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Brenda M Kellar for the degree of Master of Arts in Applied Anthropology presented on May 4, 2004.

Title: One Methodology for the Incorporation of Entomological Material in the Discipline of Historic Archaeology Using the Honey Bee (*Apis mellifera* L.) as a Test Subject.

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David R. Brauner

Using the honey bee (*Apis mellifera* L.) this thesis shows that entomological information and material can be retrieved using current historical archaeological methods. Historical archaeology has the ability to uncover connections between arenas as varied, and seemingly isolated, as the honey bee, the environment, and human cultures. By focusing on one of these arenas, the honey bee in this thesis, we can learn about the forces that drive change within all these arenas. Additionally, historical archaeology can help us to trace the affects of change outside the source, so that a change in the honey bee population is understood to affect both human cultures and the environment.

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One Methodology for the Incorporation of Entomological Material in the Discipline of Historic Archaeology Using the Honey Bee (*Apis mellifera* L.) as a Test Subject.

By

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Brenda M Kellar, Author

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Introduction

Aristophanes, 448-380 BC:
"Active, eager, airy thing, Ever hovering on the wing"
[Ransome 1937:20]

As an undergraduate I took an entomology class that changed my life. Dr. Michael Burgett, Professor of Entomology at Oregon State University and *Apis* expert for Oregon, told the class that honey producing bees did not exist in North America before the early 17th century. I am not sure what he said during the rest of the class because in my mind I was trying to experience a world without honey bees – no "busy as a bee" or "beeline" or "honey of a deal."

I must admit that after three years I am still trying to understand what that world must have been like even though I have spent those three years using historical archaeological techniques to try and trace the enormous number of impacts the introduction of the honey bee (*Apis mellifera* L.) has had on the development of the United States. Because of my search, I have received a small glimpse into a world where the honey bee is a stranger.

This paper is an attempt to share what I have learned and to instill in others some of the excitement I feel about incorporating entomological material into the discipline of historic archaeology. I want to show that entomological material is retrievable, that historic documentary sources offer intriguing insights into the role of insects in the development of culture in the United States, and that historic archaeology is the perfect discipline to trace the honey bee (or any insect) geographically, economically, ideologically, and politically through time.

The United States culture was founded on an agricultural economy and this has been investigated at length by historians, economists, archaeologists, etc. Yet the partner in this agricultural endeavor, the honey bee, has not been well researched as

an integral part of this development. Even now, when the United States is turning from an industrial nation to an information-based nation, agriculture is a necessary part of the United States culture with the honey bee, perhaps, a more important part of that agricultural component than ever. Currently, the United States produces around nine billion dollars worth of agricultural commodities requiring insect pollination; 95% done by the honey bee. In 1993 it was estimated that one hive of honey bees in Oregon was responsible for the production of $9,750 worth of crops (Burgett 2002). Added to this is the economic return from honey bee products. The wholesale value for 2002's honey production was $221,500,000 and this is just one of the products the honey bee produces (National Honey Board 2002).

Historical entomological archaeology is a new field of investigation full of possibilities and potential. The class Insecta is the world's most successful taxon with one million described species. The impact on the environment, and the resulting impact on human cultures, of this huge mass of organisms is tremendous and little understood. New insect species are discovered almost daily, but we have very little idea how they function within their environment. We have no substantial information about historical extinction or endangerment of Insecta species in North America post sixteenth century.

The honey bee is the perfect beginning for this new field of archaeology. The honey bee has evolved side-by-side with humans for tens of thousands of years. This co-evolution means that both species have affected each other without the domestication[1] of either. The honey bee, this industrious insect, has become even more productive and the average volume of honey produced per managed hive from the 19th to the 21st centuries has increased from 20 pounds to more than 60. In return

[1] Domestication requires genetic manipulation. The virgin queen mates with numerous drones 20 to 40 feet in the air (falling to ~10 feet during mating). The semen migrates up the lateral oviducts, then back down the median oviduct into the vaginal canal where 95% is ejected. Only 5% of the total semen is stored in the spermatheca. At this time it is impossible for humans to control the 174 square mile possible breeding area, what percentage of which drones' semen is kept, or the shortened life and high rejection rate experienced by I.I. and A.I. inseminated queens. For these reasons the honey bee is ***not*** a domesticated animal (Burgett 2002).

humans have incorporated the honey bee so deeply into all aspects of their cultures that it has become invisible and is no longer perceived as the helpmate, guardian, and magical creature it once was.

From the earliest times paradise has been described as a land of milk and honey. The Virginia colonists also believed this; so imagine their surprise when they discovered there was no honey in Virginia, a land they believed to be "one of the goodlyest parts of the Earth"[2] (Brown 1898:577). A letter from Captain Newport to Robert Cecil, Earl of Salisbury, Prime Minister, dated August 8, 1607 stated, "Insteed of mylke we fynde pearle – and golde insteede of honye" (Brown 1898:43). The colonists were in for an even bigger shock when they found there was no gold in the area either. On August 22, 1607, Sir Walter Cope wrote to the Earl of Salisbury, "Thys other daye we sent you newes of golde and thys daye, we cannot returne you so much as Copper" (Brown 1898:46). By the mid 19th century, when Miner was writing his book on apiculture, this had changed and he was correct to describe the United States as a "land of milk and honey" (Miner 1857:180).

The honey bee has been a catalyst for human/environment interactions. The most obvious manifestation of this would be the domestication and production of plant species beneficial to both humans and the honey bee by agriculturalists. Almonds, apples, avocados, blueberries (wild and cultivated), cranberries, asparagus, broccoli, carrots, cauliflower, onions, vegetable seed, legume seed, rapeseed, and sunflowers are all exclusively insect pollinated and 90% to 100% of that pollination is done by the honey bee. Brambleberries, cherries (sour and sweet), grapefruit,

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[2] In July of 1623 it had been decided that the King would once again be in control of the government of Virginia. The following quote was written by the 1624 Assembly in VA in an attempt to convince the King to continue supporting the investors in the Virginia colony – "3. *What hopes may truly and really be conceived of this Plantation?* We hould it to be one of the goodlyest parts of the Earth, aboundinge with navigable Rivers (full of variety of fish and fowl) falling from high and steep mountains which by the general relation of the Indians are rich with mines of Gold, Silver and Copper. Another Sea lyeing within sixe days jorney beyond them into which other Rivers descende. The soyle fruitfull and apt to produce the best sorts of Commodities – replenished with many trees for severall uses, gummes, dyes, earths, and simples of admirable virtue. Vines and Mulberry trees growing wilde in great quantities, the woods full of deer, Turkies, and other beasts and birds for more particular relation we refer you to the Reportes of Sir Thomas Gates, and Sir Thomas Dale made unto the Company, conceiving those praises no way hyperbolical, nor any Country more worthie of a Prince's care and supportance" (Brown 1898:577).

kiwifruit, macadamias, pears, plums/prunes, cucumbers (fresh and pickled), cantaloupes, honeydew, and watermelon are 70% to 90% insect pollinated with 90% to 100% being done by the honey bee[3] (Morse and Calderone 2000:3).

Because human and honey bee populations first developed in the same regions I believe that many of the plants the first agriculturalists experimented with were ones preferred by the honey bee thus creating a cycle of increasing productivity. The more plants preferred by honey bees in one area, the more the honey bee population could increase, which in turn led to a greater volume of seeds and fruits from those plants. This greater food supply allowed human populations to expand. The larger human population needed a greater food supply so the humans sowed more of the plants that were most successful, thereby providing more food for the honey bee, and so the cycle spiraled ever larger until today when the honey bee is responsible for the production of nearly 9 billion dollars in agricultural products in the United States.

The study by Morse and Calderone supports the idea that a majority of the most commonly consumed foods in the United States are those that sustain honey bees as well as humans. Many of these foods were imported from the Old World to the New, just as the honey bee was. The English settlers who lived in Virginia brought their seeds, slips, and saplings with them – all of which were familiar to the honey bee. Additionally, some native plant species (such as avocados and sunflowers) profited from the importation of honey bees. If the honey bee had not been imported to North America our diet would be very different today.

Less obvious are the effects of spillover pollination, the pollinating of wild (and home garden) fruit, nuts, and seeds harvested by wildlife and necessary for their survival. Spillover pollination coupled with preferential pollination changed the native American landscape by giving a reproductive edge to some plant and animal species at the expense of others.

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[3] This information is only on crops currently important to the United States.

Later in this paper I will discuss the spread of white clover across the North American landscape, which I believe was greatly assisted by the honey bee. Additionally, spillover pollination must have created shifts in animal and insect communities, both in the number of individuals and in the number of species within a community. The honey bee pollinated some plants (like sunflowers or clover) and ignored others, which increased the number of viable seeds for the plants preferred by honey bees thereby increasing the population for these plant species in the next generation. This not only decreased the land available for plant species least preferred by the honey bee, but also provided a greater food supply for animals utilizing plants preferred by honey bees. This in turn allowed those animal species to increase in population, which probably led to greater numbers of predators for those species, etc., etc.

These changes are evident in all areas of the continental United States. The honey bee can exist in nearly all environments that provide food, water, and shelter. Some would be surprised to discover that the top honey producing state in 2002 was North Dakota at 24 million pounds (National Honey Board 2002). The honey bees' ability to control the interior temperature of the hive – both cooling it in the summer by lining up at the entrance and flapping their wings to create a draft and heating it in the winter by massing around a central location and alternating time periods inside and outside that mass makes this species very adaptable to various environments.

There are more than 4500 exotic creatures in America today (Todd 2001:4). This figure is astounding and speaks to our increasing capacity to affect natural ecosystems. Many of these introductions were unintentional, but a large number were premeditated. For example, the introduction of the 'Africanized' honey bee[4] was a deliberate attempt to increase honey production in Brazil that got out of hand. In North America, the honey bee was first brought to the United States because the English colonists could not imagine a world without it.

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[4] Also known as the 'killer bee' this species is the same as the European honey bee – *Apis mellifera* L. It is a separate race or subspecies. There are ~25 described races of *Apis mellifera* L. and two basic biotypes – Tropical and Temperate (Burgett 2002).

The 17th century colonists were intent on domesticating the environment. They saw a world that was black or white, tame or wild, productive or unproductive. "Kine give us their milk, sheep their wool, bees their honey and wax; every one pays a tribute to man, their usufructuary lord" (Purchas 1657:163). The popular Calvinist teaching of the time stated, "Man was to be 'the helper and interpreter of nature'" (McRae 1996:159). Both ideologies are anthropocentric, viewing nature as an entity to be managed, used, and defined by humans.

This attitude was still prevalent in the 19th century. Miner believed that swarms belonging to an attentive beekeeper would settle near the hives and wait for the beekeeper to provide shelter for them, but that swarms owned by a lazy beekeeper would head to the woods with only a pause outside the hive to make sure all were present.

> "As 'the ox knoweth his owner and the ass his master's crib,' so is the little bee sensible of the fact, that a hand is ever ready to provide for her necessities...she remembers your attention, and learns to place her trust in you. This is a prominent feature of every being that depends on man for protection. It is an attribute of Him who created all. The mandate went forth at the creation of the world, 'that as man looketh to me, and I extend an outstretched arm over him; so shall every living thing be subjected unto man, knowing that he provideth for them in the day of their necessity'" [Miner 1857:275].

At the beginning of The Early Modern Period, 1500 to 1800, social hierarchies and mores were viewed as natural and were transposed onto all aspects of nature,[5] creating a moralized universe through the use of analogy or metaphor. "This system of correspondences went back a long way in Western thought...might better be described as the 'Aristotelian-Ptolemaic' world picture, though cosmic kingship (for example) is a complex of ideas with a still longer history" (Burke 1997:113). There was an absence of awareness of, or acceptance of, alternative views of nature.

During the 17th century the scientific revolution caused, or was accompanied by, a change in metaphor, both within the perception of metaphor in general and

[5] The king of beasts was the lion, the beehive represented a kingdom or papacy with all working to support the ruler who at this time was seen as a king bee, etc.

within the content of metaphor. The metaphor of the world as an animal became the world as a machine,[6] accompanied by a change from an active nature to a passive, female nature, "a body on which male scientists could operate" (Burke 1997:114). Metaphors were no longer God speaking to the masses through His works, but instead were "human devices" (Burke 1997:114).

Honey bees played a leading role in the metaphors of the Early Modern Period, especially in political thought. Burke (1997:116) claims that much of the history of political thought can be "written in the form of footnotes to Aristotle" who was the first person to recognize the three castes of honey bees and the organization of their society (Frost 1937:78). Seneca's treatise on clemency uses the social order of the beehive to demonstrate that "Nature herself conceived the idea of king" (Burke 1997:116). Columella used honey bees to show that nature allowed no sharing of power. Chapter two of *On the Rule of Princes*, written in the 13th century and attributed to Thomas Aquinas,[7] stated that monarchy was the natural form of government for "the heart rules the body, and the bees have a single king" (Burke 1997:117). In his play *Henry V* act 1 scene 2 (first performed in 1599) Shakespeare perpetuated the idea that God had written instructions for humans within the natural world, "So work the honey bees, Creatures that by a rule in nature teach The art of order to a peopled kingdom" (Ransome 1937:210). Charles Butler (1609) published *The Feminine Monarchy,*[8] which stated that "the bees abhor as well Polyarchy as Anarchy, God having showed in them unto men the most natural and absolute form of government" (Burke 1997:118). This belief that God had shown humans the proper structure for society in the beehive continued into the 17th century with Giovanni Bonifacio's *Republica delle api*, 1627.

The emblem book, one of the fashionable mixed genres of the Renaissance, where an image was combined with a moral that, "epitomized fundamental truths

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[6] "The organic metaphor would of course make a come-back, in a modified form, in the nineteenth century" (Burke 1997:113).

[7] This was either written or finished by Ptolemy of Lucca (Burke 1997:117).

[8] Jan Swammerdam, 1669, was the first to prove the queen bee was female (Burke 1997:118-119; Ransome 1937:154).

about the working of the universe" often featured honey bees and the very first emblem book in 1531 by Andrea Alciati included honey bees (Burke 1997:117). Honey bees were also used as symbols for, and examples of, purity, chastity, thrift, piety, industriousness, peace, spirituality, and cleanliness.

Any historical research pertaining to colonial America must include a majority of English sources and the subject of honey bees and beekeeping in America must also begin with British husbandry and gardening books, which by the mid-16th century had begun to include sections on the honey bee. Before the 19th century American books were usually reprints or plagiarized versions of English editions. Reverend E. T. Abbott wrote *The Busy Bee. Or Beekeeping in a Nutshell* in 1886 and began by saying, "What I have written I have written, and what I have borrowed, I have borrowed" (Mason 1998:40).

The first printing press arrived in America in 1638 and commercial publishing began in 1640 with the Bay Psalm Book. Until the American Revolution publishing was strictly regulated by civil and ecclesiastical groups who had to approve any material before it could be printed. Perhaps for this reason it was not until 1772 that a single-subject book on honey bees was published in America: George Cooke's *The Complete English Farmer: Or, Husbandry made perfectly easy in All its Useful Branches. Containing what every Farmer ought to know and Practice.* Previously Isaiah Thomas's book, 1792, was believed to be the first book of this type to be published in America[9] (Mason 1998:32).

In this paper I use documentary, iconographic, folkloric, and archaeological data to show that the honey bee has been undervalued as an instrument of cultural

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[9] "The first single-subject American bee book published in America has been attributed to Isaiah Thomas, and is dated 1792...Thomas is widely credited with plagiarizing the book substantially from Daniel Wildman (1773), whose book published in London bore the same short title as Thomas's, namely, *A Complete Guide for the Management of Bees, Throughout the Year*. The Thomas book also contained, with incomplete attribution, a section on bee hunting published ten years earlier in London in J. Hector St. John Crevecoeur's *Letters from an American Farmer* (1782). Notwithstanding the total lack of originality of the text, and its British origin, the fact that the book was published in Worcester, Massachusetts, qualifies it as an American bee book, as the place of publication in the imprint is determinative of a book's nationality" (Mason 1998:32).

and environmental change in North America. I begin by tracking the movement of honey bees across the country and within the homestead, move on to the material culture associated with beekeeping before the revolution brought on in the mid-19th century by L. L. Langstroth's hive form that incorporates bee space, then discuss how to use archaeology to retrieve entomological material, and finish with three very brief glimpses into the environmental, economic, and ideological impacts of the honey bee on North America.

