
And the bee buzzed down from the heat.

And the bee buzzed up in the cold.
When the flower was withered and old.
"Have you still any honey, my dear?"
She said, "It's the fall of the year,
But come, come!
"Hum!"
And the bee buzzed off in the cold.

The Bee

Emily Dickinson (1830-1886)

Like trains of cars on tracks of plush
I hear the level bee:
A jar across the flowers goes,
Their velvet masonry
Withstands until the sweet assault
Their chivalry consumes,
While he, victorious, tilts away
To vanquish other blooms.
His feet are shod with gauze,
His helmet is of gold;
His breast, a single onyx
With chrysoprase, inlaid.
His labor is a chant,
His idleness a tune;
Oh, for a bee's experience
Of clovers and of noon!

Bee! I'm expecting you!
Emily Dickinson (1830-1886)

Was saying Yesterday
To Somebody you know
That you were due --

The Frogs got Home last Week --
Are settled, and at work --
Birds, mostly back --
The Clover warm and thick --

You'll get my Letter by
The seventeenth; Reply
Or better, be with me --
Yours, Fly.

Fame is a bee
Emily Dickinson (1830-1886)

Fame is a bee.
It has a song—
It has a sting—
Ah, too, it has a wing.

It makes no difference abroad
Emily Dickinson (1830-1886)

It makes no difference abroad --
The Seasons -- fit -- the same --
The Mornings blossom into Noons --
And split their Pods of Flame --

Wild flowers -- kindle in the Woods --
The Brooks slam -- all the Day --
No Black bird bates his Banjo --
For passing Calvary --

Auto da Fe -- and Judgment --
Are nothing to the Bee --
His separation from His Rose --
To Him -- sums Misery --

Last night as I was sleeping

Antonio Machado (1875-1939)

Translated to the English by Katie King, 2010

Last night as I was sleeping
– blessed vision! – I dreamt
of a fountain that was rippling
deep within my heart.
Tell me, what is this hidden aquifer,
water, flowing up to me,
spring of new life
which never before did I drink?

Last night as I was sleeping
– blessed vision! – I dreamt
of a beehive that was nesting
deep within my heart;
and the golden bees
inside it,
from old bitterness weave
pure white comb and honey sweet.

Last night as I was sleeping
– blessed vision! – I dreamt
that a brilliant sun was burning,
deep within my heart.
It was brilliant because it lent
the warmth of home aglow,
and it was sun because it showed the light
and because it made the teardrops flow.

Last night as I was sleeping
– blessed vision! – I dreamt
that it was God that I had glowing
deep within my heart.

In Spanish:

Anoche cuando dormía
soñé ¡bendita ilusión!
que una fontana fluía
dentro de mi corazón.
Dí: ¿por qué acequia escondida,
agua, vienes hasta mí,

manantial de nueva vida
en donde nunca bebí?

Anoche cuando dormía
soñé ¡bendita ilusión!
que una colmena tenía
dentro de mi corazón;
y las doradas abejas
iban fabricando en él,
con las amarguras viejas,
blanca cera y dulce miel.

Anoche cuando dormía
soñé ¡bendita ilusión!
que un ardiente sol lucía
dentro de mi corazón.
Era ardiente porque daba
calores de rojo hogar,
y era sol porque alumbraba
y porque hacía llorar.

Anoche cuando dormía
soñé ¡bendita ilusión!
que era Dios lo que tenía
dentro de mi corazón

The Lake Isle of Innisfree

William Butler Yeats (1865-1939)

I will arise and go now, and go to Innisfree,
And a small cabin build there, of clay and wattles made;
Nine bean rows will I have there, a hive for the honeybee,
And live alone in the bee-loud glade.

And I shall have some peace there, for peace comes dropping slow,
Dropping from the veils of the morning to where the cricket sings;
There midnight's all a-glimmer, and noon and purple glow,
And evening full of the linnet's wings.

I will arise and go now, for always night and day
I hear the lake water lapping with low sounds by the shore;
While I stand on the roadway, or on the pavement's grey,
I hear it in the deep heart's core.

The Bee Meeting

Sylvia Plath (1932 - 1963)

Who are these people at the bridge to meet me? They are the
villagers -----
The rector, the midwife, the sexton, the agent for bees.
In my sleeveless summery dress I have no protection,
And they are all gloved and covered, why did nobody tell me?
They are smiling and taking out veils tacked to ancient hats.

I am nude as a chicken neck, does nobody love me?
Yes, here is the secretary of bees with her white shop smock,
Buttoning the cuffs at my wrists and the slit from my neck to my knees.
Now I am milkweed silk, the bees will not notice.
Thev will not smell my fear, my fear, my fear.

Which is the rector now, is it that man in black?
Which is the midwife, is that her blue coat?
Everybody is nodding a square black head, they are knights in visors,
Breastplates of cheesecloth knotted under the armpits.
Their smiles and their voices are changing. I am led through a beanfield.

Strips of tinfoil winking like people,
Feather dusters fanning their hands in a sea of bean flowers,
Creamy bean flowers with black eyes and leaves like bored hearts.
Is it blood clots the tendrils are dragging up that string?
No, no, it is scarlet flowers that will one day be edible.

Now they are giving me a fashionable white straw Italian hat
And a black veil that molds to my face, they are making me one of them.
They are leading me to the shorn grove, the circle of hives.
Is it the hawthorn that smells so sick?
The barren body of hawthorn, etherizing its children.

Is it some operation that is taking place?
It is the surgeon my neighbors are waiting for,
This apparition in a green helmet,
Shining gloves and white suit.
Is it the butcher, the grocer, the postman, someone I know?

I cannot run, I am rooted, and the gorse hurts me
With its yellow purses, its spiky armory.
I could not run without having to run forever.
The white hive is snug as a virgin,
Sealing off her brood cells, her honey, and quietly humming.

Smoke rolls and scarves in the grove.
The mind of the hive thinks this is the end of everything.

Here they come, the outriders, on their hysterical elastics.
If I stand very still, they will think I am cow-parsley,
A gullible head untouched by their animosity,

Not even nodding, a personage in a hedgerow.
The villagers open the chambers, they are hunting the queen.
Is she hiding, is she eating honey? She is very clever.
She is old, old, old, she must live another year, and she knows it.
While in their fingerjoint cells the new virgins

Dream of a duel they will win inevitably,
A curtain of wax dividing them from the bride flight,
The upflight of the murderess into a heaven that loves her.
The villagers are moving the virgins, there will be no killing.
The old queen does not show herself, is she so ungrateful?

I am exhausted, I am exhausted -
Pillar of white in a blackout of knives.
I am the magician's girl who does not flinch.
The villagers are untying their disguises, they are shaking hands.
Whose is that long white box in the grove, what have they accomplished,
why am I cold.

The Honey Tree

Mary Oliver (b 1935)

And so at last I climbed
the honey tree, ate
chunks of pure light, at
the bodies of bees that could not
get out of my way, ate
the dark hair of the leaves,
the rippling bark,
the heartwood. Such
frenzy! But joy does that,
I'm told, in the beginning.
later, maybe,
I'll come here only
sometimes and with a middling hunger. But now
I climb like a snake
I clamber like a bear to
the nuzzling place, to the light
salvaged by the thighs of bees and racked up
in the body of the tree.
and singing in the
heaven of appetite.