Separating the paper in this manner makes it easy to follow, but perhaps leaves a false impression that these areas can be studied in isolation from all others and there is no idea more harmful to any research topic. As all archaeologists know the guiding rule is context, context, and more context. The intertwining of ideology, environment, economics, etc., can be difficult to track and is even harder when you are trying to follow the associations of a past time period. Added to that are the prejudices we all bring to any activity. Can I as a 21st century middle-aged woman really discover what life was like in colonial America without blurring the truth through my idea of work, religion, social structure, etc.? This is why it is so important to look at any research project from as many perspectives as possible. We need to know the role of honey bees in the United States today and in England in the 16th century before we can begin to understand the impact of the honey bee on North America in the 17th and 18th centuries.

Historical archaeology, with its interdisciplinary approach and incorporation of historic materials with artifacts, is the discipline most suited to discovering the long-term processes that produce changes in both culture and the environment. My goal for this thesis is to prove that this is the reason historic entomological archaeology is the next logical step and that that step is possible. This thesis is only a beginning.

Settlement Patterns

The invasion of North America by the honey bee began in 1622 with one shipment of unknown quantity (Crane 1980:120; Goodwin 1956; Imirie 2000; Kingsbury 1906:532). However many honey bees survived the several months crossing of a winter Atlantic ocean, confined in their hives and very susceptible to dysentery, it was enough to establish a beach-head; enough to eventually become an unacknowledged but significant partner in the creation of an agricultural economic base for a developing United States.

Virginia was in turmoil when the honey bees arrived. The mortality rate had always been high for the Virginia colonies. As of March 1621, there were 843 English colonists in Virginia and, over the next year, 17 ships were sent from England with another 1580 people intent on making a new life or a quick profit in Virginia. Of the 2423 people en route or already in Virginia, 1183 died that year, leaving a population of 1240 in March 1622 (Brown 1898:464).

On Good Friday, March 22, 1622, the Powhatan attacked all the English settlements simultaneously. The Powhatan hoped this massacre would remove the colonists from their lands forever – either by wiping out the entire population or by intimidating any remaining colonists into returning to England. This was "the first Anglo-Native American war" and resulted in the death of 347 colonists, 28 percent of the population (Edwards 1998:7).

A letter from the Virginia Company council, written by Nicholas Ferrar, arrived in Virginia in November or December, 1622, and accused the officers in Virginia of being responsible for the massacre due to a lack of attention to piety. "In the strength of those faults undoubtedly, and the neglect of Divine worship, have the Indians prevailed, more than in your weakness" (Brown 1898:499). The council urged the colonists to make "an humble reconciliation...with the Divine Master, by future confomitie unto His most just and holie lawes" (Brown 1898:499). As an

added measure the council included instructions for the "extermination of the Indians...and rewards were offered for their taking"[10] (Brown 1898:500).

If the colonists followed the strictures of their priests and the council there was no evidence that God, or providence, took any notice. The very next year, 1623, there was an epidemic that swept through Virginia. Bruce wrote that it was possible the epidemic halved the population leaving approximately 500 English colonists in Virginia (Bruce 1907:272).

The first two years the honey bee was in Virginia were ones where few colonists could concentrate on the development of a new agricultural activity such as beekeeping. The honey bees probably existed with minimal care and due to their own pioneering spirit and ability to live very well without the help of humans.

Historical documentary sources tell us that from Jamestown the honey bees multiplied and spread out. It would be another 16 years before the next successful shipment of honey bees made it to North America (Free 1982:116; Ransome 1937:260). These hearty survivors needed little in the way of care and they immediately began doing what honey bees do best – making more honey bees. A hive will produce approximately 1000 new honey bees a day during the summer. If the mortality rate does not keep pace with the birth rate, and a queen is hatched at the right time, a swarm results. It is the swarm, a form of asexual reproduction, which increases the number of viable hives (Doddridge 1813:8-9 and190; Jardine 1843:198; Miner 1857:234-235 and 261; Quinby 1864:134 and 164).

Healthy hives can cast as many as three swarms a year, while the average remains one. Not all swarms are successful. Those leaving the main hive too late in the year to stock their new home with honey and beebread (pollen) will starve during the winter. Other swarms unable to produce a full population for the hive before winter can freeze to death. Second and third swarms are a gamble, but the first

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[10] A letter from the Governor and Council of Virginia to the London Co., January 1623 – "By computation, and confession of the Indians themselves, we have slayne more of them this yeere, than been slayne before since ye begininge of ye Colonie" (Brown 1898:503).

swarm is usually a sure thing. They will have enough time and population to survive the winter. I conservatively estimate that the honey bee population in North America by the end of 1632 as at least 1024 hives of bees around Jamestown and by the time the next shipment arrived in 1638 there must have been at least 65,536 feral and managed hives in Virginia.

In this chapter I will track the path of the honey bee across the future United States and within the homestead as it is known from documentary sources. At this time there is no archaeological data available to support or disprove this information, which illustrates the need for the incorporation of entomological information in the archaeological record.

The 17th century in North America, and much of the 18th century as well, was a period of isolation. There were few roads and even fewer newspapers. There was no mail service except for couriers – probably not much of an inconvenience since most of the population was illiterate. For this reason the entry dates for honey bees in many of the states may be totally wrong. Unlike today when everyone gets the same news almost simultaneously, in the colonial period knowledge was local for the most part and if there were no local newspapers or foreign visitors traveling through who would write a letter home then information remained local.

The written record is vulnerable to fire, war, pestilence, flood, and age – all of which have occurred in the Virginia area, destroying many of the records. Many written sources are intentional propaganda pieces. And all written material is filtered through the author's viewpoint, knowledge, prejudices, and ability.

I make no claim that archaeological material is invulnerable. Like written material it can disappear due to the elements, disasters, or negligence. And propaganda can be embodied in 3 dimensional media as well as documentary media i.e. a leader can depict themselves as much more powerful or just than they were through stele, statues, buildings, etc. Additionally, the archaeologists who interpret the data are all too vulnerable to bias.

To get at the truth (another slippery slope) you have to have as complete a record as possible through the incorporation of information from as many sources as are available, thereby gaining different viewpoints on the same set of circumstances. The varied datasets can then be compared for points of mutual agreement or aberrant claims in an effort to discover what the reality of a past point in time was. Historical archaeology, by incorporating information from many different disciplines is a good tool for any research endeavor focusing on a past time period.

Macro-location (Outside the homestead)

"Wee haue by this Shipp and the Discouerie sent you diurs [divers] sortes of seedes, and fruit trees, as also Pidgeons, Connies, Peacockes Maistiues [Mastiffs], and Beehives, as you shall by the invoice pceiue [perceive]; the preservation & encrease whereof we respond vnto you..." (Goodwin 1956; Kingsbury 1906:532). This letter was written December 5, 1621 by the Council of the Virginia Company in London and was addressed to the Governor and Council in Virginia. It is unsure whether "this shipp" was the *Bona Nova* (200 tons, John Huddleston, master, and fifty persons) or the *Hopewell* (60 tons, Thomas Smith, master, and twenty persons), also known as the *Great Hopewell.* The *Discovery* (60 tons, Thomas Jones, captain, and twenty persons) left England November 1621 and arrived in Virginia March 1622 (Langford Ship Information; Brown 1898:469-470). The *Bona Nova* was a month behind and arrived at Jamestown in April (Langford Ship Information). This was the *Hopewell's* first voyage to Virginia and there is no record of the date of its arrival (Langford Ship Information), although Brown claims it arrived at Jamestown within 24 days of the massacre (Brown 1898:469).

There were three or four ships in the James River and the *Elizabeth* was in the Pamunkey River at the time of the 1622 massacre. Ships left England for Jamestown at regular intervals so Jamestown had steady, but delayed, contact with the Virginia Company. Because it took months, from two to four depending on

weather and other variables, for a ship to reach Jamestown there was a four to eight month lag between missives sent to the Virginia Company and the replies received by Jamestown residents. For this reason the Virginia Company was unaware of the impending massacre, which occurred on Good Friday March 22, 1622 (Boddie 1993:42), and the subsequent disruption within the colony when they sent out the three ships that carried the beehives.

The *Discovery* was owned by the Southampton Hundred; a group of adventurers whose real goal of the voyage was fur-trading in the Hudson River (Brown 1898:470). They had heard that two Dutchmen had been sent to the Hudson on a fur-trading expedition and were anxious for the *Discovery* to get there before them. Even though Virginia was in disarray the *Discovery* and the *Bona Nova* left as soon as possible to pursue their trading and fishing expeditions (Brown 1898:471).

It was a smaller, chaotic Virginia that saw the first arrival of honey bees in North America. The Powhatan attack had not driven the colonists from Virginia, but the population remaining after the massacre decided to consolidate and maintain "James City, Paspaheigh, the various plantations over the river opposite James City, Kecoughtan, New Port Newce, Southampton Hundred, Flowerdieu Hundred, Sherley Hundred, and the plantation of Mr. Samuel Jourdan" (Brown 1898:470).

Did the governor or some other plantation owner collect the honey bees as they were off-loaded from the ship, or did they sit on the dock waiting for someone to claim them? It is possible that the honey bees, being true pioneers, survived without help the first year or two in Virginia. If the packing was removed, or had loosened during shipping, they probably abandoned the dock for the nearby woods. It was spring and they would find an abundance of pollen, nectar, fresh water, and shelter within the area around the settlements. Perhaps someone interested in the possibility that some honey remained in the hives after the long sea voyage broke the hives open to check, thereby giving the honey bees their freedom.

I believe someone must have picked the hives up and transported them to their holding. The bees would require no other care and the owner would reap a

sweet reward in the late summer or early fall. If that person had some knowledge of beekeeping there was the possibility that a new enterprise had begun, one that would impact the development of the United States in unforeseen ways.

We do know that the initial entry point for honey bees to North America was Jamestown, the only port city for the Virginia Company, but there is no information as to how many hives were sent or how many hives survived (Goodwin 1956; Kingsbury 1906:532). I am positive that at least enough honey bees survived to establish one hive in Virginia. This may seem like too small a beginning for an insect that has become so common that most people believe they have been here forever and can be found anywhere in North America. However, Miner in 1857 estimated the number of hives resulting from one hive that threw off one swarm per year.

> "We will now take the very reasonable, and low estimate, of one swarm from every stock, every season, and count up how many would be the result at the end of ten years. The second year, 2, in all; the third year, 4; the fourth year, 8; the fifth year, 16; the sixth year, 32; and so on – the *tenth* year showing FIVE HUNDRED AND TWELVE families from a single swarm" [Miner 1857:127; emphasis in original]!!!

Despite a request May 10, 1632 from Providence Rhode Island for honey bees to be sent from the main (Sainsbury 1964:147-148) the second import of honey bees was in 1638 to Massachusetts (Free 1982:116; Ransome 1937:260). Two years later Newbury, Massachusetts initiated a municipal apiary (Adams 1921:277; Crane 1975:475; Pellett 1938:3). This was intended to be a combination educational experiment station and welfare program. Eels, from a town now called Hingham, was put in charge of the apiary, which was placed on a farm rented by John Davis (Adams 1921:277; Pellett 1938:3).

The success of the apiary was threatened when the winter of 1640-41 was the worst in the recorded history of that area and Boston Harbor was closed because of ice from November 18 to February 21 (Adams 1921:277). A second liability for the success of the apiary was the fact that Eels was an old man who probably found it difficult to properly tend the honey bee hives. If the hives were new, or had been

affected by disease or predation, the honey bees would most likely have needed to be fed before winter came. An old man would find it more difficult to watch for mites and remove them by hand (a common method in the 17th century). By 1643 Eels was living with John Davis. For some reason Eels ran away, but he was caught, jailed, and set to constructing hives (Adams 1921:277). For these reasons, and perhaps some lost over time, the apiary was a failure and Eels became the town's first pauper (Adams 1921:277; Crane 1975:475; Pellett 1938:4).

This first attempt at beekeeping on a large scale may have been a failure, but the honey bees managed to survive the experience. There is a story that the honey bees spoken of by John Greenleaf Whittier in his poem *Telling the Bees* were direct descendents of the honey bees from the Newbury apiary[11] (Pellett 1938:4).

The first mention I found of a Virginia apiary large enough, and successful enough, to support its owner was that owned by George Pelton, a.k.a. George Strayton, in 1648. This was just 26 years after the initial entry of honey bees to Jamestown. A letter dated March 1648 and sent to England by a Virginia resident told of the success Pelton had achieved with his apiary:

> "For bees there is in the country which thrive and prosper very well there; one Mr. George Pelton, alias, Strayton, a ancient planter of twenty-five years' standing that had store of them, he made thirty pounds a year profit of them; but by misfortune his house was burnt down, and many of his hives perished, he makes excellent good metheglin,[12] a pleasant and strong drink, and it serves him and his

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[11] "Henry Rolfe is said to have obtained bees from the abandoned apiary in the town of Newbury after John Eels, the apiarist, became a public charge. In his will he bequeathed a swarm of bees to his kinsman, John Whittier. They were taken across the Merrimac to the Whittier homestead in Haverhill. It is probable that it was descendants of these same bees that were inherited by the brothers, John and Moses, and sister, Mary. Mr. Adams records the fact that he had it direct from the poet himself that the incident described in the poem was not fanciful but took place as described" (Pellett 1938:4).

[12] In the 16th century this was Queen Elizabeth's favorite drink. Her recipe follows: "Take a bushel of sweet briar leaves, as much of thyme, and a peck of bay leaves; and having well washed, boil them in a copper of fair water; let them boil the space of half an hour or better, and then pour out all the water and herbs into a fat [vat], and let it stand till it but be milk warm; then strain the water from the herbs and take to every gallon of water, one gallon of the finest honey, and beat it together for the space of an hour; then let it stand for two days, stirring it well twice or thrice a day; then take the liquor and boil it again, and skim as long as there remains any scum; when it clears put it into a fat as before and let it stand to cool. You must then have in readiness a kive of new ale or beer, which as soon as you have emptied suddenly, presently put in the metheglin, and let it stand three days a-working and then

> family for good liquor: If men would endeavour to increase this kind of creature, there would be here in a short time abundance of wax and honey, for there is all the country over delicate food for bees, and there is also bees naturally in the land, though we account not of them" [Goodwin 1956; Maxwell 1849:76; Riley 1956].

George Pelton arrived in Virginia in 1622 aboard the *Furtherness*. In the 1624 census, ordered by King Charles I when the Virginia Company was abrogated and control given to the Crown, Pelton was listed as living at "Burrows Hill James Citty [Jamestown]" (Brown 1898:627-628; Goodwin 1956; Jester 1964:36; Langford Virginia Musters; Riley 1956). According to the muster he owned "3 barrells of corne and 1 peece" (Jester 1964:36).

It is impossible to tell where Pelton's apiary was. In 1624 John Burrows lived in Pace's Pains at a place he called Burrow's Hill with his wife Bridget and her children. Not long after the census he sold his rights to John Smith who changed the name Burrow's Hill to Smith's Mount and in 1629 Pace's Pains was represented in the legislature by "Lieut. William Perry and John Smyth" (Tyler 1966:XVI:222-223). Where George Pelton eventually rented or bought land and set up his apiary is uncertain. He must have started it some time after the census, because it is hard to believe he would have set up an apiary on land he would not be living on for long. If George Pelton began beekeeping immediately after the muster his apiary may have been in existence for up to 24 years before it burnt down.

It is evident that Free, 1982, was correct when he said that beekeeping was well established in Virginia and Massachusetts[13] by the mid 17th century. The records of York County from 1644 to 1672 indicates that, "honey was a common article of food, much attention being paid to apiculture; there were few householders who did not have hives under the eaves of their outbuildings, one planter owning as many as thirteen stocks" (Goodwin 1956), and *A perfect Description of Virginia*, a compilation of information derived from letters sent to England from residents of

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tun it up in barrels, tying at every tap hole, by a pack-thread, a little bag of beaten cloves and mace to the value of an ounce. It must then stand half a year before it be drunk" (Ransome 1937:200).

[13] Virginia did a brisk business in supplying Massachusetts with food items and livestock and it is probable that many of the honey bees in Massachusetts were from Virginia (Pryor 1983:4).

Virginia and published in 1648 or 1649, stated, "There are bees in the woods that provide wax and honey and there are tame bees around the houses" (Goodwin 1956; Maxwell 1849:62-63; Riley 1956; Spencer 2000:348). Many of the honey bees escaped into the woods, "adapting themselves to the new conditions, and becoming a part of the wild landscape" (Pryor 1983:4).

This fluid movement of swarms is illustrated by the 1641 Salem, Massachusetts Supreme court case between John Kirtland and Jno. Deacon (Adams 1921:277; Crane 1999:92; Pellett 1938:3). John Kirtland had a small apiary in what is now Lynn. He gave a tree to Jno. Deacon without realizing there was a swarm of honey bees making the tree their home. Each man claimed they owned the honey bees. Unfortunately, I do not have any information on who won the case, but there had been similar cases in English courts for hundreds of years, proving this was an old, familiar problem.

Inventory records can be deceiving. Because many beekeepers kept honey bees in log hives, which resembled firewood strewn around the holding, often the hives were not recognized as such. And some of the inventories did not seem to consider honey bees worth mentioning;[14] there is no mention of honey bees in the 1624-1625 muster (an inventory of all people, livestock, and some material items in Virginia). It is possible that at the time of the muster there were no honey bees being kept, only honey bees that were living in the woods around the settlements, and that it was only later that someone with the knowledge and interest captured a swarm and transferred them to their holding.

Also confusing is the 16th and 17th century terminology. The word 'hive' was not used until the 1650 inventory of Thomas Barker of Rowley. Before that the terms 'stand', 'stok', 'stake', 'stall', or 'skep' were used to describe the hive, the honey bees, or a hive full of honey bees (Pellet 1938:3).

The feral honey bee population boomed. To such an extent that Pryor claims, "the availability of wild honey held back the growth of formal apiculture in the

[14] In 1662 York County Appraisers reported, "The Bees wee conceive not to be Appraised" (Spencer 2000:127).

Chesapeake region" (Pryor 1983:5). The average amount of honey obtained from a bee tree was fifty to seventy-five pounds[15] (Pryor 1983:5), enough to supply your family for a year or to make a quick profit. In Peter Kalm's travel diary (1748) there is a claim that all swarms head southward (Benson 1964). This is not so. Swarms branched out in all directions from human settlements and the honey bees were assisted in their immigrations by settlers who carried beehives with them as they moved into new territory. "How far they [a swarm] will travel in search of a home is also uncertain. I have heard of their going seven miles, but could not learn how the fact was proved..." (Quinby 1864:213).

By the mid 17th century honey bee hunting or 'lining'[16] was a popular activity and would continue to be so well into the 20th century. Among those who prided themselves on their ability as honey bee hunters was Pennsylvanian St. Jean de Crevecoeur (Goodwin 1956). Honey bee hunters would use a blade of grass dipped in a mixture of water and ochre to mark the back of honey bees as they came to a watering place (Wildman 1778:214). These marked honey bees were then followed as they carried their load of water back to the hive. A second method was to lure honey bees into a hollow reed by placing a small amount of honey inside the reed and then releasing the honey bees one by one. You would follow the first honey bee released as far as you could and then release a second, which you would again follow. This was repeated until you found the hive or ran out of honey bees. The assumption was that the honey bees would immediately return to the hive once released (Wildman 1778:214-215). Another hunter suggested placing sweets for the honey bees to gather and then noting the line back to the hive. A second location is then baited with sweets and, again, you note the line back to the hive. Where the two lines dissect is where the wild beehive could be found. You could then acquire the

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[15] Burgett claims that Oregon feral populations produce 30 pounds of honey on average (Burgett, 2002). Beers claimed that you only got 20 pounds of honey from a managed hive in the early 19th century (Beers 1804:29). Pryor's figure may be overly optimistic or based on the idea that feral hives would only be harvested once every few years, so a greater accumulation of honey per hive was possible.

[16] Ransome suggested this was where the term 'beeline' came from (Ransome 1937:272).

honey by sawing off the limb or felling the tree and then chasing out the honey bees with burning straw or grass (Goodwin 1956; Jardine 1843:284-285; Williams 1975:35). The optimistically minded would dress hives "with aromatic plants agreeable to bees and then with honey; after which they place them near to springs or other places that bees resort to, especially about their time of swarming. The bees, thus allured, settle sometimes in these hives, which are afterwards carried home" (Wildman 1778:215-216). Because honey bees did sometimes chose to occupy empty hives there was a law that Huish (1844:footnote:193) called obsolete, which made it illegal to place an empty hive in your garden. The intent must have been to limit court cases involving disputed ownership of swarms.

Honey bees were commented upon by people as they moved across the landscape. Some of those people were surprised that honey bees were not in the territory they were going through, others celebrated a new introduction. (See Table 1 on page 27 for a brief timeline of honey bee dispersal). Meriwether Lewis and William Clark's journals, 1804 to 1806, mention that "bees left us at the Osage River"[17] (Williams 1975:33). Crane, 1999, says that the early 19th century advance of honey bees along the eastern bank of the Missouri River was "recorded as 600 miles in 14 years." She believes this was with the help of settlers (Crane 1999:91). Jardine (1843:284) commented that the honey bee had naturalized westward as far as 95 degrees longitude in the United States.[18] There is an often told story that the honey bee only made it across the Allegheny Mountains because of a hurricane in 1670 that picked up a swarm and swept them across (Mason 1998:425; Williams 1975:33).

Canada was slow to acquire the honey bee. Peter Kalm (1750) believed that all honey bees in Canada died during the winter and that honey bees naturally swarmed southward (Benson 1964). Belknap (1792) agreed that honey bees did not

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[17] Lewis June 10, 1805 "the bee martin or *Kingbird* is common to this country tho' there are no bees in this country, nor have we met with a honey bee since we passed the entrance of the ⟨ Osage ⟩ [*NB: Kanzas*] river" (The Journals of the Lewis and Clark Expedition 2004).

[18] In the United States 95 degrees longitude are roughly in a straight line from the east Texas border to the west Minnesota border.

yet live in Canada, but he went on to say, "it is however not improbable that as cultivation extends, the bees may find their way to the northward of the lakes and rivers of Canada, even though none should be transported thither by the inhabitants."

There are two stories of how honey bees came to the West Coast – one claiming the honey bee came down through Alaska by way of Russian traders and settlers, while the second theory, and the one I believe most plausible, has the honey bee coming from the East with the help of settlers moving into a new land. Essig and Free recount the first story – where honey bees were brought to Sitka Alaska in 1809. Some people have claimed descendents of these bees were taken to Fort Ross, California soon after it was established in 1812, by the Russians when they advanced down the Pacific coastline. Essig and Free do not believe this was possible because neither J. F. Escholtz, a Russian entomologist traveling through California collecting samples 1824 to 1825, nor Captain F. W. Beechey who toured the California missions making notes of native flora and fauna in 1826, mention seeing honey bees in their travels (Essig 1931:265-266; Free 1982:117).

It is generally agreed that honey bees first came to California in the early 1850s (Crane 1975:476; Essig 1931:265-268; Imirie 2000). Essig (1931:268) cites an 1860 letter from F. G. Appleton, a San Jose apiarist, that says the first honey bees in California arrived in March 1853. There were 12 swarms purchased in Panama, which were carried across the "Isthmus and thence by water to San Francisco" (Essig 1931:268). Only one hive survived the trip and that hive was taken to San José where it produced three successful swarms that first year.

In 1847 Navy Lt. Neil M. Howison was sent by the government to make "an examination of the coast, harbors, rivers, soil, productions, climate and population of the [Oregon] Territory" (Williams 1975:32). He arrived July, 1846, aboard the *Shark* and spent the next six months fulfilling his assignment. He wrote:

> "A more lovely country nature has never provided...the natural flora of this country is said, by those acquainted with the subject, to be very rich and extensive. Speaking of flowers reminds me that the honey-bee has not yet been naturalized – a desideratum which every one seems to notice with surprise where the sweet briar and honeysuckle,

> the clover and wild-grape blossom, 'waste their sweets upon the desert air'" [Williams 1975:32].

There was an attempt made to bring honey bees to Oregon in 1846. A settler planning to travel on the Applegate trail was offered $500 for the successful delivery of just one hive of live honey bees, so he packed two hoping that one would survive the trip. The honey bees died when the cold and snow of winter arrived before the wagons made it across the mountains (Williams 1975:33). I believe that their death was probably caused by dysentery, starvation, or a lack of ventilation in the hives rather than because of the cold.

Many others believed honey bees could not survive in Oregon because of the rain. Charles Stevens in 1853 wrote:

> "There is one thing that I have always wanted to mention, but it has alwais [sic] slip my mind, and if you ever come to Oregon you must not make any calculations on keeping Bees, for they cannot be raised here, the winters are not cold enough to keep them in, they come out of the hive to fly about, and a little shower of rain will catch them and in that way the whole swarm will soon be destroyed" [Williams 1975:33].

Some claim that Tabitha 'Grandma' Brown who owned and ran a school and orphanage in Forest Grove, Oregon had a honey bee tree at the school in 1849 (Williams 1975:34). However, this may be a case of memory being slightly inaccurate because there were many accounts claiming that the first honey bees arrived in Oregon in 1854.

The August 1, 1854 *Oregon Statesman* included a story about John Davenport of Marion county who brought home a hive of honey bees from back east. These were considered the first in the area. It was later reported that this first hive of honey bees did not do well (Williams 1975:34).

Pryor (1983:5-6) claims that beekeeping around the Chesapeake area declined after 1670 due to an outbreak of the bacterial disease American Foulbrood. She cites the inventory records for Prince Georges County, Maryland, which have

only three entries for honey bees between the years 1696 to 1720 as proof of the overall decline in beekeeping.

On first glance the York County inventories seem to support this conclusion. From 1660 to 1669 the York County inventories mention honey bees only twice, from 1670 to 1679 honey bees are mentioned once, and from 1690 to 1699 honey bees are, again, mentioned twice (Spencer 2000:109). Additionally, only about 2% of the records for the Prerogative Court of Maryland from 1674 to 1675 mention apiculture (Pryor 1983:6). Finally, the Surry County estate inventories from 1680 to 1689 mention honey bees only once (Spencer 2000:348).

All of this information must be considered in context. Most of the poorer beekeepers used log hives or wooden structures that were cobbled together and these may have been considered firewood or scrap lumber and consequently not recognized, or mentioned, as hives (Pryor 1983:6). Many of the inventories were conducted to determine the level of taxation for a property or person and this may have been one incentive for making beehives inconspicuous. Another reason the written record alone cannot be relied on as an information source is the fact that many of them are missing. Several towns in Virginia were burned or shelled during the revolutionary and civil wars and records were lost. For these reasons I cannot agree that beekeeping declined due to an infestation of American Foulbrood during the 18th century without more evidence.

The fact that beeswax was an important 18th century Virginia export is another piece of evidence that disputes the low number of managed beehives present in much of the written record. Sir William Gooch, governor of Virginia from 1727 – 1749, described Virginia's commodities, which included beeswax (Bruce 1896:118). In a 1743 report to the Board of Trade, Governor Gooch stated that the wax was exported to Portugal and the Island of Madeira (Chandler 1925:238). In Mair's Book-keeping (1760) the products of Virginia and Maryland[19] also included

[19] "The produce or commodities of the growth of Virginia and Maryland are pitch, tar, turpentine, plank, clapboard and barrel staves, shingles, wheat flour, biscuit, Indian corn, beef, pork, fallow, wax, butter and liye stock, such as hogs, geese and turkeys" (Tyler 1966:1:215, XIV:87).

beeswax. All the products were "generally export, in small sloops of their own, to the West India Islands particularly to Barbadoes, Antigua and St. Christophers; and in return, bring home rum, sugar, molasses, and cash, being mostly Spainish coins" (Tyler 1966:I:215, XIV:87).

The total amount of beeswax exported from Virginia in 1730 (just over one hundred years since the first import of honey bees to North America) was 156 quintals, equal to 156,000 kilograms, or about 343,900 pounds (Pryor 1983:20). Beers (1804:29) claimed that the average managed hive yielded 20 pounds of honey and 2 pounds of wax. If this is correct then there had to be 171,950 hives harvested that year just for export purposes. There would have been many more hives harvested for domestic use. This booming Virginia beeswax export continued and in 1739 five tons of beeswax @ 12d = £12,500 were shipped out (Chandler 1925:240) and in 1743 four tons valued at £400 were exported (Chandler 1925:238; Pryor 1983:20). Even with this volume of wax production the records from 1747 to 1758 for Prince George's County, Maryland, only mention bees in 7% of large estates (over £200). There was no mention of honey bees for the middle and lower class farms (Pryor 1983:6).

Estate inventories include large amounts of beeswax that were probably either being stockpiled for later domestic resale or export. Mr. Robert Tucker of Norfolk County had 1,730 pounds of beeswax at the time of his March 1723 inventory (Bruce 1897:360). In 1728 Nathaniel Harrison Esq.'s July 15 estate inventory included 50 pounds of beeswax (Stanard 1968:XXXI:372).

Hobart tells how the feral populations of honey bees escaped domestication by pressing, "forward far into the uncleared wild; and widely in advance of the conquering colonist" (Shuckard 1866:7). To most Native American populations, the honey bee was a sign that once again they were being pushed westward. As a result the Native Americans called the honey bee 'White Man's fly' or 'English Man's

fly'[20] (Adams 1921:277; Belknap 1792; Crane 1999:91; Free 1982:116; Jefferson Notes...; Pellet 1938:2; Pryor 1983:3; Ransome 1937:272; Shuckard 1866:81; Williams 1975:33). *Tour on the Prairie* by Washington Irving (1832) commented on the speed at which the honey bees entered the west and the fact that Indians used the honey bee as a gauge of how close white settlement was getting to their territory, "it is surprising in what countless swarms the Bees have overspread the far West within but a moderate number of years. The Indians consider them the harbinger of the White man...and say that...as the Bee advances the Indian and buffalo retire" (Crane 1975:476). The poem "The Song of Hiawatha"[21] finished by Longfellow and based on *The Myth of Hiawatha* compiled by Jane (an Ojibway Indian) and Henry Rowe Schoolcraft (a geologist, historian, explorer, and superintendent of Indian affairs for Michigan 1836-1841) also mentions the honey bee as the 'stinging fly' (Poet's Corner). Dodderidge (1813:13) wrote, "that the Indians consider the appearance of bees amongst them, as a fatal omen of their speedy removal. First come bees, they say; soon after them the white man, with an iron string, meaning a surveyor's chain, and then the Indians must soon go off." John Eliot, who in 1661 translated the New Testament into a Native American language and in 1663 completed the entire Bible, both of which he published in Massachusetts, found there was no Native American word for wax or honey and claimed that the Indians used the term 'White Man's fly' (Pellett 1938:2).

The only Native American group to incorporate beekeeping into their culture were the Cherokee (Free 1982:116-117; Ransome 1937:272). This was less an incorporation of a new species, new food, or European practice into a Native culture than it was an extension of the Cherokee adoption of European culture during the late 17th and early 18th century. The portion of the Cherokee that chose to live next

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[20] An "Indian who sees the bees at work, had already seen the horse and the ox, marveled at the animals working for white men. The animals and the men were all strangers to the land. The Indian says 'Huh! White man work, make horse work, make ox work, now make fly work; this Injun go away!'" (Adams 1921:277; Pellett 1938:3).

[21] "Wherso'er they move, before them, Swarms the stinging fly, the Ahmo, Swarms the Bee, the honey-maker"

to, and in sync with, their white neighbors were very successful beekeepers and by 1706 they had a profitable beeswax trade (Free 1982:116-117; Ransome 1937:272).

It took the honey bee 231 years (from 1622 to 1853) to cross the continental United States. In the beginning the honey bee was the precursor of white settlers, moving ahead of the human colonizers. However, honey bees were only able to cross geographic barriers such as treeless prairies or mountain ranges with the help of humans or, in one instance, natural phenomenon. The last barrier, the Continental Divide, was crossed first by white settlers with the honey bee following long after. Once on the west coast the honey bee flourished, completing this exotic specie's conquering of America.