Appendix B -- Songs

Four Seasonal Songs for Pentatonic Flute

By Lauren S Johnson

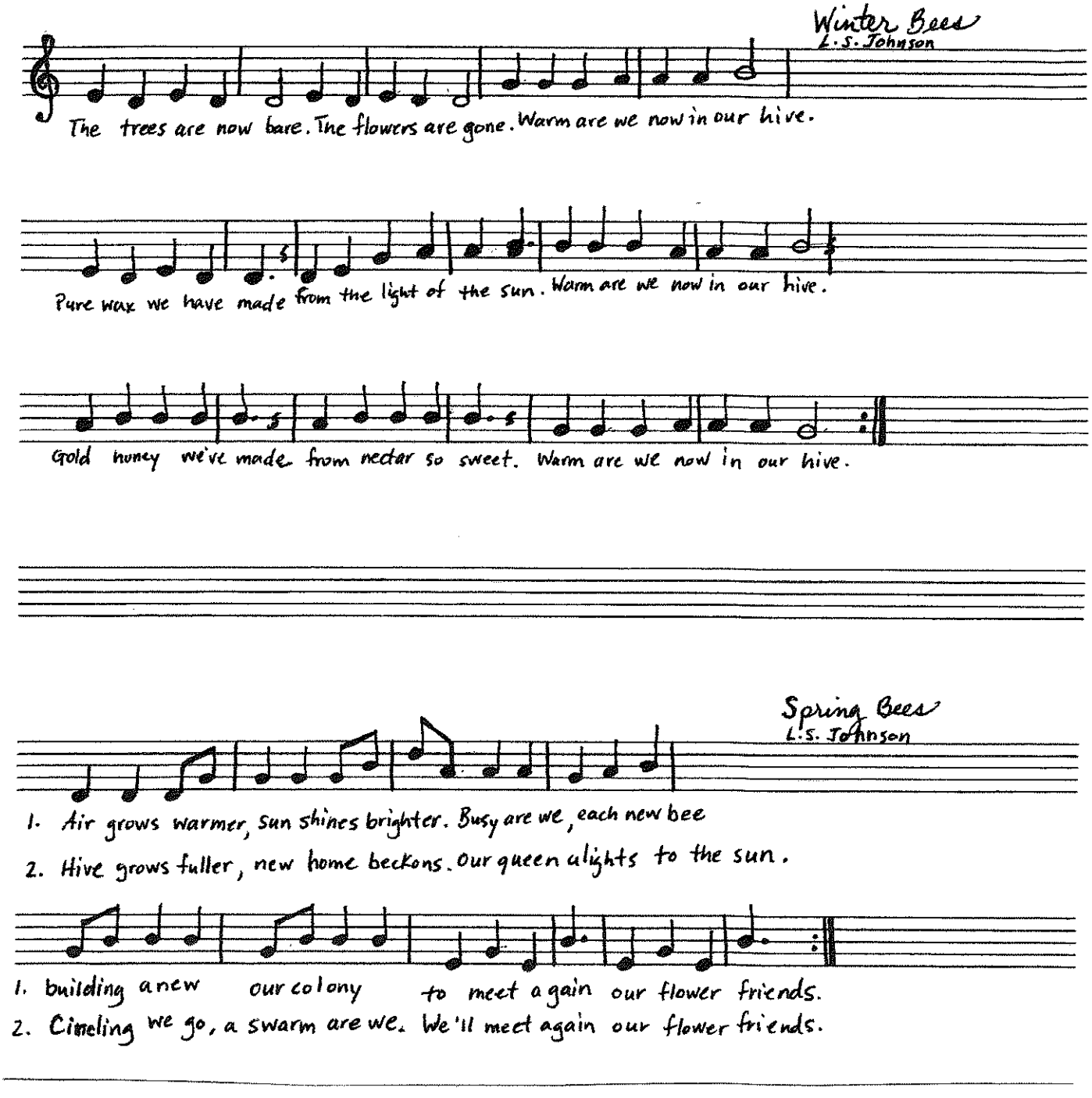
One For the Golden Sun

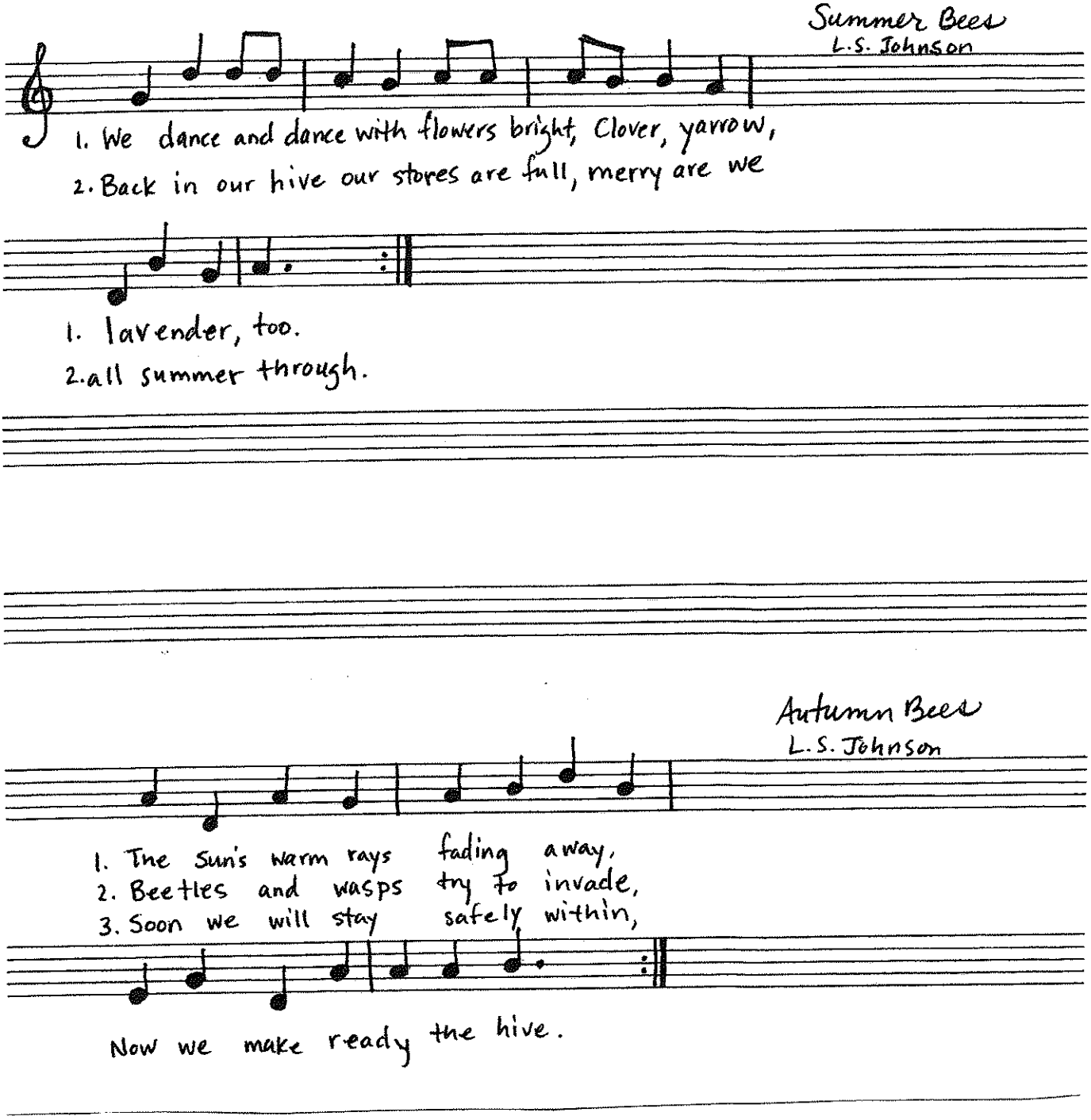
By Peter Oram

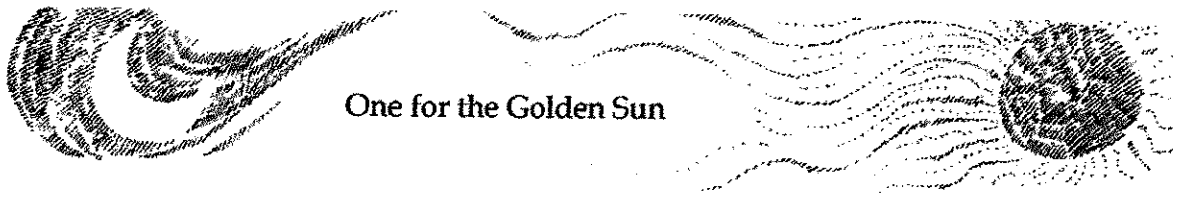
The following four songs correspond to the four seasons of a bee colony. They are written in the pentatonic scale and useful for early childhood and grades 1, 2, and 3. The melodies were written with an attempt at working with the intervals in the mood of the 5th, following the suggestions in *The Waldorf Teachers' Companion to the Pentatonic Flute* by John Cyril Miles. He says, "The heart forces are stirred by the differences in how large or small the jumps or intervals are between each note."

The four songs correspond to moods that the intervals help create. Winter is written primarily using seconds, which "intensify inner life." Spring is written with fourths which evokes a mood that "lies on the border between self and the world." Summer is written with a sixth in mind to "reach out to the world of Inspiration" and a fifth to "envelope mankind in the cosmos and the cosmos in the human being." Fall is written with an ear to the fifth as well.

"One for the Golden Sun" is by Peter Oram and can be found in his book, *One for the Golden Sun, Pentatonic Songs* published by Starborn Books, 1996 (Second Edition, 2004).


Winter Bees
L.S. Johnson
The trees are now bare. The flowers are gone. Warm are we now in our hive.
Pure wax we have made from the light of the sun. Warm are we now in our hive.
Gold honey we've made from nectar so sweet. Warm are we now in our hive.
Spring Bees
L.S. Johnson
1. Air grows warmer, sun shines brighter. Busy are we, each new bee
2. Hive grows fuller, new home beckons. Our queen alights to the sun.
1. building anew our colony to meet again our flower friends.
2. Cimeling we go, a swarm are we. We'll meet again our flower friends.


Summer Bees
L.S. Johnson
1. We dance and dance with flowers bright, Clover, yarrow,
2. Back in our hive our stores are full, merry are we
1. lavender, too.
2. all summer through.
Autumn Bees
L.S. Johnson
1. The Sun's warm rays fading away,
2. Beetles and wasps try to invade,
3. Soon we will stay safely within,
Now we make ready the hive.



One for the Golden Sun

One for the gol - den sun, one for the gol - den sun, two for the night and day, One for the gol - den sun, One for the gol - den sun,

Three for me for here I find strong limbs, warm heart and a clear true mind and Two for the night and day,

One for the gol-den sun, One for the gol-den sun, Four for the sea - sons slow - ly turn - ing, Three for me for here I find strong

limbs, warm heart and a clear true mind and Two for the night and day, One for the gol - den sun,

One for the gol - den sun, Five for the star so bright - ly burn - ing, Four for the sea - sons slow - ly turn - ing,

Three for me for here I find strong limbs, warm heart and a clear true mind and Two for the night and day, One for the gol den sun,

One for the gol - den sun, Six for the hon - ey - comb of the bee that brings its sweet sweet ho - ney to me and

Five for the star so bright - ly burn - ing, Four for the sea - sons slow - ly turn - ing, Three for me for here I find strong

limbs warm heart and a clear true mind and Two for the night and day, One for the gol-den sun, One for the gol-den sun,

one, two three, four, five, six, Se - ven for the wan - der - ers of the sky and for the days as they pass by and

Six for the ho - ney-comb of the bee that brings its sweet sweet ho-ney to me and Five for the star so bright - ly burn - ing,

Four for the sea - sons slow - ly turn - ing, Three for me for here I find strong limbs, warm heart and a clear true mind and

getting softer and slower.....

Two for the night and day, One for the gol-den sun, One for the gol-den sun, One for the gol-den sun, One for the gol-den sun!

Appendix C

The Queen Bee

Grimm's Fairy Tales

Two King's sons who sought adventures fell into a wild, reckless way of living, and gave up all thoughts of going home again. Their third and youngest brother, who was called Witling, and had remained behind, started off to seek them. And when at last he found them, they jeered at his simplicity in thinking that he could make is way in the world, while they who were so much cleverer were unsuccessful. But they all three went on together until they came to an anthill, which the two eldest brothers wished to stir up, that they might see the little ants hurry about in their fright and carrying off their eggs, but Witlng said, "Leave the little creatures alone, I will not suffer them to be disturbed."

And they went on farther until they came to a lake, where a number of ducks were swimming about. The two eldest brothers wanted to catch a couple and cook them, but Witling would not allow it, and said, "Leave the creatures alone, I will not suffer them to be killed."

And then they came to a bee's nest in a tree, and there was so much honey in it that it overflowed and rand down the trunk. The two eldest brothers then wanted to make a fire beneath the tree, that the bees might be stifled by the smoke, and then they could get at the honey. But Witling prevented them, saying, "Leave the little creatures alone, I will not suffer them to be stifled."

At last the three brothers came to a castle where there were in the stables many horses standing, all of stone, and the brothers went through all the rooms until they came to a door at the end secured with three locks, and in the middles of the door a small opening through which they could look into the room. And they saw a little gray-haired man sitting at a table. They called out to him once, twice, and he did not hear, but at the third time he got up, undid the locks, and came out. Without speaking a word he led them to a table loaded with all sorts of good things, and when they had eaten and drunk he shoed to each his bed-chamber. The next morning the little gray man came to the eldest brother, and beckoning him, brought him to a table of stone, on which were written three

things directing by what means the castle could be delivered from its enchantment. The first thing was that in the wood under the moss lay the pearls belonging to the Princess -- a thousand in number -- and they were to be sought for and collected, and if he should undertake the task had not finished it by sunset -- if but one pearl were missing -- he must be turned to stone. So the eldest brother went out, and searched all day, but at the end of it he had only found one hundred; just as was said on the table of stone came to pass and he was turned to stone. The second brother undertook the adventure next day, but it fared him no better than with the first; he found two hundred pearls, and was turned into stone.