Historic archaeology would benefit from an established geographic timeline for the honey bee. Discovery of the presence of the honey bee in soil samples associated with any archaeological project would help to date the strata the soil sample came from as well as the items uncovered in association with the soil sample. This can only be accomplished after a honey bee dataset has been established; one which confirms or corrects the timeline known currently from documentary sources.

Date	Location
1622	Jamestown, VA[22]
1638	Massachusetts[23]
1654	Delaware[24]
1660	New England[25]
1748	Pennsylvania[26]
1763	Florida[27]
1780	Kentucky[28], New York[29]
1793	Kentucky[30]
1797	West of the Mississippi R.[31]
1809	West of the Missouri R.[32]
1843	East of the Kansas R.[33]
1853	Pacific Coast, CA/OR[34]

Table 1 Time table of honey bee dispersal in North America according to documentary sources.

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[22] Crane, Eva. *A Book of Honey*. New York: Charles Scribner's Sons. 1980:120; Imirie, George W. Jr. "History of Honey Bees." George's Pink Pages. December 2000. GImasterBK@aol.com; Pryor, Elizabeth B. *Honey, Maple Sugar and Other Farm Produced Sweetners in the Colonial Chesapeake.* Accokeek, Maryland: The National Colonial Farm Research Report, 1983:2; Rockefeller, John D. Jr. Library. Mary Goodwin's response to request for info on beehives and bee culture Jan 26, 1956.

[23] Free, John B. *Bees and Mankind.* London: George Allen and Unwin Ltd. 1982:116.

[24] Pryor, Elizabeth B. *Honey, Maple Sugar and Other Farm Produced Sweeteners in the Colonial Chesapeake.* Accokeek, Maryland: The National Colonial Farm Research Report, 1983:2.

[25] Pryor, Elizabeth B. *Honey, Maple Sugar and Other Farm Produced Sweeteners in the Colonial Chesapeake.* Accokeek, Maryland: The National Colonial Farm Research Report, 1983:4.

[26] Benson, Adolph B. *The America of 1750 Peter Kalm's Travels In North America Vol I.* New York: Dover Publications Inc., 1964.

[27] Free, John B. *Bees and Mankind.* London: George Allen and Unwin Ltd. 1982:117; Pellett, Frank Chapman. *History of American Beekeeping.* Iowa: Collegiate Press, Inc., 1938:2.

[28] Barton, Benjamin Smith (1793) "An Inquiry into the Question Whether the *Apis mellifera* or the True Honey-Bee is a Native of America". Trans. Am. Phil. Soc.: 3:241-261; Pellett, Frank Chapman. *History of American Beekeeping.* Iowa: Collegiate Press, Inc., 1938:2.

[29] Ransome, Hilda M. *The Sacred Bee in ancient times and folklore.* Boston: Houghton Mifflin Co, 1937:260.

[30] Free, John B. *Bees and Mankind.* London: George Allen and Unwin Ltd. 1982:117; Ransome, Hilda M. *The Sacred Bee in ancient times and folklore.* Boston: Houghton Mifflin Co, 1937:260.

[31] Ransome, Hilda M. *The Sacred Bee in ancient times and folklore.* Boston: Houghton Mifflin Co, 1937:260; Williams, Catherine. "Bringing Honey to the Land of Milk and - *Beekeeping in the Oregon Territory.*" *The American West "The Magazine of Western History."* Vol XII No 1 January 1975:35.

[32] Crane, Eva. *The World History of Beekeeping and Honey Hunting.* New York: Routledge. 1999:92.

[33] Williams, Catherine. "Bringing Honey to the Land of Milk and - *Beekeeping in the Oregon Territory.*" *The American West "The Magazine of Western History."* Vol XII No 1 January 1975:32-33.

[34] Crane, Eva. *Honey A Comprehensive Survey.* London: William Heinemann Ltd. 1975:476; Imirie, George W. Jr. "History of Honey Bees." *George's Pink Pages.* December 2000. GImasterBK@aol.com; Essig, E. O. *A History of Entomology.* New York: The Macmillan Co. 1931:265.

Micro-location (Within the Homestead)

As described above the honey bee entered North America at Jamestown Virginia in 1622, but who became the beekeepers? It is important to remember that most of the colonists were from England where beekeeping as a supplementary activity to farming had been practiced for hundreds of years. Many of these English beekeepers were of the yeoman class[35] and that would remain true for the American colonies in the 17th century. By the 18th century Bidwell and Falconer (1925:127) claimed that honey bees were "considered an important adjunct of every well-managed farm." As the country grew in population, and cities became more common, beekeeping became an activity practiced in towns as well as on farms.

For hundreds of years beekeepers touted the honey bee as a profitable venture for rich and poor alike.[36] Some kept honey bees for the wax and honey they needed for personal use as noted by Durand of Dauphine (1687) who visited Maryland and Virginia and wrote, "They also have bees, so they make wax candles and eat the honey" (Spencer 2000:371). Others kept honey bees for trade. Bidwell and Falconer (1925:133) pointed out that in the 18th century hard money was scarce and barter was the usual practice at country stores, beeswax being one of the items the storekeeper would desire. As noted above, beeswax was an important export for Virginia during the 18th century and as a consequence some of the 18th century beekeepers became cottage industrialists.[37]

By the mid 17th century, honey was fairly common due to bee hunting and a growing apiculture industry. Even in New England nearly every house had one or two hives (Pryor 1983:4). The 18th century saw an increase in the dispersion of

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[35] Yeoman is a very plastic term. Generally it refers to a freeholder who cultivates their own land, but has lower status than gentleman. The rural middle-class were yeomen.

[36] For quotes about the low cost of beekeeping see this paper, the section on material culture.

[37] Cottage industries were those undertaken by the members (usually family) of a farm during the seasonal lulls in farming activities. Winter days were spent making products specifically for resale rather than just for self-sufficiency. This was the primer for industrialization – focusing some of the family's time on production of goods not to be used on the farm, creating a surplus income for the farm household that could be used to purchase luxury items, and creating a network of suppliers for merchants in towns who then set-up trade networks with other countries . These were the tracks on which the train of industrialization began.

honey bees, but the average beekeeper still kept from 5 to 7 hives. (See table 2). This is an easily managed quantity and gave the beekeeper enough honey bees to harvest honey each year even using the smothering[38] method. As well as the small beekeeper there were some high volume apiculturists. Sometime around 1781 Edmund Bacon[39] had a stand of fifty hives (Monticello Note Card). Huish (1844:426) agreed that the average beekeeper had five hives and he was aware of "only one apiary which ever reached the number of sixty." He believed that it was impossible to make a profit with more than twenty-five hives in an apiary (Huish 1844:426). However, Quinby was not so short sighted. The Civil War had interrupted supply lines for sugar imports and honey once again became the most available sweetener. In 1865, the last year of the Civil War, Quinby and a partner owned ~1,200 hives and he shipped eleven tons of honey to New York City, "causing both quite a stir in the press and a strain in the market" (Mason 1998:484).

Time Span	Total # of Inventories	# of Inventories Mentioning Bees	Avg # of Hives with Bees/Person
1745-1753	141	3	9
1753-1760	120	4	2.25
1760-1767	152	2	4
1767-1772	95	2	3.50
1772-1778	102	16	4.31
1778-1787	124	9	4.78

Table 2 Augusta County, VA Inventories. (Beekeeping Bibliography last print date 2/13/93, last revision date 6/21/92. Rockefeller Library, Williamsburg, VA). Few inventory records include information on bees. The average number of hives containing bees is per person/inventory. The minimum was one hive and the maximum was 14.

Where were beehives placed within the homestead? Currently beehives are placed next to crops and in some cases this was true for 17th to 19th century

[38] Using sulphur matches to kill the bees. See this paper, the section on material culture and the portion dealing with hives and honey extraction/beeswax processing.

[39] Edmund Bacon was the resident overseer at Monticello for 22 years. Thomas Jefferson included bee houses in one of his plans for a building at Monticello, but there is no evidence that they were ever constructed (Monticello Note Card).

beekeepers. "It is well known, that where land is cultivated, bees find a greater plenty of food than in the forest. The blossoms of fruit trees, of grasses and grain, particularly clover and buck wheat, afford them a rich and plentiful repast" (Belknap 1792). Corn fields, however, were "a barren desert to them during the most considerable part of the year" (Wildman 1778:163).

Other cultivated areas that were possible sites for beehives included orchards, which were numerous. The first record of an orchard in Virginia was Sir Thomas Gates' in 1615 (Spencer 2000:343) and the largest 17th century orchard belonged to Colonel Fitzhugh who in 1686 had "2500 [apple] trees of many varieties, such as mains, pippins, russentens, costards, marigolds, kings, magitens and bachelors, mostly grafted and well-fenced with a locust fence" (Ayres 1990:5). There were apple, quince, pear, and peach orchards from which colonists made alcoholic beverages like cider, used surplus fruit as animal fodder, and ate fresh and preserved fruits. Self-sufficiency had always been encouraged and in 1641 a law was passed in Virginia that anyone with 100 acres of land had to plant a garden and orchard protected by a fence, ditch, or hedge (Bruce 1907:331). Many of the orchards were used for multiple purposes, which would increase their attractiveness for honey bees by extending the bloom time. According to Ayres (1990:43) George Washington sowed turnips, spelts and wheat in his peach and apple orchards, Thomas Jefferson sowed white clover in one of his orchards in 1791, and William Murray, 1789, raised turnips in his orchard. "They therefore delight in the neighborhood of the white settlers' and are able to increase in numbers, as well as to augment their quantity of stores, by availing themselves of the labour of man" wrote an 18th century apiarist (Pryor 1983:4).

Many apicultural writers touted the benefits of a mixed environment where both cultivated and uncultivated areas were accessible to the foraging honey bees. In 1778 Wildman (96) listed the plants he considered of benefit to honey bees: thyme, oak, pine, cedar, all fruit trees, broom, mustard, clover, heath, turnip blossoms, and mustard. He also suggested seasonal movement of the hives to take advantage of

differing bloom times (Wildman 1778:163). Beehives were often placed to take advantage of the different areas found around villages, towns, and cities. According to Hobart, "their excursions to collect are variously estimated at from one to three miles, and they make about ten a day" (Shuckard 1866:351).

Some beekeepers (Huish 1844:424-425) did not believe cultivated areas were of any use to honey bees[40] and wrote that beehives should be placed within foraging distance from native plants. Miner (1857:244; emphasis in original) agreed and wrote that:

> "some people imagine that the vicinity of extensive flower gardens, is highly beneficial to bees; such as the gardens of gentlemen residing in the immediate vicinity of large cities, where almost every flowering plant and shrub that adorns both hemispheres may be seen. This is a mistake. Bees do not frequent such places at all, unless it be to visit a few of the common order of flowers. *Roses, pinks, tulips, carnations, dahlias, &c.*, have no attractions for this insect."

Swarms were greatly desired. They were the only way to increase your stock, which was absolutely necessary if you used the smothering method of harvesting honey and beeswax. If you wished to expand your apiary or offer stocked hives for sale, the capture of swarms was your only way of doing this. For this reason many apiarists suggested that the beehives be placed next to the house or near enough so that departing swarms would be noticed and re-hived. Denton (1670) said, "you shall scarce see a house, but the South side is begirt with Hives of Bees, which increase after an incredible manner..." (Bidwell and Falconer 1925:32). Hives were placed so they would receive the earliest sun in the morning and were free from drafts and damp. For these reasons many beehives were placed under the eaves of the house or outbuildings (Goodwin 1956). (See figures 1 and 2).

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[40] "The bee in general despises all cultivated flowers, and will pass by them with disdain to luxuriate on the common furze, the broom, the willow, the hawthorn, or the blackberry of our common hedges...but a hedge of furze and broom, or a field of wild mustard or white clover, commonly called cow-grass, is higher appreciated by the bees, than all the flowers which bloom in a garden...A highly cultivated country is by no means beneficial to the bee, for as soon as the harvests are got in, the fields are a complete desert to the bee" (Huish 1844:424-425).

Figure 1 17th century English children's picture book. (Rockefeller, John D. Jr. Library. Mary Goodwin's response to request for info on beehives and bee culture Jan 26, 1956). Notice sheltered beehives. Also depicted are a swarm and tanging.

Figure 2 Beehives under a protective roof outside a blacksmith's shop. (Rockefeller, John D. Jr. Library. Mary Goodwin's response to request for info on beehives and bee culture Jan 26, 1956). From Bowles's Moral Pictures: or Poor Richard Illustrated late 18th century.

Wildman (1778:102) wrote that the hives should be placed four yards apart and low enough to the ground that the honey bees descend upon returning with their heavy loads, while Huish (1844:163) claimed they should be four to five feet apart in a single line. The most stringent requirements were listed by Jardine (1843:158) "quiet is essentially necessary to their [the bees] doing well...The apiary, therefore, should be at a distance from smithies, mills, steam-engines, &c., and also from such manufactories as emit noisome smells." Huish (1844:162-170) agreed that honey bees do not like unpleasant odors or smoke and for those reasons their hives should not be placed next to areas that stink or in cities.

It is hard to believe but some beekeepers advocated wintering hives in cellars, or buried in the ground. Huish (1844:322), and Miner (1857:314-315), both disparaged these practices writing that cold did not harm honey bees, dampness did. As an alternative, Huish (1844:322) recommended covering the hives in pitch to keep them dry and free of pests.

Based upon these sources, there was no standardization of beekeeping in the 17th through the mid 19th century in America. I believe that each beekeeper placed the hives according to their level of interest in beekeeping and their understanding of what honey bees need to prosper. This variability can be tested by incorporating data on *Apis mellifera* L. from soil samples in any future archaeological investigations.

Based upon the information in the documentary record, outlined above, the best places to look for evidence of beehives on farmsteads would appear to be within or around orchards, on the edges of towns, in the riparian zones between farmland and forest, and on the south sides of farm buildings. This is difficult for many reasons. The riparian zones were constantly changing as the colonist's population grew and pushed outward. What was once farmland became towns as rural centers developed.

However, this does give us a place to start looking. As evidence of where farm structures were placed within the homestead is uncovered, soil samples should be taken at sequential distances from the south wall to a distance of approximately

1/8th of a mile or 201 meters. This is especially true if the south wall would have been easily visible from the house or was adjacent to the common areas of the farmstead where observation of swarms would also have been facilitated.

Sites containing evidence of colonial orchards should also have soil samples taken. The locations for these samples should depend on the size of the orchard. For small orchards a pattern of samples that evenly covers the entire area would be best, but for larger orchards a random sampling would be the most efficient and frugal method of retrieving evidence of honey bee populations.

One area worthy of sampling, but not mentioned in the literature, is outhouses. Honey bees collect water and for some reason are drawn to urine (Burgett 2002; Huish 1844:196). It may be the salts or minerals contained in urine that the honey bee finds attractive, but I am not sure. For our purposes it does not matter. I would suggest taking soil samples both within the pit area and immediately outside the outhouse.

Until archaeologists begin incorporating entomological evidence in their excavation plans we will have no clear understanding of the most basic aspects of insect and human interactions. Even the honey bee, with its thousands of years of co-evolution with humans, remains a mystery. Where were they? I believe this is a question worthy of an answer.

Material Culture

Most of the implements associated with beekeeping up until the mid 19th century were multi-purpose tools whose presence cannot definitively point to the existence of honey bees in North America. Even hives can be difficult to recognize due to deterioration or form. Straw skeps may have been reduced to basketry fragments and remnants of log hives may appear to be nothing more than wood fragments. Even extant log hives may not be recognized as part of a colonial apiary. Other wooden hive forms made of plank, or deal, may also go unrecognized because of the great variety of styles prevalent until L.L. Langstroth's model, with its initiation of bee space, became the norm.

As late as 1790, the natural history of the honey bee was largely unknown and bee management depended on custom and practices handed down through generations. "Very few men of talent had given the subject a profound attention, and the traditions and absurd fancies of olden times, in regard to this insect, were believed and acted upon, by the majority of bee-keepers" (Miner 1857:9). Huish (1844:231) deplored the lack of progress in beekeeping methods, "...the cottagers...those prejudiced and superstitious people...we have always found them so riveted to their antiquated habits, that all advice appeared to be thrown away upon them."