And so at last it was Witling's turn, and he began to search in the moss; but it was a very tedious business to find the pearls, and he grew so out of heart that he sat down on a stone and began to weep. As he was sitting thus, up came the ant-king with five thousand ants, whoes lives had been saved through Witling's pity, and it was not very long before the little insects had collected all the pearls and put them in a heap.

Now the second thing ordered by the table of stone was to get the key of the Princess's sleeping-chamber out of the lake. And when Witling came to the lake, the ducks whose lives he had saved came swimming, and dived below, and brought up the key from the bottom.

The third thing that had to be done was the most difficult, and that was to choose out the youngest and loveliest of the three Princesses, as they lay sleeping. All bore a perfect resemblance each to the other, and only differed in this, that before they went to sleep each on had eaten a different sweetmeat -- the eldest a piece of sugar, the second a little syrup, and the third a spoonful of honey. Now the Queen-bee of those bees that Witling had protected from the fire came at this moment, and trying the lips of all three, settled on those of the one that had eaten honey, and so it was that the King's son knew which to choose. Then the spell was broken: every one awoke from stony sleep, and took his right form again.

And Witling married the youngest and loveliest Princess, and became King after her father's death. But his two brothers had to put up with the two other sisters.

Appendix D -- Four Fables

The Bee and Jupiter

Aesop

A Bee from Mount Hymettus, the queen of the hive, ascended to Olympus to present Jupiter some honey fresh from her combs. Jupiter, delighted with the offering of honey, promised to give whatever she should ask. She therefore besought him, saying, "Give me, I pray thee, a sting, that if any mortal shall approach to take my honey, I may kill him." Jupiter was much displeased, for he loved the race of man, but could not refuse the request because of his promise. He thus answered the Bee: "You shall have your request, but it will be at the peril of your own life. For if you use your sting, it shall remain in the wound you make, and then you will die from the loss of it."

(Evil wishes, like chickens, come home to roost.)

The Bear and the Bees

Aesop

A Bear roaming the woods in search of berries happened on a fallen tree in which a swarm of Bees had stored their honey. The Bear began to nose around the log very carefully to find out if the Bees were at home. Just then one of the colony came home from the clover field with a load of sweets. Guessing what the Bear was after, the Bee flew at him, stung him sharply and then disappeared into the hollow log.

The Bear lost his temper in an instant, and sprang upon the log tooth and claw, to destroy the nest. But this only brought out the whole hive. The poor Bear had to take to his heels, and he was able to save himself only by diving into a pool of water.

(It is wiser to bear a single injury in silence than to provoke a thousand by flying into a rage.)

The Bees, The Drones, and The Wasp

Aesop

Some Bees had built their comb in the hollow trunk of an oak. The Drones asserted that it was their doing, and belonged to them. The cause was brought into court before Judge Wasp. Knowing something of the parties, he thus addressed them: "The plaintiffs and defendants are so much alike in shape and color as to render the ownership a doubtful matter. Let each party take a hive to itself, and build up a new comb, that from the shape of the cells and the taste of the honey, the lawful proprietors of the property in dispute may appear." The Bees readily assented to the Wasp's plan. The Drones declined it. Whereupon the Wasp gave judgment: "It is clear now who made the comb, and who cannot make it; the Court adjudges the honey to the Bees."

(Professions are best tested by deeds.)

How Elephants Got Their Trunks and Bees Their Hives

A Fable from Thailand

In Stephen Buchmann's *Letters from the Hive*

In ancient times, elephants did not have the long trunks they do today and bees did not live in nests in hollow trees. Instead, they built their nests on branches in the open air.

One year the rains were extremely meager and the land became dangerously dry. The elephants found it increasingly difficult to find enough leaves to feed on. The bees were also having trouble collecting the nectar and pollen they needed, as all of the flowers were dying.

Finally, as dry as tinder, the forest caught fire. The elephants tried to outrun the danger, but the lumbering creatures soon grew tired as the flames spread unchecked. When they called for help, the bees offered to lead them to safety in return for free

transport. The elephants opened their mouths, and the bees flew inside to excape the hot air and choking smoke. They settled in the elephants short snouts and from there directed their companions to a nearby lake. The elephants waded into the middle of the lake and stayed there until the fire had spent itself.

It was now time to leave the lake and resume their hunt for food, but the bees had become accustomed to the cool, dark interior of the elephants' snouts and began building their hives there. The elephants bellowed and trumpeted in rage and began to exhale mightily in order to evict their unwanted lodgers. After several hours of trumpeting and exhaling, their snouts had stretched into full-sized trunks, but the bees remained stubbornly inside.

The elephants finally decided that since the bees had flown inside their snouts to escape the smoke, smoke would be the best way to get them out. So they walked into the still-smoldering ashes of the fire, inhaled deeply, and held the smoke in their mouths and trunks until the bees had fled. Then they returned to the lake to drink and cleanse their palates. Thanks to their new, improved appendages, they could reach the water without having to stoop.

The evicted bees, having become very comfortable building their hives in cool, dark places, searched for something similar and found that the next best thing to an elephant's nose was the hollow trunk of a tree. This is why an elephant's nose and the body of a tree are called trunks, and why bees who live in hollow trees are called phung phrong, or "elephant's mouth bees."

Appendix E --
St. Gobnait of Ireland and a Scottish Folktale

St. Gobnait (Gov-nay)

There are few historical sources for the life of St Gobnait, but there are many local traditions. One connects her with bees and Ballyvourney, County Cork, Ireland. Another tradition is her care for the sick. Her feast day is February 11.

Early life
Gobnait is said to have been born in County Clare. In her youth she went to the Aran Islands to study with St Enda. There is a church dedicated to her, Kilgobnet, on Inisheer. An angel told her that this was not to be the place of "her resurrection" (her death) and that she should tour Ireland until she found a place where she found nine white deer grazing. On her travels she is said to have founded churches at Dunquin in County Kerry and Dungarvan in County Waterford.

Ballyvourney and bees
But it was at Ballyvourney, County Cork, that she eventually found the nine white deer grazing. Here she founded a monastery with the help of St Abban.

Famous among the miracles of Gobnait's prayer was keeping away the pestilence (the plague) by marking off the parish as consecrated ground. She is also famed for her cultivation of bees and a story relates how she routed an enemy by loosing her bees upon them.

Care of the sick
She is remembered for her care of the sick. In the church yard at Ballyvourney many discarded crutches show that people believed they were cured by Gobnait answering their prayers. Her well is still at Ballyvourney and is an attraction for pilgrims.

Associations
In 1602 when he was retreating after the defeat at Kinsale to the territory of O'Rourke of Breifne, O'Sullivan Beara with his soldiers - along with their women, children and servants - stopped at Ballyvourney to pay homage to the memory of Gobnait.

(Source: Patrick Duffy, www.catholicireland.net downloaded May 9, 2011)

The Song of Rinn

In Stephen Buchmann's *Letters from the Hive*

On a visit to the world of the living, Rinn, the Lord of Shadow and Lord of the Land of the Heart's Desire, met Bobaran the Druid and the beautiful maid Aevgrain.

"I am come here," Rinn told Bobaran, "because I follow the shadow of my dream."

As he listened to Rinn, the old Druid thought he had never heard a voice so sweet. At dusk when Rinn sang his song of love, Bobaran saw a forest glade filled with moonlight. Soon the image lulled him to sleep. While Bobaran slept, Rinn gazed at Aevgrain, whose eyes were shing upon him as two stars.

"Play be no sweet songs, O Rinn," she murmured, "for already I love you."

Rinn smiled, but he touched the strings of his harp.

"O heart's desire, my delight!" he whispered.

"O heart's desire," she repeated. Then her white hands moved like swans through the shadowy flood that was her hair and she leaned forward, looking into the eyes of Rinn.

"Tell me who you are, whence you are," she said.

"Will you love me if I tell this thing?"

"You are my heart's desire."

"Will you follow me if I tell this thing?"

"Yes."

"I am called Rinn, Honey of the Wild Bees. I am the Lord of the Shadow. But here, O Aevgrain, my name is Death."

Honey -- the sweetness of desire, the longing of love, the seductiveness of death. Despite what Rinn told her, Aevgrain followed him to the Land of Shadow, where she fell into a sweet dream from which there was no awakening.

Appendix F -- Pollinator Gardening Resources

Creating a Pollinator Garden

(from www.kidsgardening.com)

You don't need a lot of space to start a pollinator garden. Even a few containers can attract perusing pollinators. If you don't already have a garden site, have the class scope out a location that receives at least six hours of full sun each day. They should also have an idea about the basic needs of wildlife — food, water, shelter, and places to rear young — and a notion of what makes pollinators tick.

Consider launching the project by exploring who's already in the neighborhood and what plants they seem to prefer. Next, decide who you'd like to attract (a variety of pollinators? butterflies?) and what they need to thrive and reproduce. In general, the greater variety of plant types you have (trees, shrubs, perennials, annual flowers and herbs), the more pollinators you'll attract. Since pollinators have different needs during different life cycle stages, maintaining diversity will also make your site more of a full-service oasis!

Plant plenty of nectar- and pollen-rich flowers.
See chart, below, for ideas.

Use as many plants native to your region as possible. Native plants have evolved closely with native insects and are well-suited to meet their needs. In fact, some pollinator species are entirely dependent on the availability of certain native plants. Whether using native or nonnative plants, shoot for old-fashioned varieties. Many garden varieties have been bred to look or smell nice for humans, but they often lack accessible nectar or pollen for animal partners. (Never dig plants from the wild unless the area is slated for destruction and development and you have permission from the landowner. The best source for native plants in a local nursery if they have been grown and not gathered.)

Try to put in flowers with a range of shapes and sizes. Trumpet or cup-shaped flowers, such as cardinal flower, honeysuckle, and bee balm, attract a wide range of pollinators. Pollinators with shorter tongues, such as small native bees and wasps, feed on tightly packed clusters of small flowers, such as those found on milkweed, zinnia, phlox, and mint. Hummingbirds feed on red, purple, or orange flowers with lots of nectar, such as bee balm, fuchsia, sage, and nasturtium.

Include a variety of flowers that bloom throughout the season. By doing so, you will accommodate different pollinators' preferences and provide a sequence of pollen and nectar sources throughout different life cycle stages. Consider shrubs and tress, such as dogwood, blueberry, cherry, plum, and willow, that provide nectar or pollen in early spring when other food is scarce.

Use containers, if necessary. If your growing space is limited, consider growing the following types of pollinator plants in containers filled with a rich, well-drained soil mix: Aromatic herbs (coriander, catnip, mint, parsley, lavender); annuals (marigold, phlox, bachelor's button, zinnia, cosmos, salvia); perennials (bee balm, Shasta daisy, iris, coneflower, lobelia, delphinium).

Provide food sources (host plants) and overwintering places for eggs and larvae. Although pollinators in their adult stages generally thrive on flower nectar and/or pollen, larval stages have more of a penchant for plant leaves. Allow a section of your schoolyard to revert to wild grasses, weeds, and wildflowers (e.g., milkweed and Queen Anne's lace). The chart, below, offers more suggestions.

Provide water. Pollinators such as butterflies will gather and sip at shallow pools, mud puddles, and bird baths; bees and wasps can use mud as a home-building material. Mud puddles also provide important minerals for some pollinators.

Avoid using pesticides and herbicides. Many can be harmful to pollinators as well as pests. Herbicides may wipe out key plants (weeds) that are important for pollinators' food mix. If you feel that you must control pests, judiciously use homemade remedies such as garlic spray, or pesticides derived from plants or microbes. Apply them only after sundown, when most pollinators have stopped their rounds.

Provide sites and materials for nesting and overwintering. Leave cut plant stems exposed, turn flowerpots that have drainage holes upside down, leave twigs and brush in small piles, create mud puddles, or put out pieces of string or other light fibers. Students can build nesting structures for certain types of bees and bats.

Pollinator Flower

Pollinators	Flower Preferences
Bees	
Did you know? There are about 4,000 species of native bees in the U.S. ranging in length from less than one eighth of an inch to more than one inch. Most of these bees are "solitary" nesting and, having no hive to defend (as do nonnative honeybees), they are unlikely to sting!	Yellow, blue, purple flowers. There are hundreds of types of bees that come in a variety of sizes and have a range of flower preferences. They can't see red, but are attracted to some red flowers, such as bee balm, that reflect ultraviolet light. Small bees, which have short tongues, prefer packed clusters of tiny flowers (e.g., marigold, daisy, butterfly weed, aromatic herbs).

Butterflies	Red, orange, yellow, pink, blue flowers. They need to land before feeding, so like flat-topped clusters (e.g.,
Moths	Light-colored flowers that open at dusk such as evening primrose.
Pollinating beetles	They prefer wide-open flowers, such as aster, sunflower, rose, and butterfly weed.
Flies	Green, white, or cream flowers. They have short tongues, so prefer simple-bowl shapes.
Hummingbirds	Red, orange, purple/red tubular flowers with lots of nectar (e.g., honeysuckle, sage, fuchsia, jewelweed,
Bats	Large, light-colored, night-blooming flowers with strong fruity odor (e.g., many types of cactus).

Honey Bee Forage

"Top Five" plants for honey bees
(from Melissa Garden)

Borage (*Borago officinalis*) Annual herbaceous plant bees primarily helpful to bees for nectar. It is a self-seeding medicinal plant that can over-winter. Young leaves and blue blossoms may be used in salads. Provides spring forage for honey bees and blooms into the summer.

Echium (*Echium vulgare*, and other species) Shrub that is used by bees for both nectar and pollen (pollen is a dark blue color). Depending on the climate, it will bloom in the spring with repeat blooms. Fall bloom can provide nectar for bees overwintering. The most unusual feature of Echium vlgare is the protection of the nectar inside the flower from vaporization when it is hot out, or flushing away when it rains. These features provide a nearly constant source of nectar for bees for months at a time. In addition, it produces nectar throughout the day unlike most plants which produce nectar for a short period of time.

Goldenrod (*Solidago*, various species) Perennial plant bees use mostly for nectar (the pollen granules can be too big for honey bees, but might use if nothing else is available). Goldenrod bloom from July through September, and so it is important for the timing of a colony preparing for winter. It has a long bloom period of 25 days, grows anywhere and can be invasive. It is a medicinal plant that helps with fungus, especially in the urinary tract.

Melissa (*Melissa officinalis*) Also called Lemon Balm, it is a perennial medicinal herb providing nectar. It has a prolonged bloom of 45 to 50 days generally in summer.

Phacelia, Tansy (*Phacelia tanacetifolia*) An annual that produces nectar and pollen that honey bees can use. This is one of the best spring forage sources for honeybees. Blooms 45 to 60 days and continuously produces nectar throughout the day. Can be seeded several times per year.

Attracting Native Pollinators

By: Kathy Van Mullekom, Newport News, Va., Daily Press

The troubled lives of honeybees get a lot of media attention.

Yet, many other pollinators are in serious trouble, according to Eric Mader, assistant pollinator program director with The Xerces Society for Invertebrate Conservation. "In some cases, their fates are potentially worse," he says. "For example, a number of our roughly 50 native bumblebee species are in precipitous decline, with a couple of species likely having gone extinct in recent years, and a few other possibly teetering on the brink of extinction.

"Similarly, the once ubiquitous monarch butterfly has declined to some of the lowest population levels ever documented since scientists first began tracking their numbers in the 1970s. "While the monarch butterfly is not going to become extinct anytime soon, the mass annual migration of monarchs across North America is dwindling, and leaving our experience of the natural world poorer as a consequence."

These alarming declines in pollinators motivated the society, founded in 1971 and named after the extinct Xerces blue butterfly, to author the just-released book, "Attracting Native Pollinators: Protecting North America's Bees and Butterflies." The 384-page, softback book features chapters that cover why you should care about pollinators, biology of pollination, threats to pollinators and how you can help pollinators.

"The book, while ostensibly 'about native pollinators' is really a vehicle intended to reconnect people to the greater ecology of the world around them," says Mader. Which is why it's written in an easy-to-read manner for everyday people. Simple garden designs are outlined for residential gardens, school and office sites, roadside plantings, riparian buffers and field-like habitats. Its many full-color photographs and illustrations offer appeal to schoolage children.

Chapters in the back of the book profile native pollen and nectar plants for all planting regions and suggest host plants for the caterpillars that morph into butterflies.

Why care about pollinators?

Even if you have no green thumb, these tiny creatures have a profound impact on your daily life because more than a third of our food supply relies on the plants they pollinate. "We all eat food produced by pollinators, whether it is insect-pollinated fruits or vegetables, or even meat or dairy products produced by animals that are fed insect-pollinated forage crops like alfalfa or clover," says Mader.

"Pollinators contribute to higher cotton yields, which impact the prices of our clothing, and pollinators produce a number of oilseed crops like canola, which are increasingly

being used for energy."

Importantly, pollinators are also central to biodiversity of the natural world by helping native plants reproduce, producing fruits and seeds that feed other wildlife such as songbirds and grizzly bears.

Important little-known pollinator
Our roughly 4,000 species of native bees, as a group, are overlooked, according to Mader. Many people assume the honeybee is native to North America, but, in fact, it was first imported by Europeans in the 1600s.

"Our native bees represent an amazing diversity of species," he says. "They range from large bumblebees that form social colonies of a single queen and her daughter-workers, to tiny metallic blue or green sweat bees that excavate nests in the ground and live solitary lives, laying few eggs on a pollen provision and not living long enough to see their offspring hatch."

These native bees have complex life cycles. Some nest inside snail shells, some construct elaborate origami-like nests out of carefully folded leaf pieces. And, they have cozy relationships with specific native plants, emerging for only a few weeks each year when their preferred wildlife blooms. And, contrary to popular belief, most of our native bees are gentle creatures that do not sting.

"If fact, a number of our native bees have stingers too weak to even penetrate human skin," he says.

How you can help pollinators
Pollinators thrive in landscapes with weedy, slightly overgrown gardens and big spreading patches of wildflowers.

No yard or farm? You help pollinators when you plant wildflowers in containers on a small balcony.

"Pollinator conservation in some settings can be as simple as putting away the mower and planting wildflowers in your lawn," says Mader.

"Especially if you include a diversity of native flowering plants in your landscape so there is a succession of different species blooming throughout the year. By including a diversity of native flowering plants, you also support a diversity of different types of pollinators. "Aside from flowers, pollinators need refuge from pesticides, and messy areas of twigs, brush piles, stones and other natural shelter to lay their eggs and to spend the winter."

Pollinator pointers
No matter where you live, the common denominators to pollinator conservation are

simple, according to The Xerces Society:

- Plant flowers, lots of them.
- Use as many native plant species as possible.
- Don't use pesticides.

About the book

"Attracting Native Pollinators: Protecting North America's Bees and Butterflies," a guide by The Xerces Society, looks into the world of pollinators, including bees, wasps, flies, beetles, butterflies and moths. The 384-page softback book highlights the roles of these insects in home gardens, farms, parks and natural areas. Included are regional lists of bee-friendly wildflowers, advice on building nests and plans for pollinator gardens, meadows and other landscapes. $29.95; Storey Publishing, Storey.com.

Help the bees

Are you ready to help the bees? The Xerces Society has three online resources that enable you to take the next step:

Pollinator Seed Store, where you buy regional wildflower seed mixes that provide season-long blooms on pollinator-friendly plants; mixes are locally produced in their respective regions by independent farmers — xerces.org/pollinator-seed.

Pollinator Conservation Resources Center, where you find additional information to help protect pollinators — xerces.org/pollinator-resource-center.

Great Sunflower Project, encourages all ages, preschoolers to scientists, to plant a sunflower and count how many bees visit in 15 minutes — greatsunflower.org.

Appendix G

Raising Mealworms -- Observing Metamorphosis

Source: *Insectigations,* by Cindy Blobaum

Mealworms are one of the easiest animals to raise from egg to adult to egg again. Mealworms earned their name because they are often found in containers of cornmeal and cereal. In nature, they they can be found under rocks or the bark of rotting logs. If you don't want to go on a mealworm hunt through your house or backyard, you can pick some up at a pet store where they sell them as food for reptiles and amphibians.

Materials:

a clear shoe box or food keeper with a lid
Oatmeal or bran cereal
Potato, carrot, or apple slices
Mealworms
Fine-tip permanent markers of various colors
Ruler

Poke 50 or 60 small holes in the lid of the box to ensure enough aeration. Spread an inch or two of oatmeal or bran cereal on the bottom to provide food for both the larvae and adults. Since these insects get their water from the food they eat, add a slice of potato, carrot, or apple. Be sure to replace these every few days so you don't grow mold instead of mealworms! Add the mealworms to the box.

The larvae will be more active if you keep them in a warm (70-80 degrees F), dark place, but light and cooler temperatures will not hurt them. In nature, it can take nine months or more for mealworms to complete a life cycle. In your box, it will probably take only between 76 and 136 days. Mealworms hatch from their eggs after about six to 14 days, grow and molt as larvae for 60 to 120 days, pupate for about 10 days, and finally emerge as adult darkling beetles. Use fine tip permanent markers to make a small dot or

two on mealworm eggs and larvae. For example, eggs laid on September 10 might have one orange dot, while eggs laid on September 15 might have one orange dot and one blue dot. The larvae that emerge from those eggs get the same code. Record your color code in a journal to keep track of the development of each egg and larva.