In this chapter I will discuss the material culture surrounding colonial beekeeping from the 17th century to the mid 19th century. Beehives are, perhaps, the most obvious material manifestation of beekeeping, and may be the easiest to recognize archaeologically, so I begin by separating the hives by material (wood, straw, and all others) and then discuss the many different forms. The different materials used to make, and reasons for, hive covers is next. Then the moving of hives and the processes necessary to extract honey and bees wax are described as completely as possible. Finally, swarming and bee hunting also have a material

culture. I discovered that before the mid 19th century innovations of bee space, smokers, centrifugal honey extractors, and rolled wax foundations beekeeping was accomplished using tools common to any colonial homestead.

Beehives

Pryor (1983:6) believes that the lack of information about honey bees in inventory records is due to the fact that many hives were hollow logs or "decrepit boxes" and so were considered lumber or of no value. In addition, inventory records may only indicate the presence of honey bees on wealthier estates because of the more elaborate, and therefore more easily recognizable, hive forms found on those estates. There were many different wooden hive forms. Some were for special purposes, such as hivers used to capture and temporarily house a swarm, while more often the differences in size and shape were due to personal preference or because that was what mom or dad had used. Dodderidge (1813:5-6) built an actual bee house, which allowed him to walk inside to tend the hives and where each outside honey bee entrance was painted a different color so the honey bees would not be confused as to which hole was the door to their home. M. Biege at Lileau, France built a bee wall and claimed that the honey bees did so well in it the wall was paid for within three years (Huish 1844:290-291).

In areas where trees were scarce, hives were often made of clay. Burgett (2002) mentions the use of clay beehives in the Greco-Roman wars. The hives could be launched from one ship onto another, where they would break open and surround the enemy crew with an angry, stinging swarm.[41] It is possible the first hive form used by early beekeepers was made of clay. Clay hives are depicted in early

[41] Huish (1844:26) does not mention whether clay or straw hives were used when "a small corsair, which, with a crew of forty or fifty men, and having on board some hives of bees, formed the daring project of boarding a galley with a crew of five hundred men, which was in pursuit of it. The corsair from the bowsprit threw the hives on the deck of the Turkish galley. The Turks, not being able to protect themselves from the stings of the enraged insects, became so alarmed, that they tried every means of sheltering themselves from their fury; the crew of the corsair, however, being provided with gloves and masks, boarded the galley, sword in hand, and obtained possession of the vessel, with scarcly any opposition."

iconography; one example is the stone relief fragment from the sun temple of Ne-user-re in Lower Egypt dating to c. 2400 B.C. (Crane 1999:164). (See figure 3).

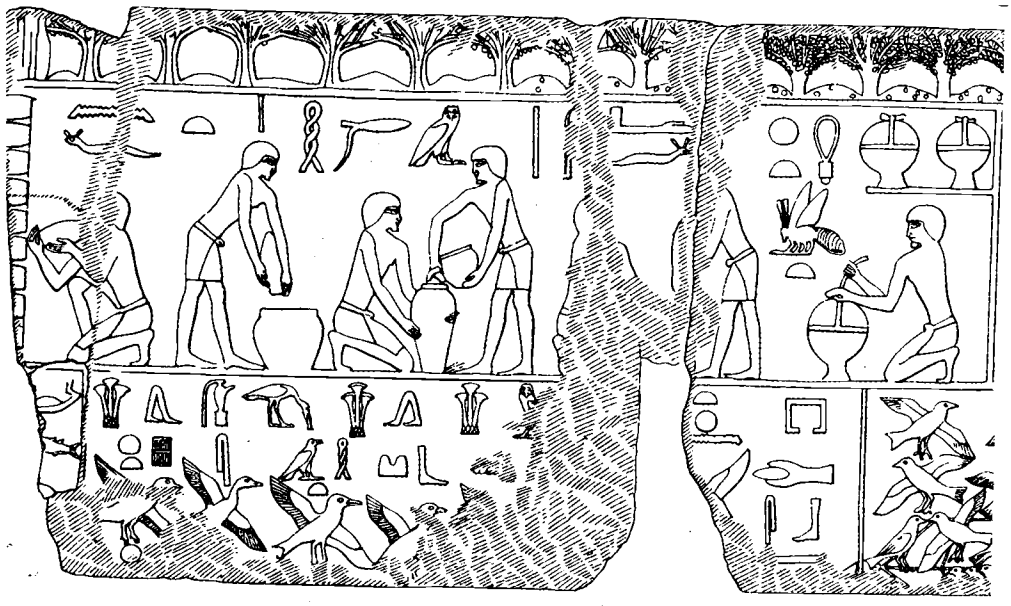

Figure 3 Bas-relief from sun temple of Ne-user-re. (© 1999 From *The World History of Beekeeping and Honey Hunting.* Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). The clay hives are stacked vertically on the far left with a figure kneeling in front of them.

Log hives, called gums in Virginia and some other parts of the country (Miner 1857:135), may be the original hive form for areas with a plentiful supply of trees. It is possible that the log hive is the natural next step after bee hunting. Instead of just stealing the honey, the hunter sawed off the section of tree containing the hive and transported it onto his property, thereby claiming the honey bees and all the profits of their future labors.

Log hives were still in such common use in the 19th century that Miner (1857:180; emphasis in original) wrote,

> "every one, I presume, has seen hives made from hollow trees, by cutting off the log of a suitable length, and then nailing a board on the opening at the top...I recommend this kind of hive to those who wish

> to keep bees *without any expense whatever*. There is no principle of the habits and economy of the bee, that conflicts with log-hives."

He went on to say, however, that all beehives in the United States should be made of plank because lumber was plentiful and cheap in this country (Miner 1857:181).

Huish (1844:243) claimed log hives were being used in Poland, Germany, Siberia, and Spain. He described a Polish log hive:

> "hollow out a piece of a middling sized pine tree, of about two yards in height, making an opening in front of the whole length of the hive, by which the comb is extracted, and which is made to open and shut at pleasure by two hinges. From the contracted limits of this hive, the bees seldom made more than one or two combs."

In Siberia the log hives were placed on the periphery of wooded areas and suspended to the trees "by bands of rushes, in order to prevent the bears from eating the honey, of which they are very voracious" (Huish 1844:323).

> "One of the greatest drawbacks to the storied hives is the *flatness* of the top, and this defect is even acknowledged by the staunchest advocates of the system. In the summer, the perspiration settles on the top, and thence falls in drops on the bees; and it was to obviate this evil, that Madame Vicat placed a piece of tin, bored with little holes, on the top of her boxes or stories" [Huish 1844:257].

The storifying hive,[42] hives placed on top of each other with a hole to allow access inside the hive to each area, was recommended by many 19th century apiarists. (See Figure 4). Dodderidge (1813:20) wrote that the "colony must consist of at least three hives, on top of each other." In this grouping the brood would remain in the bottom and the honeycombs would fill the top two stories. Huish (1844:246) wrote that "above a hundred hives have been invented, some being modifications or improvements of preceding inventions, and others professing to be wholly original." Each hive claimed to be superior in some, or all, aspects of beekeeping. Huish

[42] Modern hive systems are called supers with various numbers of supers, or stories, per hive dependent on the size and health of the colony and the reason for the hive, i.e. pollination, honey production, or both.

claimed that the storifying hive had undergone the most modifications of all[43] (Huish 1844:251).

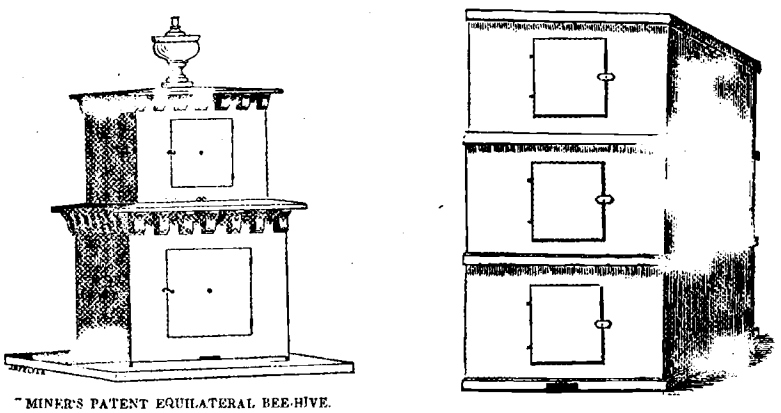

Figure 4 Storifying hives. (Miner, T. B. *The American Bee Keeper's Manual; Being a Practical Treatise on the History and Domestic Economy of the Honey-Bee Embracing a Full Illustration of the Whole Subject, with the Most Approved Methods of Managing this Insect Through Every Branch of its Culture, The Result of Many Years' Experience*. New York: C.M. Saxton and Co, Agricultural Book Publishers, 1857). On the left is a stylish two story hive and on the right is a more utilitarian three story hive.

A hiver was used when swarms would cluster upon the branches of trees too high to allow re-hiving in the normal fashion.

> "It is made by taking three light, thin boards about ten inches wide, and 18 inches long, and nailing them together in the form of a triangle, with both ends left open, and sundry auger holes bored through the sides, near the center. An iron strip is then secured to it, with arms extending along two of its sides, and a short shank projecting, which is made fast to a pole. This hiver may be raised by the means of the pole to any usual height that bees cluster, and by the use of additional joints to the handle, secured with ferrules, it may be raised to any reasonable height. It will be necessary to make the hiver as light as possible, in order to handle it conveniently. All that is to be

[43] "There is, perhaps, no species of hive which has undergone so many modifications, improvements, and alterations, as the storifying hive. At one time, the practice of storifying was so prevalent in France, that every other system gave way to it. Swammerdam may be considered as the father of the storifying system, and he mentions that he once possessed a colony of *thirty stories*" (Huish 1844:251).

> done when bees cluster beyond the reach of ordinary means, is to place the hiver over them, with some of the holes in contact with them, and in a few minutes they will enter it, when it may be taken down, and the bees shaken out on a table in front of a hive intended as a permanent residence, with one side raised about an inch, and they will enter speedily" [Miner 1857:267-268].

This light weight contraption was constructed by the beekeeper and could also be used for the dividing of a hive or the temporary storage of a swarm.

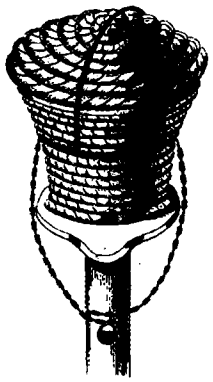

Figure 5 Theft-proof hive. (Jardine, Sir William, Bart. Ed. *The Naturalist's Library* Vol. XXXVIII. Edinburgh, 1843). This picture appears to be similar to Huish's description.

Hive forms continued to evolve to meet the needs of the moment. Huish had a problem with people stealing his hives. To prevent this he developed a chain and lock system to go over the hive. (See figure 5). The tools needed to steal a hive were few.

> "The only implements which the robbers of hives carry with them are a tinder box and some bundles of matches; and in order to obtain possession of their intended booty, they have simply to apply the ignited sulphur underneath the hive, and the property becomes their own" [Huish 1844:166].

The hive that revolutionized beekeeping was L. L. Langstroth's 1853 design which incorporated bee space. This allowed free movement inside the hive by the honey bees while combs were created only within the frames placed in the hive. The honeycomb being unattached to anything but the frames allowed easy removal of the honeycombs and a more thorough inspection of the hive for pests, disease, or mold. Bee space is the concept that makes our modern honey bee industries possible and finally led to a consolidation of hive form.

Finally, before I begin describing the straw hives, I cannot ignore the instructional hive, where glass, or a mirror, was used as part, or all, of the hive. The glass bell hive offered a complete view of the bees at work, but could only be used for short periods of time. Some hives used glass as one wall or inserted a window into one wall. This offered a very limited view of the interior, especially considering the lack of light inside the hive. The most elaborate instructional hive form was the leaf hive which had hinged glass panels that allowed a person to open it comb by comb like a book; when closed it looked much like any other wood hive. (See figure 6). These hives were used by students of natural history or the general public for entertainment. They were not used for honey production.

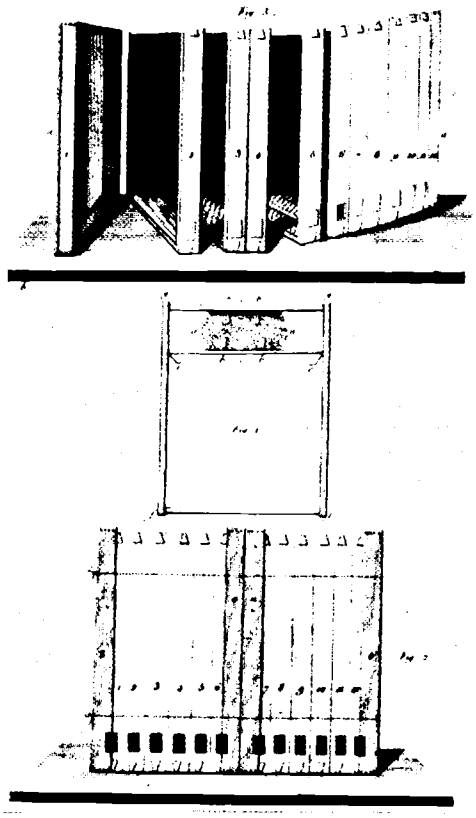

Figure 6 Huber's leaf-hive, 1792. (© 1999 From *The World History of Beekeeping and Honey Hunting.* Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). Top picture is with the hive open, while the bottom picture is with the hive closed

Straw hives were popular for hundreds of years in many countries including colonial America. (See figures 7, 8, and 9). Wildman (1778:98) was a proponent of the straw hive:

> "Straw hives, as far as regards the bees, are preferable to any other habitations, because the straw is not so liable to be heated by the rays of the sun at noon, to which they are generally exposed, and is a better security against the cold, than any kind of wood or other material. Their cheapness renders them of an easy purchase, even to the cottager."

Wildman's straw hive held a peck (8.8 liters or 8 quarts) (Wildman 1778:99) while the Germantown, Pennsylvania Society for "promoting domestic manufacture" recommended a straw hive that held six gallons (Goodwin 1956). Straw hives were cleaned inside and out with a coarse cloth which removed loose straw and other impurities attached to the straw (Wildman 1778:135).

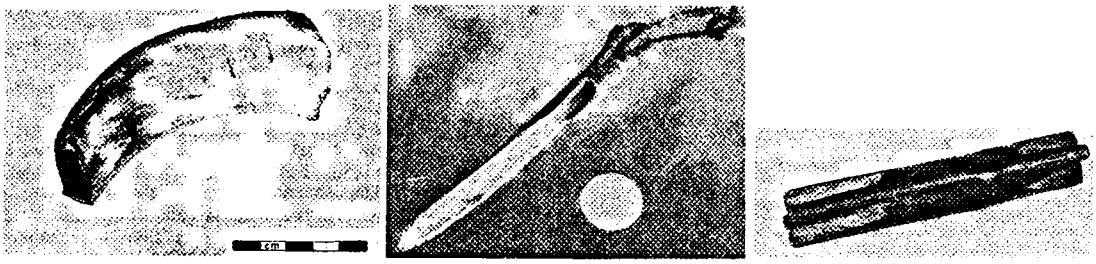

Figure 7 Straw hive construction tools. (© 1999 From *The World History of Beekeeping and Honey Hunting*. Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). Left: English girth made from cow's horn. Middle: English awl made from chicken bone. Right: Dutch cleaver for splitting cane or briars.

Although many agree that straw made a better beehive than wood, straw hives were not always possible. "Straw I should think preferable to wood, but I have never used it for want of a workman to make them of that material" (Dodderidge 1813:9). Huish blamed the straw hive for the continuing practice of killing the honey bees to harvest the honey as most people were too fearful to turn the hive bottom up to remove some of the combs while the bees were still alive.

"It is well known that the hives in this country are generally made of straw in the form of a bell, and although no immediate objection can be made to the shape, yet in many of the necessary operations with the bees, and especially in the act of deprivation, it is a decided obstacle to any successful result; and we are thoroughly convinced that as long as the bell hive is in use, the system of suffocating the bees will be preserved in" [Huish 1844:244].