Journal Example

Color code:

- How long did each stage last?
- How long is each instar larva (instar is the stage of development between two molts)
- How many instars does a mealworm go through? (a honey bee goes through 5)
- What color is the adult when it first emerges from the pupa? What color is it after one hour? After one day?

Appendix H
Two Biographies: L.L. Langstroth and Karl Von Frisch

L.L. Langstroth

From Wikipedia
http://en.wikipedia.org/wiki/LL_Langstroth

Rev. **Lorenzo Lorraine Langstroth** (December, 25, 1810 – October 6, 1895), apiarist, clergyman and teacher, is considered the "Father of American Beekeeping."

L. L. Langstroth was born in Philadelphia, Pennsylvania. As a youngster, he took such an extraordinary interest in observing the habits of insects that he was punished for wearing holes in the knees of his pants while learning all he could about ant life. He graduated from Yale University in 1831, and subsequently held a tutorship there in 1834-1835. After this he was pastor of various Congregational churches in Massachusetts, including the South Congregational Church in Andover, Massachusetts in May 1836. In 1848, Langstroth became principal of a young ladies' school in Philadelphia. He took up beekeeping in part to distract himself from severe bouts of depression. He married Anne Tucker (1812—23 January 1873) of Massachusetts. They had three children, all born in Massachusetts: James (1837), Anna (1841) and Harriet A. (1847).

The Leaf Hive, invented in Switzerland in 1789 by Francis Huber, was a fully movable frame hive, but had solid frames that were touching and made up the "box". The combs in this hive were examined like pages in a book. Langstroth acknowledged Huber's contribution: "The use of the Huber hive had satisfied me, that with proper precautions the combs might be removed without enraging the bees, and that these insects were capable of being tamed to a surprising degree. Without knowledge of these facts, I should have regarded a hive permitting the removal of the combs, as quite too dangerous for practical

use."

Langstroth revolutionized the beekeeping industry by using bee space in his top-opened hive. In the summer of 1851 he found that, by leaving an even, approximately bee-sized space between the top of the frames holding the honeycomb and the flat coverboard above, he was able to quite easily remove the coverboard, which was normally well cemented to the frames with propolis, making separation hard to achieve. He later used this discovery to make the frames themselves easily removable. He found that, if he left a small space (less than 1/4 inch or 6.4 mm) between the combs, or between the combs and the sides of his hives, the bees filled it with propolis, cementing the combs into the hive. On the other hand, when he left a larger space (more than 3/8 inch or 9.5 mm), the bees filled it with comb.

On 5 October 1852, Langstroth received a patent on the first movable frame beehive in America. A Philadelphia cabinetmaker, Henry Bourquin, a fellow bee enthusiast, made Langstroth's first hives for him and by 1852 Langstroth had more than a hundred of these hives and began selling them where he could. Langstroth spent many years attempting to defend his patent without success. He never earned any royalties because the patent was easily and widely infringed. Langstroth hives are still in common use today.

He wrote that "... the chief peculiarity in my hive was the facility with which they could be removed without enraging the bees .... I could dispense with natural swarming, and yet multiply colonies with greater rapidity and certainty than by the common methods .... feeble colonies could be strengthened, and those which had lost their queen furnished with the means of obtaining another. .... If I suspected that anything was wrong with a hive, I could quickly ascertain its true condition, and apply the proper remedies."

Langstroth also found that several communicating hive boxes can be stacked one above another, and that the queen can be confined to the lowest, or brood, chamber, by means of

a queen excluder. In this way, the upper chambers can be reached only by the workers, and therefore contain only honey-comb. This made hive inspection and many other management practices possible, and turned the art of beekeeping into a full-scale industry. At the time of Langstroth's contributions, honey was the chief sweetener in American diets, so Langsrtoth's new beekeeping techniques were of great importance. His discoveries and inventions allowed beekeeping to be done more cost-effectively on a large scale. His was the first design to use comb that was enclosed on four sides by a wooden frame and surrounded by a "bee space", allowing for the easy removal and reuse of the comb. Since four to twelve pounds of honey, and many hours of bee time, are consumed by bees in the production of one pound of beeswax, honey production was increased from reuse of the comb. Also, being able to remove surplus honey without having to kill the bees meant that many more bees were available the following spring to gather honey.

In 1853, Langstroth published *The Hive and the Honey-Bee* (Northampton (Massachusetts): Hopkins, Bridgman, 1853), which provided practical advice on bee management and, after more than 40 editions, is still in print today. *Langstroth on the Honey Bee* was published in 1860.

After 1858 Langstroth made Oxford, Ohio, his residence, and devoted his time to beekeeping. The site was 10 acres (40,000 m^2) and was an ideal place to keep bees. Langstroth planted a row of Linden trees along the street and apple trees throughout his property. He sowed buckwheat and clover seed, using 1-acre (4,000 m^2) of ground for a formal garden, filled with the flowers that bees like best, calling it his honey garden. The home where he lived from 1858 to 1887 was built in 1856 and is now called Langstroth Cottage; it is designated a National Historic Landmark. It was donated to Western College for Women and is today home to the Miami University Center for the Enhancement of Learning and Teaching.

Langstroth received his first Italian bees at his home in 1863; Italian bees were more

productive than the other European bees that were most common in America at the time. He and his son sold Italian queens at 20 dollars each and in one year sold 100 of them, many being sent by post all over the United States.

In 1887, he moved with his daughter, Mrs. H. C. Cowan, and her family to Dayton, Ohio. Langstroth died in the pulpit of the Wayne Avenue Presbyterian Church in Dayton, just as he was beginning a sermon on the love of God. He is buried at Woodland Cemetery, Dayton, Ohio. His epitaph reads as follows:

> Inscribed to the memory of Rev. L.L Langstroth, "Father of American beekeeping," by his affectionate beneficiaries who, in the remembrance of the service rendered by his persistent and painstaking observations and experiments with the honey bee, his improvements in the hive, and the literary ability shown in the first scientific and popular book on the subject of beekeeping in the United States, gratefully erect this monument.

The 1885-1895 papers of Lorenzo L. Langstroth are located at the American Philosophical Society Library in Philadelphia.

Karl Von Frisch

From Wikipedia -- http://en.wikipedia.org/wiki/Karl_von_Frisch#cite_note-4

Karl Ritter von Frisch (20 November 1886 – 12 June 1982) was an Austrian ethologist, (a zoologist who studies animal behavior), who received the Nobel Prize in Physiology or Medicine in 1973, along with Nikolaas Tinbergen and Konrad Lorenz.

His work centered on investigations of the sensory perceptions of the honey bee and he was one of the first to translate the meaning of the waggle dance. His theory was disputed by other scientists and greeted with skepticism at the time. Only recently was it definitively proved to be an accurate theoretical analysis.

Karl von Frisch was the son of the surgeon and urologist Anton Ritter von Frisch (1849-1917) and his wife Marie, née Exner. He was the youngest of four sons, all of whom became university professors. He studied in Vienna initially in the field of medicine but later turned to the natural sciences. He received his doctorate in 1910 and in the same year started work as an assistant in the zoology department of Munich University. In 1912 he became a lecturer in zoology and comparative anatomy there; and in 1919 was promoted to a professorship. In 1921 he went to Rostock University as a professor of zoology and director of an institute. In 1923 he accepted the offer of a chair at Breslau University, returning in 1925 to Munich University, where he became the head of the institute of zoology. After that institute was destroyed in World War II, he went to the University of Graz in 1946, remaining there until 1950 when he returned to the Munich institute after it was reopened. He retired in 1958 but continued his research.

Karl von Frisch married Margarete, née Mohr. Their son, Otto von Frisch, was director of the Braunschweig natural history museum between 1977 and 1995. Karl von Frisch studied the European honey bee (Apis mellifera carnica).

Bee Perception

Sense of smell: Frisch discovered that bees can distinguish various blossoming plants by their scent, and that each bee is "flower constant". Surprisingly, their sensitivity to a "sweet" taste is only slightly stronger than in humans. He thought it possible that a bee's spatial sense of smell arises from the firm coupling of its olfactory sense with its tactile sense.

Optical perception: Frisch was to first to demonstrate that honey bees had color vision, which he accomplished by using classical conditioning. He trained bees to feed on a dish of sugar water set on a colored card. He then set the colored card in the middle of a set of gray-toned cards. If the bees see the colored card as a shade of gray, then they will confuse the blue card with at least one of the gray-toned cards; bees arriving to feed will visit more than one card in the array. On the other hand, if they have color vision, then the bees visit only the blue card, as it is visually distinct from the other cards. A bee's color perception is comparable to that of humans, but with a shift away from the red toward the ultraviolet part of the spectrum. For that reason bees cannot distinguish red from black (colorless), but they can distinguish the colors white, yellow, blue and violet. Color pigments which reflect UV radiation expand the spectrum of colors which can be differentiated. For example, several blossoms which may appear to humans to be of the same yellow color will appear to bees as having different colors (multicolored patterns) because of their different proportions of ultraviolet.

Powers of orientation: Frisch's investigation of a bee's powers of orientation were significant. He discovered that bees can recognize the desired compass direction in three different ways: by the sun, by the polarization pattern of the blue sky, and by the earth's magnetic field, whereby the sun is used as the main compass, with the alternatives reserved for the conditions arising under cloudy skies or within a dark beehive.

Polarization pattern: Light scattered in a blue sky forms a characteristic pattern of

partially polarized light which is dependent on the position of the sun and invisible to human eyes. With a UV receptor in each of the lens units of a compound eye, and a UV filter oriented differently in each of these units, a bee is able to detect this polarization pattern. A small piece of blue sky is enough for a bee to recognize the pattern changes occurring over the course of a day. This provides not only directional but also temporal information.

Variations in the daytime position of the sun: Karl von Frisch proved that variations in the position of the sun over the course of a day provided bees with an orientation tool. They use this capability to obtain information about the progression of the day deep inside a dark beehive comparable to what is know from the position of the sun. This makes it possible for the bees to convey always up-to-date directional information during their waggle dance, without having to make a comparison with the sun during long dance phases. This provides them not only with alternative directional information, but also with additional temporal information.

Internal clock: Bees have an internal clock with three different synchronization or timekeeping mechanisms. If a bee knows the direction to a feeding place found during a morning excursion, it can also find the same location, as well as the precise time at which this source provides food, in the afternoon, based on the position of the sun.

Horizontal orientation of the honeycomb: Based on the magnetic field, the alignment of the plane of a honeycomb under construction (e.g., the new honeycomb of a swarm) will be the same as that of the home hive of the swarm, according to Karl von Frisch. By experiment, even deformed combs bent into a circle can be produced.

Sensing the vertical: The vertical alignment of the honeycomb is attributed by Karl von Frisch to the ability of bees to identify what is vertical with the help of their head used as a pendulum together with a ring of sensory cells in the neck.

Dances as language

Knowledge about feeding places can be relayed from bee to bee. The means of communication is a special dance of which there are two forms:

Round dance

The "round dance" provides the information that there is a feeding place in the vicinity of the beehive at a distance between 50 and 100 meters, without the particular direction being given. By means of close contact among the bees it also supplies information about the type of food (blossom scent).

> "The foraging bee...begins to perform a kind of "round dance". On the part of the comb where she is sitting she starts whirling around in a narrow circle, constantly changing her direction, turning now right, now left, dancing clockwise and anti-clockwise, in quick succession, describing between one and two circles in each direction. This dance is performed among the thickest bustle of the hive. What makes it so particularly striking and attractive is the way it infects the surrounding bees; those sitting next to the dancer start tripping after her, always trying to keep their outstretched feelers on close contact with the tip of her abdomen....They take part in each of her manoeuvrings so that the dancer herself, in her mad wheeling movements, appears to carry behind her a perpetual comet's tail of bees (Karl Von Frisch, *The Dancing Bees).*"

The "waggle dance" is used to relay information about more distant food sources. In order to do this, the dancing bee moves forward a certain distance on the vertically hanging honeycomb in the hive, then traces a half circle to return to her starting point, whereupon the dance begins again. On the straight stretch, the bee "waggles" with her posterior. The direction of the straight stretch contains the information about the direction of the food source, the angle between the straight stretch and the vertical being precisely the angle which the direction of flight has to the position of the sun. The distance to the food source is relayed by the speed of the dance, in other words, by the number of times the straight

stretch is traversed per unit of time. The other bees take in the information by keeping in close contact with the dancing bee and reconstructing its movements. They also receive information via their sense of smell about what is to be found at the food source (type of food, pollen, propolis, water) as well as its specific characteristics. The orientation functions so well that the bees can find a food source with the help of the waggle dance even if there are hindrances they must detour around like an intervening mountain.

As to a sense of hearing, Karl von Frisch could not identify this perceptive faculty, but it was assumed that vibrations could be sensed and used for communication during the waggle dance.

Appendix I -- Beekeepers and Teachers Surveys

Beekeepers

1. Welcome!

Thank you for taking a few minutes to share your experience with beekeeping. This survey is part of a research study I am conducting for a masters thesis at Antioch University New England. I am collecting information about bees and beekeeping that can be used in the elementary curriculum for Waldorf teachers.

A central goal of the Waldorf curriculum is to engender a love of all beings, yet insects are rarely or only cursorily introduced. There is a wealth of resources available for hobbyists and commercial beekeepers, but it is often more information than most busy elementary teachers have time to digest or apply. The information you provide will help me understand small-scale beekeepers' perspectives and stimulate ideas for teachers who want to involve honey bees in their teaching.

The survey is voluntary and all responses are confidential. It should take about 10 minutes. If you are willing to participate further in an in-person or phone interview, there is space at the end to provide your contact information. Thank you, I am grateful for your time.

1. How many years have you been beekeeping?

- ◯ Less than 1 year
- ◯ 2 to 3 years
- ◯ 4 to 5 years
- ◯ 6 to 7 years
- ◯ 8 to 9 years
- ◯ 10 to 15 years
- ◯ Over 15 years

2. Where do you live?

State/Province: _____

Country: _____

3. Please characterize the location of your hive(s).

- ◯ Rural (primarily surrounded by farms or wilderness)
- ◯ Semi-rural (some houses or other development nearby)
- ◯ Suburban (largely surrounded by houses or commercial buildings)
- ◯ Urban (densely developed area)

Beekeepers

4. What is your age?

- ◯ 18 to 24 years old
- ◯ 25 to 35
- ◯ 36 to 45
- ◯ 46 to 55
- ◯ 56 to 65
- ◯ Over 65

5. What was the MOST important source of INSPIRATION for you to start beekeeping?

- ◯ Family member
- ◯ Neighbor
- ◯ Friend
- ◯ Something you read or watched
- ◯ Teacher or college course
- ◯ 4-H or other youth experience
- ◯ One-time workshop
- ◯ Other

6. What was the PRIMARY spark of interest that led you to START beekeeping?

- ◯ Honey and/or other bee products for personal use
- ◯ Honey and/or other bee products for commercial use
- ◯ Queen production for commercial use
- ◯ Scientific or academic interest
- ◯ Other personal or spiritual interest
- ◯ Enhance own farm or garden
- ◯ Enhance surrounding local ecology
- ◯ Other

Beekeepers

7. What was the MOST helpful source of INFORMATION for you to start beekeeping?

- ◯ Books/Manuals
- ◯ Websites
- ◯ List serves or other on-line groups
- ◯ Workshops or field days
- ◯ Friends
- ◯ Family members
- ◯ Extension agents
- ◯ Beekeeping suppliers

*** 8. Please share any additional thoughts about important sources of information or inspiration for you to start or continue beekeeping. If you answered "other" in the previous questions, please specify to what it refers.**

*** 9. What is your favorite aspect of beekeeping now?**

10. What type(s) of hive do you use? Check all that apply.

- ☐ Langstroth
- ☐ Modified Langstroth
- ☐ Warre
- ☐ Top Bar
- ☐ Other (please specify in next question)

*** 11. Please share why you choose to use one hive type over another.**

Beekeepers

12. What types of honey bees do you have?

- ☐ Italian
- ☐ Carniolan
- ☐ Russian
- ☐ Caucasian
- ☐ Other (please specify in next box)
- ☐ Don't know

*** 13. Please share why you chose this type (or these types) of bees.**

14. How many hives do you have (total). Please add up multiple locations if applicable.

- ◯ 1
- ◯ 2 to 5
- ◯ 6 to 10
- ◯ 11 to 20
- ◯ Over 20

15. Have you ever experienced the loss of a hive?

- ◯ Yes
- ◯ No

16. If yes, what was the reason for the loss of the hive? If there have been several losses, please explain the primary reasons for the losses. If you aren't sure, please share what you think are the reasons.

Beekeepers

17. What is the primary way you obtain your queen(s)?

- ◯ Regularly purchase new from a breeder/supplier each year or two
- ◯ Purchase new from a breeder/supplier only when own hive(s) fail to produce a new queen
- ◯ Self propagated in own hive
- ◯ Swarm capture (other than own swarm re-capture)
- ◯ Other

18. Do you gain income from your bees?

- ◯ Yes
- ◯ No

19. If yes, what are the primary ways you create income with your bees? (Answer all that apply.)

- ☐ Pollination services to farmers
- ☐ Honey sales
- ☐ Other bee products sales
- ☐ Queen sales
- ☐ Teaching/Demonstrations/Workshops
- ☐ Other (please specify below)

*** 20. Please share additional thoughts about your experience with earning income as a beekeeper. What kinds of challenges do you have, etc.?**

*** 21. In your experience, what is the biggest misconception people have about bees or beekeeping?**

*** 22. What do you feel are the biggest problems honey bees face today?**

Beekeepers

23. Please share anything more you would like me to know about honey bees or beekeeping. Your thoughts about educating teachers and elementary school children about honey bees are especially welcome.

24. If you are willing to speak with me in an interview about your experience with bees, I would greatly appreciate it. Please provide your name and email address below and I will contact you to arrange a time. Thank you very much. And thank you for your work with honey bees!

Teachers

1 Welcome!

Thank you for taking time to complete this survey about insects, honey bees and the Waldorf curriculum. My name is Lauren Johnson and I am an assistant teacher at Portland Waldorf School in Oregon and in my third year of the summer sequence teacher training at Antioch University New England. With information gathered from this survey, a survey to beekeepers, and other research, I hope to create a resource guide for Waldorf teachers who would like to involve honey bees in their class teaching.

The survey is voluntary and responses will be confidential unless you are willing to participate further in an in-person interview or wish to be cited directly. Completion of this survey implies consent to be involved in this research. Please try to answer the questions as thoroughly as you can. The entire survey should take about 10 minutes.

1. How many years have you been teaching in a Waldorf setting?

- ◯ Less than 1 year
- ◯ 2-3 years
- ◯ 4-5 years
- ◯ 6-7 years
- ◯ 7-8 years
- ◯ 9-15 years
- ◯ More than 15 years

*** 2. In what town/city and state/province do you teach?**

City/Town:

State/Province:

3. If you have other teaching experience, please specify how many years and what settings (outdoor education, special ed, public elementary, etc.)

Teachers

4. What grade level are you now primarily teaching? If you are a subject teacher, please answer "other."

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ other

5. If you are a subject teacher (games, foreign language, handwork, etc.), please specify what subject you primarily teach.

6. How important is it for you to integrate insects in any way into your lesson planning?

- ◯ 1 Not important
- ◯ 2 Somewhat important
- ◯ 3 Very important

*** 7. Why did you answer question #6 in that way? Please share any thoughts or reasons you have for your response.**

8. Have you looked for information or teaching materials about insects (or specifically honey bees) for your teaching?

- ◯ Yes
- ◯ No

Teachers

9. If applicable, how satisfied with the information or teaching materials on insects or honey bees have you been?

- ◯ 1 Not at all satisfied
- ◯ 2 Somewhat satisfied
- ◯ 3 Very satisfied

* 10. Please comment on your answer to #9. What about the materials were helpful or not helpful?

11. Please name any specific resources you have found helpful in your teaching about insects and/or honey bees.

12. If applicable, please identify the grade(s) in which you have involved insects and/or honey bees or beekeeping in your lessons.

- ☐ Not applicable
- ☐ Grade 1
- ☐ Grade 2
- ☐ Grade 3
- ☐ Grade 4
- ☐ Grade 5
- ☐ Grade 6
- ☐ Grade 7
- ☐ Grade 8

13. If applicable, please name the block(s) and/or other activities in your classes that have involved insects and/or honey bees or beekeeping. Please be specific about the grade levels or seasons of the year that might be relevant.

Teachers

14. Does your school have bee hives on site?

- ◯ Yes
- ◯ No

15. If your school does NOT have bee hives, what do you think are the primary reasons for this?

16. If your school does have bee hives, who cares for them?

17. Please share any other thoughts you have about involving insects or honeybees in your classroom or school activities.

18. Thank you! If you wish to share your name and e-mail or other contact information, please do so here. It would be beneficial to my research to speak directly with teachers about their experiences related to insects or honey bees. I am especially interested in your challenges or hesitations if you have never involved insects or honey bees into your work with children. All references to this survey or subsequent interviews will remain confidential.

With warm regards for your work,
Lauren Johnson

A Honey Bee Glossary

Adapted from www.backyardbeekeepers.com and Wikipedia. (information downloaded May 8, 2011)

Beeswax: Material produced from the glands found in the abdomens of worker bees and used to build combs. Typically, for a beekeeper, 10 pounds of honey yields 1 pound of wax. The new wax scales are initially glass-clear and colorless, becoming opaque after mastication by the worker bee. The wax of honeycomb is nearly white, but becomes progressively more yellow or brown by incorporation of pollen oils and propolis. The wax scales are about 3 millimeters (0.12 in) across and 0.1 millimeters (0.0039 in) thick, and about 1100 are required to make a gram of wax.