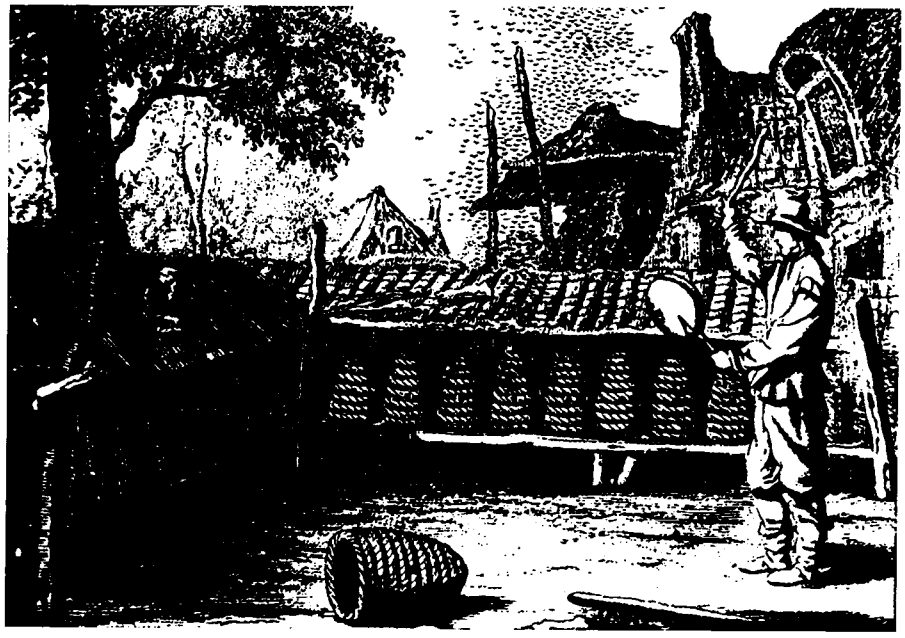

Figure 8 Bell shaped straw hives. (© 1999 From *The World History of Beekeeping and Honey Hunting.* Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). Illustration by J. van der Groen, 1670, gardener to the Prince of Orange.

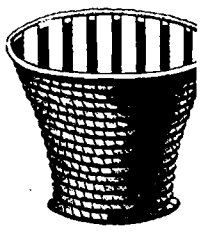

Figure 9 Straw hive with bars. (Jardine, Sir William, Bart. Ed. *The Naturalist's Library* Vol. XXXVIII. Edinburgh, 1843). The bees were supposed to hang the honeycombs off the bars so they were easier to remove and so that beekeepers would have a view into the hive. There was a removable top as part of this hive.

Not everyone was a fan of the straw hive.

> "Straw hives are not much used in this country; and they never would have been made in any country, but for their cheapness. The peasantry of Europe, who are not able to furnish their apiaries with wooden hives, still continue in the use of those made of straw. I consider this kind of hive as wholly unfit for the use of people who live in a land of plenty, and who are able to make wooden ones at a rate but a little dearer than those made of straw. Straw hives are only worthy of a state of abject poverty, and I hope that I shall never see one in use in this land of milk and honey, where every man can sit down to his 'roast beef and plum pudding,' and go to bed with his pockets jingling with 'mint drops.'" [Miner 1857:180].

Although Huish (1844:290)[44] rated straw as the best material from which to make beehives he disliked the straw hive because he believed it encouraged the continuation of the practice of suffocating the bees to harvest the honey and because it made inspection of the hive for pests, diseases, etc. very difficult (1844:244 & 359). In answer to at least one of these problems, Huish suggested that beekeepers place a small ball shaped hive on top of the original straw hive with a hole connecting the two on the interior. "One of these small hives will weigh from fifteen to eighteen pounds, and supposing that it fetches at the market only one shilling a pound, which is a very low price indeed for pure white honey comb, fit for the breakfast table or the dessert" it made for a fine profit (Huish 1844:363).

While some people using log hives simply set them on the ground around their property, most people who used other hive forms placed them on a bench or on posts. Huish (1844:295) recommended the post as one of "the best preventives against the attacks of almost every enemy; to ensure success, however, the bottom of it must be covered over with some unguent, such as pitch or tar; or a piece of sheep's skin with the wool on, will be found, of all preventives, the most efficacious."

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[44] "Were we required to form a scale of excellence relative to the materials used for the construction of hives, we should place straw undoubtedly as the first, wood as the second, earthenware as the third, and glass as the fourth and the worst" (Huish 1844:290).

A second pest control was to hang a bottle, containing a small amount of some sweet liquid, near the hives to trap wasps. Unfortunately, it also helped attract wasps to the bee yard and lured bees to their death (Huish 1844:299).

To kill worms and other pests ensconced in the hives, Quinby (1864:189) recommended enclosing the hives in a fairly air tight container and then setting several sulphur matches[45] in a dish and lighting them. The hives should remain in the closed container for several hours. "A little care is required to have it just right. If too little is used, the worms are not killed; if too much, it gives the combs a green color" (Quinby 1864:189). If the worms were not killed the fumigation could be repeated. Quinby (1864:189) was not sure if sulpher would kill the eggs of the wax moth, but he was positive it would kill the larvae.

Both the larvae and the eggs of the wax moth are killed by freezing. For this reason Quinby (1864:189-190) recommended that those living in an area with long freezing winters leave the hives out in the cold.

Hive covers

Hives were covered in different materials for different reasons: warmth, pest control, to keep out damp, and to prevent the honey bees from leaving the hive. Many of these covers were detrimental or simply unnecessary. Honey bees can control the temperature within the hive to a remarkable extent and, except under extreme conditions, do not need protection from the cold even in freezing environments. Upon selecting a home, the honey bee begins covering the inside with propolis, a waterproof substance that also fills small niches where pests can hide, but before the 20th century this was not known.

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[45] "They are made by dipping paper or rags in melted sulphur... Much less sulphur will adhere to paper or rags if it is very hot when dipped than when just above the temperature necessary to melt it" (Quinby 1864:189).

Wildman (1778:100-101) wrote about straw mats, sealed with cow dung, being used to protect the hives from cold and rodents. In 1792 the Germantown, Pennsylvania Society for "promoting domestic manufacture" stated that:

> "Whoever makes use of hives should at all times have them well secured from the inclemency of the weather; by means of a substantial straw cap, which not only preserves the bees from wet, than which nothing is more injurious, but also preserves the hive in a more equal temperature during the severity of summer heats and winter colds" [Goodwin 1956].

Figure 10 Bee hive caps. (Rockefeller, John D. Jr. Library. Mary Goodwin's response to request for info on beehives and bee culture Jan 26, 1956). This 18th century English engraving depicts tanging to bring down a swarm, but behind the group of four are beehives with straw hive caps.

Huish (1844:287-288 & 322) who appears from his writing to look down on women in general and female beekeepers in particular,[46] believed that cold was good

[46]"Ladies in general are but very sorry apiarians, and their very mode of dress exposes them to danger, from which the male sex are exempt" (Huish 1844:287-288).

for the honey bees.[47] It placed the bees in a state of torpor which meant they ate less. This enabled the beekeeper to take more honeycombs during harvesting and helped prevent a need to feed the honey bees so they could make it through the winter. For areas that did not have consistent cold weather in the winter Huish (1844:234) recommended placing the hives in an icehouse. However, he did suggest using a straw cap to protect the hives from too much sun, which could melt the combs, and for protection from humidity due to long periods of rain (Huish 1844:234 & 328). (See figure 10).

It is damp rather than cold that is detrimental to the honey bee. For this reason Huish recommended plastering the hives with pitch. "It is a direct preservative against the lodgment of any noxious vermin between the bands of straw, and in all seasons, the interior of the hive will be dry and wholesome, independently of the durability, which it imparts to the hive itself" (Huish 1844:322).

Moving Hives

Beehives have been moved from place to place to take advantage of differing bloom times for hundreds of years. By the mid 19th century, several apiculturists were recommending the practice for the United States. Unlike contemporary hive movements, which are planned mainly for pollination purposes, these movements were to increase honey production.

There was a more mundane reason for moving hives – in the transfer of ownership or due to a desire to move your apiary to another area. Remember, the honey bees entered North America because humans moved them from their homeland. And honey bees were only able to over spread the United States because

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[47] "The cottagers however, and particularly the aged females amongst them, from an amiable and well intentioned motive, entertain the notion that the cold will kill their bees; and therefore they wrap up their hives in old blankets, or any warm substances that they can collect together, little thinking, that if the hive be not well stocked with provisions, they have taken the most effectual means of bringing about its destruction. The greater the cold, the greater is the torpor of the bees; the greater the torpor of the bees, the less is their consumption of food" (Huish 1844:322).

of the help they received from humans. Treeless plains, wide rivers, and mountain ranges like the Continental Divide were impossible for the honey bees to surmount on their own.

Miner described the process of preparing the hives for moving, a practice best undertaken in the fall, winter, or spring when the cooler weather made the combs less likely to bend or break.

> "The bottom-boards should be secured firmly, with sufficient ventilation; and then hives may be placed in a spring-wagon, and transported almost to any distance. They should be turned bottom upwards, if the shape of the hive will admit it. Ordinary box-hives should have the floor-boards nailed on, and then pry them off just enough to admit the air, and the bees will go safely. I refer to common hives, used by those who pay little or no regard to improvement in such things; and which contain no means of ventilation, when the floor-boards are nailed close" [Miner 1857:327].

The ventilation should not be large enough to allow the bees to escape. Huish (1844:156-158) recommended using perforated tin doors for the hive entrances and then wrapping a sheet or table cloth around the hive.[48] This allowed ventilation without letting any honey bees outside the hive.

Shuckard (1866:85), wrote that in France "the hives of bees are moved up and down the adjacent rivers upon rafts, as the flowering of the crops succeed each other" and Huish (1844:156), claimed that water transport was the best for moving honey bees any distance. In the United States this form of movement was called "leading them to pasture" (Huish 1844:413). The beehives remained approximately two months in each place and "the peasants take care of them for a very trifling salary" (Huish 1844:413).

For short distances bee hives could be carried on a yoke or in a wheelbarrow. (See figure 11). To carry two hives by yoke you would prepare them with tin doors and a sheet as described above; a pole was slipped through the knots in the cloth

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[48]"A single cart contains thirty or forty hives. They travel only during the night and at a foot-pace, and as much as possible on sandy roads. The hives are covered with linen, and are arranged in stories; those of the upper being reversed between those of the lower story" (Huish 1844:413).

covering the hives, one on each end, and the pole was placed over your shoulders. Or several hives could be placed on the pole and two men, one carrying each end, could transport the hives to the desired location (Huish 1844:413). Mules, oxen, or horses could be used to replace the two men. It was important to minimize swaying of the hives so that the combs remained undamaged. Huish (1844:158-159) wrote, "When there are two or more hives to move, the handbarrow is decidedly the most appropriate vehicle of conveyance. We have moved a half a dozen hives at a time by means of that instrument."

Figure 11 Moving beehives by hand cart. (© 1999 From *The World History of Beekeeping and Honey Hunting.* Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). San Remo, 19th century.

Honey extraction/Beeswax processing

For centuries in England, Europe, and Germany honey bees were smothered so that humans could harvest the honeycombs. Ransome (1937:194) suggested that this practice was initiated by bee hunters robbing from feral honey bee populations and continued when these same bee hunters began keeping honey bees in hives. This practice was very similar to that described above to kill worms. The hive, or hives, chosen were placed in a nearly airtight box or barrel[49] and a dish was placed inside with sulphur matches, which were lit (Quinby 1864:189).

George Cooke (1772) wrote,

> "Various have been the endeavors to find out some way of reaping the profit of bees without destroying them, but as these all have failed in their attempts, we shall only describe the common method, and that is, the taking of combs by killing the bees, which certainly must be the only way of ordering them, because it is impossible for them to live, if you deprive them of their food; and therefore, about the latter end of August, consider with yourself what stalls you will keep, and what you will kill"[50] [Mason 1998:34].

Huish (1844:244 & 359), and Quinby (1864:314), claimed that it was the continued use of straw hives, as well as extremely large wooden hives, that made smothering a more attractive option than deprivation. Dr Bevan wrote,

> "the fumes of sulphur are converted into sulphuric acid, (vitriolic acid,) and the quantity which mingles with the honey is very small. I am fully persuaded, that so far from its causing the honey to disagree with the stomach and bowels, its tendency would be to produce a contrary effect. It is the honey, and the honey only that disagrees; to a greater or less extent, of course, according to the pasturage from which it has been collected" [Jardine 1843:227].

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[49] There must be enough draft to allow the sulphur matches to smolder.

[50] "Cooke, George. [1772]. *The Complete English Farmer: Or, Husbandry made perfectly easy, in All its Useful Branches. Containing what every Farmer ought to know and Practice.* [American edition]. Boston: Reprinted by Daniel Kneeland, for Henry Knox in Corn-hill. 142 p., [4] leaves. This book, it can be argued, may be the earliest bee publication in America" (Mason 1998:125).

As early as 1778, deprivation, the removal of excess honeycombs from the hive, was recommended over smothering[51] (Wildman 1778:175-176). This could be accomplished by the application of smoke made with linen rags, dung, rotten hay (Wildman 1778:177,188, & 208-213), rotten wood, rags, chips, wetted tow (Dodderidge 1813:22), a tobacco pipe filled with dried leaves or pounded tea (Huish 1844:229), or tobacco (Quinby 1864:31). It was believed that the honey bees disliked the smoke and would retreat from the harvester, but in actuality it initiates a preoccupation with feeding and the honey bees will ignore nearly everything else during this frenzy (Burgett 2002). Huish (1844:230) claimed that "the smoke of tobacco, however, should never be used; its pungency is too powerful for the bees, and it leaves behind it that unpleasant odour, which is so offensive to them, that they will frequently forsake their hive, rather than dwell in it."

Protective clothing was also recommended for those who still felt nervous.

> "But the most secure way of all, and beyond the completest harness yet published, is to have a net knit with so small meshes, that a bee cannot pass through, and of fine thread or silk, large enough to come over your hat, and to lie down to the collar of your doublet, through which you may perfectly see what you do, without any danger; having also on a pair of gloves, whereof woollen are the best" [Wildman 1778:144].

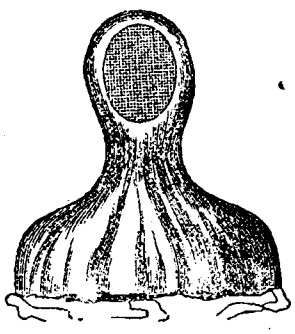

Figure 12 Protective hood. (Miner, T. B. *The American Bee Keeper's Manual; Being a Practical Treatise on the History and Domestic Economy of the Honey-Bee Embracing a Full Illustration of the Whole Subject, with the Most Approved Methods of Managing this Insect Through Every Branch of its Culture, The Result of Many Years' Experience*. New York: C.M. Saxton and Co, Agricultural Book Publishers, 1857).

[51] "In the works of Varro and Columella, we find some interesting remarks relative to the deprivation of hives, for it would appear in their time as if suffocation were totally unknown. The former of those naturalists mentions two methods of proceeding; one by changing the bees from one hive to another, and the other by deprivation" (Huish 1844:364).

Figure 13 Protective clothing. (© 1999 From *The World History of Beekeeping and Honey Hunting.* Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). 16th century German depiction of working the hives while wearing protective clothing.

(See figures 12 and 13). Huish (1844:229) used linen, iron wire, horsehair or gauze for a hood, coarse leather gloves "such as the housemaids' gloves," and gaiters or boots.

When it came to tools for honey extraction and beeswax processing, I believe colonists used what they had. In the 17th century few colonists had extra money for specialized equipment, especially when something they already had would do the job. Additionally, beekeeping was an agricultural industry that the poorest farmer could practice, especially with a little ingenuity.

Quinby used two tools for cutting out honeycomb. The first was a fairly broad knife 18 inches long, made by modifying an old scythe. It was square across like a chisel so that it was easily guided down the sides of the hive and thin so that it did not squash the honeycomb. The second tool was used to cut off combs at the top or any other place where they were attached to the hive. "It is merely a rod of steel three-eighths of an inch diameter, about two feet long, with a thin blade at right

angles, one and a half inches long, and a quarter inch wide, both edges sharp, upper side bevelled, bottom flat, etc" (Quinby 1864:33). (See figure 14). Huish (1844:285) also used two knives; "one long, for the purpose of detaching the combs from the side of the hive; and the other for cutting away any part of the comb which may be attached to the next bar to that which is to be extracted."

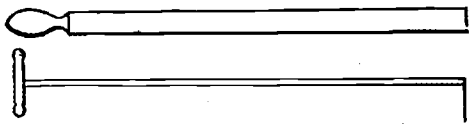

Figure 14 Honeycomb extraction equipment. (Quinby, M. *Mysteries of Beekeeping Explained Being a Complete Analysis of the Whole Subject* 8th edition. New York C.M. Saxton, Publisher, 1864). Drawings of the tools described above.

"The machinery of a hive generally consists of seven combs, that is, supposing the bees to be in the common cottage hive" (Huish 1844:286). Honeycomb should be removed twice, according to Wildman (1778:176) the first time removing 1/5th and the second 1/3rd of the stored honey.

Huish (1844:244) claimed that if you could find a cottager willing to turn a straw hive upside-down "the side combs are so very small, arising from the contracted segment of the circle, that they are scarcely worth extracting." However, he gave instruction for removing combs from straw hives even though it was an operation he "would recommend few persons to undertake" (Huish 1844:361). The honey bees had to be driven from the hive into an empty hive or a hiver, where they were confined by perforated tin over the openings or by tying a large piece of fabric around the entire structure as described above for moving a hive. The support sticks that many people used in straw hives were, according to Huish, quite unnecessary and caused a great deal of difficulty in removing the combs without loosing much of the honey on your hands or the sides of the hive. Each honeycomb cell that was cut immediately began to ooze the very thing you were trying to collect. Once you had

removed the appropriate number of honeycombs the bees had to be driven back into their original hive (Huish 1844:360-362).

In storied hives the upper hives, or stories, were the ones containing the honey and they could be removed by passing a wire in between the hives. This was best done in cooler weather so that the wax was stiff and would cut cleanly rather than mashing against each other or falling off and crushing some of the honey bees and possibly the queen. Empty hives were then placed on the bottom (Huish 1844:255-257).

To extract the honey from the combs there were several methods, all of which worked best on warm days, or in a room with a fire, so the honey was in a fluid state. This should be done in an area inaccessible to the honey bees, and other honey eaters, or else you would be surrounded while you were trying to work and some of the product would be lost (Huish 1844:375-377; Jardine 1843:229-230; Wildman 1778:200-203).

The finest honey was that which flowed from the comb without aid of anything but gravity.

> "Pure honey is that which has dripped from the combs without pressure, and consequently uncontaminated by any of the crude substances in the hive, such as bee bread, abortive brood, &c. Common, or heath honey, is that which has undergone the operation of pressure, and is consequently an adulterated article" [Huish 1844:369-370].

For gravity extraction of honey, the wax caps were cut off the combs and then the combs were cut in half and laid on a sieve placed over a catch basin of some sort (Huish 1844:375-377; Jardine 1843:230; Quinby 1864:364-367; Wildman 1778:208-213). To remove all particles from the honey, Jardine placed the combs over a wire mesh, which was set over a series of finer sieves until the last filter, which was a piece of fine muslin. The sieve Huish used was a yard long by two feet wide and made of tin perforated with large holes or of horse hair woven loosely enough that the honey would pass through. Quinby broke the comb up into small pieces, and placed the pieces in a colander over a bowl either in an oven or a warm room. In the

oven the wax melted and hardened into a cake on top of the honey in the bowl. "Many prefer this method, as there is less taste of bee-bread, no cells containing it being disturbed, but all the honey is not certain to drain out without stirring it" (Quinby 1864:364). "Glazed earthen vessels are the best adapted for receiving the honey, as wood, particularly deal, from its resinous nature, is apt to impart an unpleasant flavour to the honey, which is prejudicial to its sale" (Huish 1844:375).

Once you could get no more honey by this method the combs were then broken by hand, put in a bag, and placed in a press (Wildman 1778:208-213). If there was no press available you could use your hands, a spatula, or a spoon (Huish 1844:376). This method was not encouraged as it lost some of the wax which is more valuable then the honey (Wildman 1778:210).

> "In the great honey districts of France and Germany, the honey is almost always obtained by means of a press, somewhat similar to the cider presses of this country, or to the oil mills of Holland. In this country, however, the collection is not so great, but that the whole operation may be performed by the hand; and it is certain that the honey so obtained is better and purer than that which is obtained by the press" [Huish 1844:375].

Quinby (1864:364-367) broke the comb up into small pieces and placed the pieces in a bag over a jar for his first honey extraction.

The honey should be put into the storage pots as soon as possible. These pots should be kept in a place free from humidity and unpleasant odors (Huish 1844:376), while the equipment used should be placed outside where the honey bees had access to them. The honey bees would clean them for you better than you could do it yourself (Huish 1844:377).

Wildman (1778:208-213) took the drained combs and put them in a copper with boiling water. This was stirred constantly and when it was totally melted it was poured through bags to strain the wax. The strained liquid wax was put in vessels that had a little water in the bottom to prevent sticking and so that any remaining impurities could fall down into the water. The harder the wax was boiled the harder it would be to bleach it later. Another method was to tie the broken wax combs into a

fine mesh bag, drop the bag in boiling water and skim the wax off into dampened dishes to harden (Jardine 1843:230). Miner (1857:341) placed the broken wax in a woolen bag and sank it to the bottom of the boiling water with a rock. He boiled the bag for a half an hour, then removed the bag and took the kettle off the fire to cool. The wax would rise to the top and harden. If there were impurities this process could be repeated.

Quinby (1864:367) would whiten wax by laying it in the sun on cool days. "Exposed to the sun in a window or on the snow, it will become perfectly white, when it can be made into cakes for market, where it commands a much higher price than the yellow."

Tools that are specific to beekeeping, such as fumigators and honey extractors, were not used in the United States until the last half of the 19th century and only became common as the 20th century began. Huish (1844:284) described a bellows made specifically for apiarists, "...a pair of bellows, to the orifice of which is attached a small tin box with the lid and bottom well perforated, into which some old rags or dried leaves in an ignited state must be placed." (See figure 15). The bellows smoker was originally designed by Quinby, but he did not believe in patents and T. F. Bingham made a slight change and patented Quinby's design. "The contribution of the bellows smoker to beekeeping, particularly made, as it was, at the time of the contribution by Langstroth of the movable frame hive, was enormously significant in the development, especially, of commercial beekeeping" (Mason 1998:483).

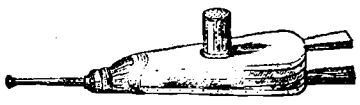

Figure 15 Bellows fumigator. (Miner, T. B. *The American Bee Keeper's Manual; Being a Practical Treatise on the History and Domestic Economy of the Honey-Bee Embracing a Full Illustration of the Whole Subject, with the Most Approved Methods of Managing this Insect Through Every Branch of its Culture, The Result of Many Years' Experience*. New York: C.M. Saxton and Co, Agricultural Book Publishers, 1857).

The Farmer's Guide to Beekeeping by H. M. Johnson, 1872, was one of the first publications to print information about the newly invented honey extractor (Mason 1998:266-267). Amos Ives Root in his 1879 edition of *The ABC of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey Bee: Bees, Honey, Hives, Implements, Honey Plants, &c., &c.: Compiled from Facts Gleaned From the Experience of Thousands of Bee-Keepers, All Over Our Land, and Afterward Verified by Practical Work in Our Own Apiary* claimed that information about the honey extractor came from Germany, reaching the United States in 1867 and that with "a simple home-made machine, I took 1000 lbs. of honey from 20 stocks, and increased them to 35" (Mason 1998:522-523).

Swarming

"The departure of a swarm is one of the most gratifying sights to an apiarian, and it well repays him for many hours of anxious watching" (Huish 1844:190). When a swarm left the hive they would cluster in a nearby tree or bush before taking off. This was why most apiculturists recommend having low trees or tall bushes near your hives. Dodderidge (1813:8) recommended fruit trees ringing the apiary for this reason as well as for the shade and food the trees provided.

"When bees are determined to seek a home for themselves, they revolve in a mass, gradually getting higher and higher, until the coast is clear, and then their flight is rapid" (Miner 1857:282). To get the swarm to settle so that they could be re-hived, several apiculturists suggested throwing fine dirt, sand, or water on them with the idea that this felt like rain to the honey bees and they would seek shelter (Jardine 1843:198; Miner 1857:282; Purchas 1657:34). Jardine (1843:198) claimed that if this did not work the honey bees would fly in a straight line, usually into the wind.

Tanging, the banging of pots and pans or anything else that would make a lot of noise, was another common practice to make a swarm settle (Betts 1937:90-91; Huish 1844:195; Jardine 1843:198; Mason 1998:33-34; Miner 1857:268-269;

Quinby 1864:209; Ransome 1937:225-226; Simpson and Roud 2000:20; Sooder 1946:27; Williams 1975:34-35). There were several theories about this practice – the noise drowned out the queen's calls to the other honey bees and confused they returned home (Betts 1937:90-91), the noise resembled thunder and the honey bees sought shelter (Betts 1937:90-91; Simpson and Roud 2000:20), or it was a continuation of the practice initiated by King Alfred of Wessex's 9th century law which made it mandatory for a beekeeper to follow all swarms while proclaiming his ownership of the swarm by making a noise that proceeded him (Betts 1937:90-91; Ransome 1937:225-226; Simpson and Roud 2000:20; Sooder 1946:27).

There were various methods for re-hiving a swarm, but all depended on the swarm settling on a branch accessible to the beekeeper.

> "If the swarm be clustered within six or eight feet from the ground, which is generally the case, where many low trees and shrubs exist. I place my table under them and spread a blanket over it. I then place my hive in such position, that the bees may be made to fall directly before it, and within a few inches of it. I then raise the front of the hive with a block of wood, as you perceive, so as to give the greatest facility for the bees to enter rapidly. Having done this, and being protected by my bee-dress, I take a chair to stand on, and with a brush, such as this, I am prepared for the operation. I will now show you how I do it. With one hand hold of the branch, and the brush in the other, I give a sudden jar to the limb, and down they fall before the hive; and the small portion that adhere to the branch after jarring it, I brush off and all that take wing again, follow their companions below" [Miner 1857:265].

(See figure 16). Miner (1857:267) went on to say that some beekeepers held the hive bottom up underneath the clustered swarm and then jarred them so they fell into the hive. The hive was then turned right side up with small blocks holding it up off the table slightly so that any honey bees still outside the hive could enter. Dodderidge (1813:15-16) described much the same methods as above, but he used a plate to scoop portions of the swarm directly into the hive if the swarm was within reach. He then placed a white rag at the entrance of their hive so the honey bees would recognize their home. In places where you could not jiggle the branch the swarm was

on, Quinby (1864:206) used a tin water dipper to scoop the bees and then throw them into the upside down hive. A more destructive method was to saw off the branch the bees were clustered on and then shake them off onto the table in front of the hive.

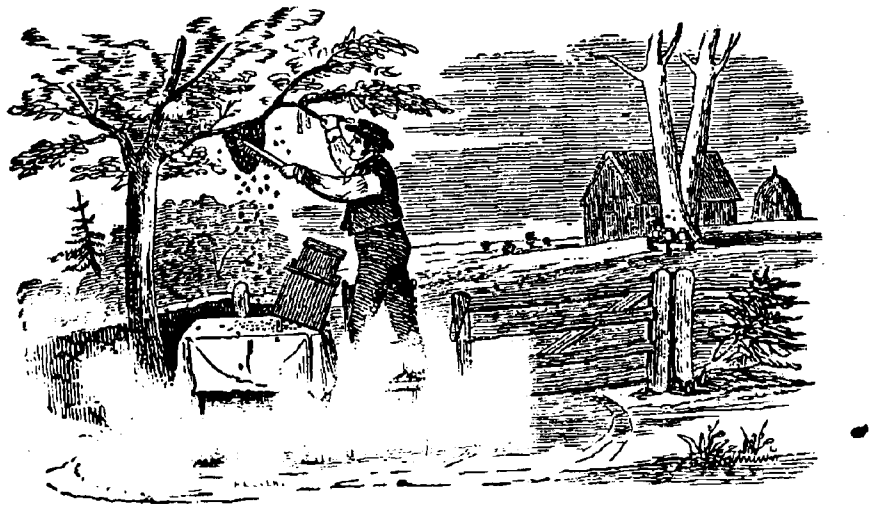

Figure 16 Rehiving a swarm. (Miner, T. B. *The American Bee Keeper's Manual; Being a Practical Treatise on the History and Domestic Economy of the Honey-Bee Embracing a Full Illustration of the Whole Subject, with the Most Approved Methods of Managing this Insect Through Every Branch of its Culture, The Result of Many Years' Experience*. New York: C.M. Saxton and Co, Agricultural Book Publishers, 1857). This shows the swarm clustered on a low branch, the table and cloth placed beneath the swarm, and how the hive is propped up so that the bees could enter it after falling onto the table.

If the honey bees were too high to re-hive with either of these methods a light-weight hiver could be used.[52] The hiver had to be attached to a pole long enough to reach the branch where the bees were clustered. The hiver was placed over the swarm so that the holes brushed the honey bees' backs and was held there for the few minutes it would take for the honey bees to enter the hiver. Once all the honey bees were in the hiver was brought down and the honey bees were shaken out onto the table in front of the hive. Like before the honey bees would enter the propped up

[52] See this paper, the section on material culture, and the portion on hives.

hive on their own (Miner 1857:264-267). An alternative was to saw off a small branch with leaves, climb a ladder and hold the branch under the swarm. The branch the swarm was resting on was shaken until the honey bees fell onto the branch you were holding. Once all the honey bees were on your branch you climbed down the ladder and shook them onto the table in front of the hive (Quinby 1864:204-205). If you had someone to help you then a two-bushel basket could be substituted for the branch (Quinby 1864:205).

Wildman (1778:134) was the only one to recommend immediately covering the hive once a swarm had been placed in it. He did this so the honey bees could become familiar with their new home and, hopefully increase their likelihood of staying. Many other beekeepers dressed the hives just before placing a swarm in them. Dressing a hive consisted of rubbing the interior with some substance. Miner (1857:264) used a sponge soaked in a mixture of honey and water. "There is one liquid, however, the efficacy of which we have frequently tried with success, although it was not clear to us that the bees would not have settled in the hive equally well without it. This liquid is human urine" (Huish 1844:196). Salt, hickory leaves, and fennel are some of the things used to make the hive more attractive to a swarm (Dodderidge 1813:15) although by the 19th century most beekeepers did not think it was necessary. Quinby (1864:204) would sprinkle water over any stragglers who did not want to enter the hive, again mimicking a rain shower.

A prosperous bee hive may cast more than one swarm in a year, but most apiculturists agreed that the first swarm was the only one that would be early enough, and large enough, to survive the winter and make a successful hive. The second swarm may be early enough to gather provisions for winter, but would have problems because there was not enough time to create a large enough population to both gather the winter stores and maintain a warm temperature in the hive. This led to several sayings that commented on the depreciation in value of a swarm as the year went by. "A swarm of bees in May, Is worth a load of hay; A swarm of bees in

June, Is worth a silver spoon; A swarm in July, Is not worth a fly" (Ransome 1937:230).

For the maximum production Huish would put two second swarms together or would put a second swarm in with a poor hive. To do this he would fumigate both groups and then mix "them together like so many beans in a bushel measure" (Huish 1844:215). He would put both in a container and then shake it vigorously until the bees were disoriented. Believing that honey bees recognize each other by smell he finally devised an improvement on this system.