Drones: Male bees, whose main function in the colony is to fertilize the queen. Drones make up a very small percentage of the total colony. In the Autumn drones are expelled from the hive by the female worker bees.

Foundation: Thin sheets of beeswax imprinted with a pattern of honey comb. The beekeeper installs these sheets into wooden frames as "starters" for the bees in making uniform combs. This is not a recommended practice for holistic or biodynamic beekeeping where it is preferred to allow the bees to form cells of varying sizes to rear drones and queens or otherwise adapt to local conditions.

Frames: The removable wooden structures which are placed in the hive. The bees build their comb within these frames. The removable quality allows the beekeeper to easily inspect the colony. Warre and Top Bar hives have only the top part of the frame, allowing the wax comb to be built in a shape that the bees create naturally.

Hive Bodies: The first one or two wooden boxes of the colony in a Langstroth hive. The hive bodies contain the brood nest of the colony.

Larva: The grub-like, immature form of the bee, after it has developed from the egg and before it has gone into the pupa stage.

Nectar: Sweet fluid produced by flowers is 60% water and 40% solids. This is collected by the bees and converted into honey at 17 -18% moisture content.

Pollen: Very small dust-like grain produced by flowers. These are the male germ cells of the plant. Bees collect 66 lbs of pollen per year, per hive. Pollen is the male germ cells produced by all flowering plants for fertilization and plant embryo formation. The Honeybee uses pollen as a food. Pollen is one of the richest and purest natural foods, consisting of up to 35% protein, 10% sugars, carbohydrates, enzymes, minerals, and

vitamins A (carotenes), B1 (thiamin), B2 (riboflavin), B3 (nicotinic acid), B5 (panothenic acid), C (ascorbic acid), H (biotin), and R (rutine).

Propolis: Sticky, brownish gum gathered by bees from trees and buds and used to seal cracks and drafts in the hive. Also called "bee-glue".

Pupa: The immature form of the bee (following the larval stage) while changing into the adult form.

Queen: A completely developed female bee (with functioning ovaries) who lays eggs and serves as the central focus of the colony. There is only one queen in a colony of bees. A queen's productive life span is 2-3 years.

Royal Jelly: The milky white secretion of young nurse bees. It is used to feed the queen throughout her life, and is given to worker and drone larvae only during their early larval lives.

Super: The supplementary wooden boxes places on top of the hive body the expand the size of the colony, and to provide for storage of surplus honey.

Supercedure: When a colony with an old or failing queen rears a daughter to replace her.

Workers: Completely developed female bees that do have developed ovaries and do not normally lay eggs. They gather pollen and nectar and convert the nectar to honey. A worker's life expectancy is only several weeks during the active summer months. However, they can live for many months during the relatively inactive winter period.

Venom: Also called apitoxin, and similar to nettle toxin, is a colorless liquid comprised of formic acid and a complex mixture of proteins, which causes local inflammation and acts as an anticoagulant. The venom is produced in the abdomen of worker bees. A honeybee can inject 0.1 mg of venom via its stinger. It is estimated that 1% of the population is allergic to bee stings. Bee venom therapy is widely practiced overseas and by some in the USA to address health problems such as arthritis, neuralgia, high blood pressure, high cholesterol and multiple sclerosis.

Honey Bee Math

Adapted from University of Arizona College of Agriculture and Life Sciences

Use the following information about European honey bees to answer the questions below.

- Maximum number of eggs laid daily by the queen: 2,500 eggs
- Average number of days a worker bee needs to complete all developmental stages from egg to adult: 21 days
- Average length of time worker bees live during the spring and summer: 42 days
- Average length of time worker bees live during the winter: 135 days

1. How long would it take for a colony of honey bees to lay 10,000 eggs?
Answer: 2,500 laid the first day + 2,500 laid the second + 2,500 laid the third + 2,500 laid the fourth day = 4 days

2. What is the maximum number of eggs that one European honey bee queen can produce in a year?
Answer: 365 x 2,500 = 912,500!

3. The maximum number of worker bees in a well-managed hive is about 80,000. How many days would it take for an European honey bee queen to lay that many eggs?
Answer: 80,000 eggs/ 2,500 eggs per day = 32 days

++

Use the following information about European honey bees to answer the questions below.

- The worker bee weighs 80 milligrams.
- Her honey crop will hold 70 milligrams of nectar,
- Her pollen baskets will hold 20 milligrams of pollen.
- Workers can fly 12 to 15 miles per hour
- Workers will average 8 to 12 trips from the hive each day
- An average distance of 1 1/2 miles from the hive.

1. If a worker bee flies 15 miles per hour from the colony to a pollen and nectar source 3/4 miles away, how long does it take her to complete one trip?
[6 minutes]

2. If a worker bee makes 10 round trips from the colony to the nectar source 3/4 miles away, how many miles does she travel all together?
[15 miles]

3. If a worker bee makes 10 complete trips to get food 3/4 miles away by flying 15 miles per hour, how much time has she spent flying?
[One hour]

4. If a worker bee can carry 90 milligrams of nectar and pollen each trip, how much total weight has she carried after making 10 trips?
[900 milligrams]

5. Based on your answer for problem 4, how many grams of weight does the worker bee carry all together?
[.90 grams or almost 1 gram]

6. How does the total weight carried by the worker bee after making 10 trips compare to her body weight?
[11.25 times her body weight]

7. Of the total weight carried (in milligrams), how much of the weight was from carrying nectar and how much of the weight was from carrying pollen?
[700 milligrams of nectar, 200 milligrams of pollen]

From: *Africanized Honey Bee Curriculum*, developed by Betsy A. Leonard, H. Steven Dasher, and Karen L. Robb. Published by the University of California Cooperative Extension Farm and Home Advisor's Office, San Diego, CA., 1994.

Appendix K -- Recipe

Visit the National Honey Board website: www.honey.com for more recipes. Note that this is the official site for the commercialization of honey and take care to learn about how to find local, sustainably-harvested or organic honey. There is no central authority for this information, but a good start is your closest beekeeping association or organic or biodynamic farm.

The following recipe and introduction is taken from Stephen Buchmann's, *Letters from the Hive* (2005), pp 175-176.

Gingerbrede

Gingerbread was a popular staple throughout medieval and Renaissance Europe. The recipe below is not significantly different from those found in 15th and 16th century manuscripts. Gingerbread was traditionally boiled rather than baked and was usually stamped with decorative designs. You may with to express your own creativity with a cookie or butter press while your loaf is still warm and malleable.

Serves 8

1 cup honey	1/8 teaspoon ground cinnamon
1 teaspoon powdered ginger	1 tablespoon anise (fennel) seeds
1/8 teaspoon ground cloves	1 ¾ cup dry bread crumbs

Heat the honey in the top of a double boiler. Add all the spices except the anise seeds and stir to blend. Now add the bread crumbs and mix thoroughly. Cover and cook over medium heat for 15 minutes. The mixture should be thick and moist. Place the gingerbread on a large sheet of waxed paper and mold the dough into small rectangular shapes. Sprinkle the anise seeds on top and press them gently into the dough with the side of a knife. Allow to cool, then cover and refrigerate for 2 hours. Serve at room temperature in thin slices.

Appendix L -- Further Resources

See also References for a complete list used in this paper.

On-Line Resources

Beekeeping Associations are a good way to meet local beekeepers and get started with beekeeping. Not all espouse holistic or organic methods, but are still valuable for someone interested in connecting to bees.

Master Gardener Networks -- often administered through the state university extension service. Not always organic/sustainable, but still a very good resource

Spikenard Farm and Honeybee Sanctuary is a good source for biodynamic inspiration and contacting master beekeeper Gunther Hauk. www.spikenardfarm.org

The Melissa Garden www.themelissagarden.com is a biodynamic bee sanctuary using the Bien as its organizing principle

Pfeiffer Center for biodynamic agriculture and beekeeping, also good resource for the Outdoor Lesson and a biography of Ehrenfried Pfeiffer, www.pfeiffercenter.org

www.beesource.com is widely recommended by beekeepers

www.bushfarms.com is widely recommended by beekeepers

www.Beethinking.com has helpful information for Warre hive and top bar hive use and construction.

www.biobees.com -- beekeeping forum

OrganicBeekeepers@yahoo.com is a busy list serve committed to natural beekeeping

Xerces Society for Invertebrate Conservation -- great for learning about native bees and other pollinators -- visit www.xerces.org/educational-resources/ for helpful links for teachers and school gardens, including the Great Sunflower Project (www.greatsunflower.org)

Queen of the Sun: What are the bees telling us? Documentary Film website: www.queenofthesun.org

Ron Breland and his work building sacred geometric beehives (visit YouTube.com for short videos to view) an interview can be found here: http://www.himalayaninstitute.org/Yogaplus/Article.aspx?id=3020

Children's books recommended by Waldorf Teachers:

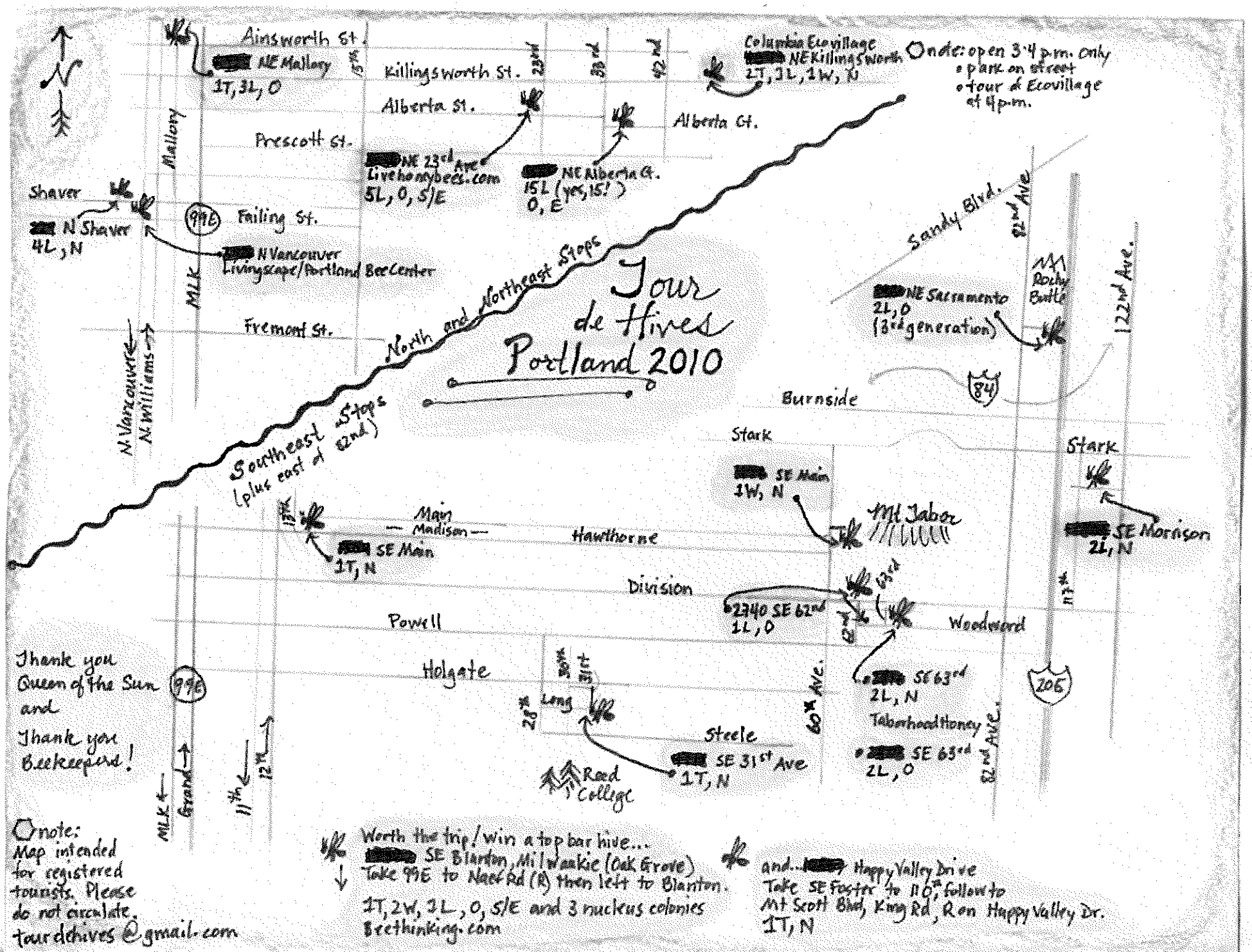
- *The Life and Times of the Honeybee* by Charles Micucci
- *In the Trees, Honeybees* by Lori Mortenson
- *The Bee Book* by Jacob Streit (AWSNA books) (read aloud or grades 3-4)
- *The Bee Who Lost His Buzz* by Reg Down (early childhood)

Classics in Beekeeping

- *American Bee Journal* -- past and present online at www.americanbeejournal.com
- *The History of American Beekeeping*, Frank Pellett
- *The Hive and the Honeybee*, Charles Dadant and Sons
- *Langstroth on The Hive and the Honey-bee (1853)*
- *Fifty Years Among the Bees*, CC Miller
- *Social Life in the Insect World*, Jean-Henri Fabre
- *ABC and XYZ of Beekeeping*, AI Root

Other Resources Recommended by Beekeepers and Waldorf Teachers

- *Drawing from the Book of Nature*, Dennis Klocek
- *Bees: Nature's Little Wonder*, Candace Savage
- *Bees, Wasps and Ants*, Eric Grisell
- *The Buzz About Bees: The Biology of a Superorganism*, Jurgen Tautz
- *Voice of the Infinite in the Small: Re-visioning the Insect Human Connection*, Joanne Elizabeth Lauck
- *The Joys of Beekeeping*, Dr. Richard Taylor
- *Idiots Guide to Beekeeping*
- *Beekeeping for Dummies*
- *Keeping Bees*, Ashley English (good introduction for setting up a backyard hive)
- *The Beekeeper's Handbook*, Diana Sammataro and Alphonse Avitabile.
- Zoology and agriculture books by Eugen Kolisko (wide variety)


Tour de Hives
Portland 2010
North and Northeast Stops
Southeast (plus east of 82nd) Stops
Ainsworth St.
NE Mallory
1T, 3L, O
Killingsworth St.
Alberta St.
Prescott St.
NE 23rd Ave
Livehoneybees.com
5L, O, S/E
NE Alberta Ct.
15L (yes, 15!)
O, E
Alberta Ct.
Columbia Ecovillage
NE Killingsworth
2T, 3L, 1W, N
Onde: open 3-4 p.m. only
• park on street
• tour of Ecovillage at 4 p.m.
Mallory
Shaver
N Shaver
4L, N
Failing St.
N Vancouver
Livingscape/Portland Bee Center
MLK
Fremont St.
N Vancouver
N Williams
Sandy Blvd.
82nd Ave
NE Sacramento
2L, O
(3rd generation)
Rocky Butte
122nd Ave.
Burnside
84
Stark
SE Main
1W, N
Mt Tabor
SE Morrison
2L, N
Main
Madison
Hawthorne
SE Main
1T, N
Division
2340 SE 62nd
1L, O
Powell
Woodward
Holgate
Long
Steele
SE 31st Ave
1T, N
Reed College
SE 63rd
2L, N
Tabernacle Honey
SE 63rd
2L, O
60th Ave.
82nd AVE.
205
Thank you
Queen of the Sun
and
Thank you
Beekeepers!
note:
Map intended
for registered
tourists. Please
do not circulate.
tourdehives@gmail.com
Worth the trip! Win a top bar hive...
SE Blanton, Milwaukie (Oak Grove)
Take 99E to Naef Rd (R) then left to Blanton.
1T, 2W, 1L, O, S/E and 3 nucleus colonies
Beethinking.com
and... Happy Valley Drive
Take SE Foster to 110th, follow to
Mt Scott Blvd, King Rd, R on Happy Valley Dr.
1T, N

Tour de Hives Guidelines

"Insects teach us nothing short of what might be considered the highest understanding we can derive from nature." (Wisdom of the Bees by Erik Berrevoets)

Thank you for participating in Portland's first Tour de Hives! This is a self-guided tour -- you set your route and your pace. There are likely more stops than you will be able to make in the 3-hour window, so plan carefully. The tour depends on everyone's common sense, courtesy, care, and respect. Please follow the guidelines below as you are making your tour. If you need to report any problems (or highlights, too!), please contact Lauren Johnson at [redacted] or email her at tourdehives@gmail.com.

1. Do not circulate, post, or reproduce this map or tour locations -- it is intended only for registered tourists (you!). Please respect the privacy of the people whose homes are on this tour by not using this map for any reason beyond its use for the day of the tour.
2. Do not arrive at any tour stop before 1:00 p.m. or after 4:00 p.m. (Note: Columbia Ecovillage is open only from 3-4 p.m.)
3. Respect parking rules in each neighborhood and take care when walking onto anyone's property. It is up to you to walk safely and also to help your children to be calm, safe and respectful.
4. Beekeepers have no obligation to do any demonstrations or open their hives. This is for each bee's and each human being's safety. There is still plenty to learn and see by observing each hive and some hives have viewing windows to see the interior.
5. Ask permission of each beekeeper if you want to take any photos or video.
6. If there is a big crowd of people (more than 8 or 10) at a given home, please be patient while waiting to speak to the beekeeper, or consider visiting another location for that time.
7. Do not interfere with hives. Pay attention to the flight pattern of the honeybees entering and exiting the hives. Stay out of the way!
8. Please do not drink any alcohol prior to or during your tour. Bees can be sensitive to people who have alcohol in their system.
9. Consider turning off your cell phone while in the vicinity of hives. Some beekeepers consider cell signals to be disruptive to bees and unnecessary conversation is disruptive to others.
10. A bee that is forced to defend itself or its hive might sting. If you have an allergy to bee stings, please carry an epi-pen. Call 911 immediately if you are stung and experience a severe reaction (i.e. extreme swelling that may be the result of an anaphylactic reaction). Follow the advice of your healthcare provider if you are unsure how to treat bee stings.

Reading the map:

Three types of hives are represented in the tour. Some beekeepers have several hives of different types.
"L" stands for Langstroth "W" stands for Warre (pronounced wah-ray) "T" stands for Top Bar

A tour stop that says "2T, 1L" has two Top Bar hives and one Langstroth hive.

A range of experience is also represented. Learn from new beekeepers ("N") and old hands ("O") with at least 3 years' experience.

Finally, there are several beekeepers who are also great resources for beekeeping supplies or classes. Those stops are listed with "S" for supplies and/or "E" for educators (S/E for both).

Here's your map reading quiz:

At a stop marked: 2L, 2W, O, S You will find: 2 Langstroth hives, 2 Warre hives, a beekeeper with at least 3 years experience, and beekeeping supplies available for purchase or demonstration.

They alone hold children in common: own the roofs of their city as one: and pass their life under the might of the law. They alone know a country, and a settled home, and in summer, remembering the winter to come, undergo labour, storing their gains for all. (Virgil, Book IV of the Georgics)

CITY OF
PORTLAND

Whereas

Whereas, the honey bee is responsible for over 40 percent of all of the pollination of the food that we eat; and

Whereas, the honey produced by honey bees is delicious, healthful, and therapeutic; and

Whereas, the honeycomb wax created by honey bees is a miracle of engineering and the light it creates is a comfort and joy to people; and

Whereas, the honey bee's domestication thousands of years ago resulted in dependence upon human care; and

Whereas, Portland is a leader among cities involved in sustainable farming and beekeeping practices that will be necessary to reverse Colony Collapse Disorder; and

Whereas, the new documentary, Queen of the Sun: What Are The Bees Telling Us?, a project of the non-profit Collective Eye, is created by Portland citizens and features our residents with other beekeepers, scientists, artists, and philosophers from around the world who are working to bring these problems to light; and

Whereas, Queen of the Sun is partnering for its theatrical release in Portland with many diverse local organizations including the Portland Farmer's Market, Ecotrust, The Audubon Society, Oregon Tilth, The City of Portland's Bureau of Planning and Sustainability, Oregon Sustainable Agriculture Land Trust, The Oregon Wildlife Federation, Northwest Earth Institute, The Portland Waldorf School, Growing Gardens, Edible Portland, The Northwest Coalition for Alternatives to Pesticides, New Seasons Markets, and others to promote environmental sustainability and a healthy community; and

Whereas, every Portland resident can be part of supporting the health of the honey bee by avoiding the use of toxic pesticides on their lawns and gardens, by buying food from farmers who avoid toxic pesticides, by planting flowers for honey bee forage, by calling for a swarm rescue expert rather than an exterminator if a bee swarm arrives near their house, and by reducing the misplaced fear of honey bees with an understanding that honey bees are very rarely the source of most insect stings,

Now, therefore, I, Sam Adams, Mayor of the City of Portland, Oregon, the "City of Roses," do hereby proclaim September 17 through September 23, 2010 to be

Honey Bee Week

in Portland, and I encourage all residents to observe this week.

Sam Adams

1891

Appendix M

Leave blank for presentation form and evaluation