> "We diluted about a pound of sugar with about two gallons of ale, adding a small quantity of honey, and a few drops of the essence of bergamot, or any other odoriferous herb. The whole of the liquid was put into a tub, the upper rim of which exceeded the height of the hive about two inches...[drive bees from weaker stock into a hiver or small hive and submerge them in the liquid until almost drowned]...We then plunge the stronger hive into the fluid, taking care that the whole of the hive be immersed in it, in order that the liquid may reach the very uppermost part of the combs. We allow the hive to remain in that state until it may be supposed that the bees are nearly drowned, when it is taken out, and the bees and the liquid poured into a garden sieve..." put the honey bees in a tumbler before the fire and find the queen or queens, return the honey bees to the hive and seal it, then place the hive before the fire. Upon their reviving, place the hive outside, and put the largest queen in the hive when you see the bees clustering at the hive's doorway [Huish 1844:215-216].

Hives could also be separated when there was a newly hatched queen in the hive. All the honey bees were tapped out onto a sheet. A glass bell jar was placed over them and you began separating the colony, as evenly as possible, into a second bell jar. It was extremely important that there was one queen in each grouping. Once divided both colonies were rehived and then left undisturbed for a day (Huish 1844:198).

Bee hunting[53]

Bee hunting began thousands of years ago. There are rock paintings ~8,000 B.C.E. in Spain (Crane 1999:43) and bee hunting probably began long before this. By the 1640s honey bees were common around colonial Massachusetts, Virginia, and the Chesapeake region both in the settlements and the woods surrounding them (Free 1982:116; Maxwell 1849:62-63; Pellett 1938:2-3; Pryor 1983:2 & 4; Riley 1956; Goodwin 1956; Spencer 2000:348) and more people relied on "wild" honey than took up beekeeping because feral populations were so plentiful around the settlements (Pryor 1983:5).

The equipment for bee hunting was the same as that used to harvest from domesticated hives and as such I will not repeat it. Suffice it to say that bee hunting was very popular in all areas of the future United States. In 1698, Gabriel Thomas noted that in Delaware "the Sweeds often get great store of (bees) in the woods where they are free for any Body" (Pryor 1983:5).

Summary

Beekeeping was not a standardized operation until the last half of the 19th century when the development of equipment and ideas, such as bee space, shaped and rolled wax foundations, centrifugal extractors, bellows smokers, etc., changed beekeeping forever. All of these innovations were introduced at nearly the same time and revolutionized apiculture allowing for closer observation of honey bee anatomy, and behaviors, and the commercialization of apiculture. Without these changes our multimillion dollar honey bee industries, involving medicine, pollination, honey, cosmetics, and more, would not be possible.

Unfortunately, the lack of standardization and specialization of apicultural material culture before the late 19th century presents a challenge to historical

[53] See the chapter on settlement patterns for more information on bee hunting.

archaeologists. Many colonial beekeepers used the materials they had available for beehives and beekeeping equipment. Beehives may have deliberately been disguised in attempts to dodge taxation. For these reasons, it would be impossible to say definitively that a homestead or farm found with these materials also had honey bees.

I believe that it is only with an understanding of beekeeping and all it entails that archaeologists will begin to recognize the material culture surrounding this vital economic and agricultural activity. I hope that this thesis will become a foundation on which future archaeologists can build.

Archaeology

A colony of honey bees is a superorganism of 10,000 to 70,000 individuals. The population fluctuates with the season. In Oregon's Willamette Valley there are an average of 10,000 workers/hive in January and 40,000 in June, summer being the time of maximization for the colony. In summer, on any given day, there are approximately 31,500 immature individuals consisting of 4,500 eggs, 9,000 larva, and 18,000 pupa. These figures are for a healthy established hive. Newly created hives or those suffering from disease or other hindrances will be smaller. Feral populations are also smaller than managed hives, averaging 15 to 20,000 individuals in mid-summer and producing around 30 pounds of honey (Burgett 2002).

Honey bees die from physiological senescence; they work themselves to death (Burgett 2002). Each honey bee is geared for approximately 800 kilometers of flight in a lifetime and once that is reached they die.[54] This explains why summer bees, who are busy foraging for winter stores and to feed a nursery that is always full, live only four to six weeks, while winter bees, who spend a minimum amount of time outside the hive, live for four to six months. In the summer most of the honey bees die away from the hive while foraging, although a small percentage will die overnight and be carried to the mouth of the hive by worker bees assigned housekeeping duty where the bodies are dropped to the ground. In the winter a greater percentage of honey bees die in the hive and their bodies receive the same treatment.

For this reason I believe there will be a concentration of honey bee bodies within one foot of the hive entrance. This would appear to be the optimal site for soil sampling; however few 17th century American records indicate where the hive(s)

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[54] In the 17th century it was believed that honey bees lived much longer lives than is known to be true today. Bees "feldome attain to nine years, but never to ten. Although we know by good experience, knowledge of place, and the credible atteftation of men worthy belief, that they have lived thirty years" (Topsel 1572 – 1625:647).

were positioned on the property. In theory a large number of honey bee remains in a soil sample would point to the position of the hive, however at this time no statistics have been done for varying concentrations of honey bee remains at set distances from a hive. This would be a great project for the future as it would help us to understand functioning landscapes and settlement patterns within the farmstead as well as the spread of exotic species across the country with all of the attendant impacts.

The fact that approximately 1,000 honey bees per hive per day die means there is a plethora of material to be discovered. The only diagnostic traits of *Apis mellifera* L. are the schleria of the eye (the sensitive hairs on the eye that help the honey bee compensate for wind), the mandibles, and the barbed stinger (both constructed of chitin, a protein based material). The schleria would not survive deposition so the mandibles and the barbed stinger are the only diagnostic indications of *Apis mellifera* L. that can be found archaeologically. (See figures 17, 23, 24, and 25).

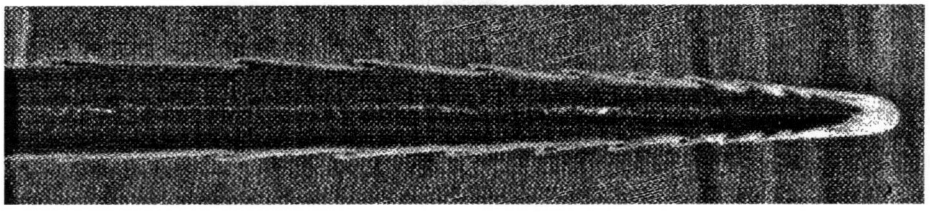

Figure 17 *Apis mellifera* L. stinger. (© 1999 From *The World History of Beekeeping and Honey Hunting.* Eva Crane. Reproduced by permission of Routledge/Taylor & Francis Books, Inc). This image is magnified 180 times. There are two lancets with barbed edges (the dark image) upon the stylet, which appears white in the image. The three pieces surround the venom canal.

To prepare myself for analyzing soil samples with the goal of recovering honey bee mandibles and stingers I began dissecting *Apis mellifera* L. bodies. Taking frozen honey bee bodies I baked them in a low oven to dry out their internal organs. Once I began dissecting the honey bees I found the honey remaining in their crop, or honey stomach, at death had hardened around the stingers creating impenetrable

balls. I put the honey bee bodies in a vial with some water and let them soak for ten minutes. I poured the soaked bee remains through a dust mask to separate the water from the chitin. As the honey was staining much of the material I ran a small stream of water over the chitin in the dust masks until it was clean. I then placed pieces of chitin on slides and, at 30X on a dissecting microscope, looked for the mandibles and stingers. In this manner I found all three stingers and 6 mandibles from the three honey bees I dissected.

I placed the mandibles and stingers in a vial so I could use them for comparison in the future.

Excavation 1

Goal

The purpose of my first excavation was to see if honey bee mandibles and stingers were recoverable archaeologically. I planned to excavate a one foot square of soil directly in front of a hive entrance, the theorized area of maximum potential. The age of the honey bee remains was not of importance, the ability to recover honey bee mandibles and stingers by flotation was. If I could not retrieve either from soil directly in front of a viable hive by using flotation there would be no reason to assume mandibles and stingers of any age could be retrieved and, correspondingly, there would be no reason to continue my research.

Site location

I was given permission to dig in front of the hives at the bee lab on the campus of Oregon State University (OSU). The hives had been set in place at least ten years ago and I hoped that this was time enough to allow for some of the honey bee remains to become buried. During the excavation I noticed numerous charcoal flecks in the soil. The area is ringed by trees and on the western side is Oak Creek, while the north, east, and southern sides of the area are bounded by the gravel drive

into the honey bee lab area. All of the grassy area where the six hives were placed was filled with rodent holes, which caused a great deal of turbation in the soil.

Sampling

On January, 10, 2002, directly in front of one of the hive entrances, I excavated a one foot square area to a depth of 20 cm below the overburden. (See figure 24). I arbitrarily chose to separate the matrix into three groups: overburden; layer one 0-10cm; layer two 11-20cm. I had originally planned to take a sample of greater depth, but the volume of matrix collected was becoming unmanageable, so I decided to stop. I closed the square by placing a 2001 penny in the bottom,[55] covering it with plastic and filling the hole with 1.4 cubic feet of potting soil.

Figure 18 String outline of first excavation.

[55] It is a common archaeological practice to place a coin of recent date in the bottom of any excavation pit before placing a piece of plastic in the bottom of the pit and filling it in with dirt or some other material. This makes the area immediately recognizable as part of an archaeological dig in any future excavating of the area and the date on the coin can help lead future excavators to information about the original dig.

Flotation

To process the matrix I put the dirt, or overburden, one bag at a time in a clean bucket and added water until it was covered by at least two inches. Then I stirred the mass until particles began to float on the top. I used coffee filters to skim the floating particles off. Then I stirred and skimmed, stirred and skimmed, until there were few particles left floating. I took the bucket and poured the contents into a sieve with fairly large holes, approximately ¼ inch, placed over an empty bucket. The mud was so thick yet that I had to use a wooden spoon to press it through the sieve. This removed any large pieces such as tree roots. Next I took the water and dirt matrix and poured it through a kitchen strainer using the first bucket to catch what went through. Again I had to use the wooden spoon to get it through the mesh. I then repeated the process with a very small mesh screen. The process of successively smaller meshes also helped to break up the dirt and clay thereby freeing the smaller particles such as honey bee stingers. I ended up with a batch of small particles trapped by the smallest mesh, which I spread out on a tray covered in coffee filters. I then placed the tray in front of the fireplace to dry. This method of processing the matrix through progressively smaller meshes was time consuming and took an average of one hour per one gallon bag of matrix.

Microscopic recovery

I chose to look at the deepest layer, layer two 11-20cm, first on the theory that any honey bee remains found would have been buried the longest. Additionally, I believed that if honey bee remains were found in the deepest layer they would be present in the layers above.

I did find honey bee mandibles and stingers in the 11-20 cm layer, but to my surprise I found as many honey bee stingers in the particles that had not floated as in the particles that had floated and I had skimmed off the top. Because honey bee remains were found in the 11-20cm layer there had either been ~20 cm of fill that covered the deposited remains (in just 10 years) or the rodents, and possibly other

scavenging insects, had intentionally, or unintentionally, moved bee body parts underground.

I had been concerned the vigorous pressing and stirring I had done with the wooden spoon in an effort to breakdown the matrix would break the honey bee stingers into pieces. However, I not only found complete stingers, I found complete honey bee wings! (See figure 19).

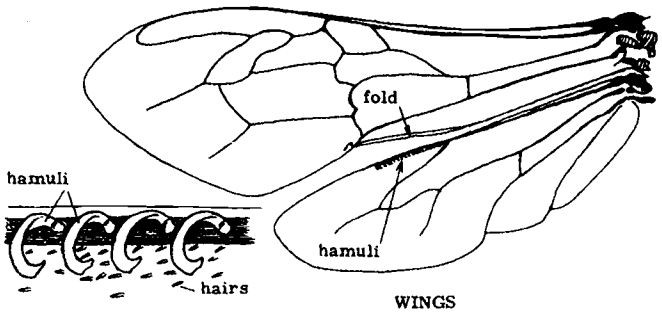

Figure 19 Honey bee wing. (Dade, H. A. *Anatomy and Dissection of the Honeybee*. London: Bee Research Association, 1962. International Bee Research Association. www.ibra.org.uk).

Conclusion

Honey bee mandibles and stingers are recoverable using flotation technology. Just as interesting was the fact that honey bee stingers were also found in the particles that had not floated. For this reason I decided to change my particle recovery process for the next excavation from flotation to a washing of the matrix.

The great amount of soil turbation makes it impossible to assign any age to the honey bee mandibles and stingers I recovered. Even though honey bee remains were recovered in the deepest matrix excavated, wind, water, insects, or rodents may have moved the honey bee bodies below ground.

Excavation 2

Goal

This excavation was to discover if honey bee remains could be recovered from lower levels. My hope was that the turbation of the soil was near the surface and that I could obtain matrix below the soil disturbances. If this was possible then any honey bee remains recovered could be assumed to have been deposited at least ten years ago.

Site location

The second excavation took place at the same apiary on the Oregon State University campus as the first. I chose to sample in front of the hive farthest from the trees because I was afraid the tree roots would halt our homemade PVC core sampler.

Sampling

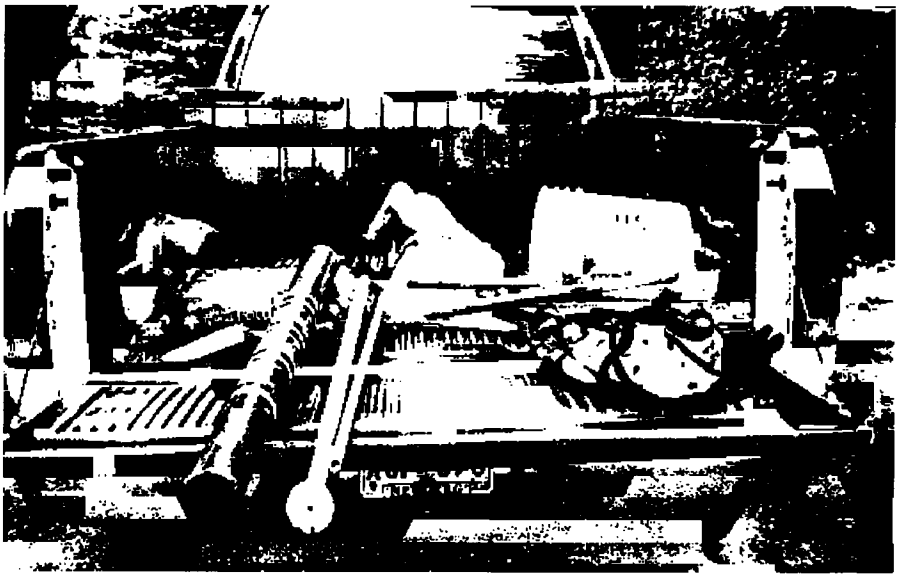

Figure 20 Equipment used for second excavation. PVC pipe corer, wood plunger, and pipe for handle among other items.

The week before I planned to take my sample I called the utility company and had them mark any underground obstacles. There were none near the hives. Because I wanted a deeper soil sample, but not a greater quantity of soil to process, I decided to make a soil corer out of PVC pipe. I took a PVC pipe four inches in diameter and five feet long and drilled a one inch hole through the pipe six inches from one of the ends. This was for the insertion of a one inch metal pipe that could be used as a handle to help pull the pipe corer up with the soil sample inside. I filed the opposite end of the pipe so it had a beveled edge that would facilitate movement through the soil. To push the corer into the ground I used a two inch thick board placed over the top of the pipe as a striking platform for a sledgehammer. This is a two person process, one to hold the board in place and one to swing the sledgehammer. I marked the PVC pipe with paint at ten inch intervals and I drove the pipe into the ground up to the 30 inch mark. We inserted the metal pipe handle and twisted the PVC pipe to break the core loose at the bottom. Then we pulled the core up. To remove the core I made a plunger from a four inch wooden disk that would fit the inside of the pipe with a dowel handle nailed to the center. I could use this to push the core sample out. However, the core began sliding out of the pipe as soon as we cleared the hole. We quickly laid the pipe down and I bagged the 18 inch piece of core that had come out. We capped the pipe with plastic and duct tape and transported the core home inside the pipe where we then pushed it out onto a piece of plastic spread across the tailgate of the truck. I placed the bottom piece that had previously slid out on the end where it had come from, removed the overburden and then sliced the core at 10cm intervals, bagging each separately. We ended up with seven layers; overburden, 0-10cm, 11-20cm, 21-30cm, 31-40cm, 41-50cm, and 51-60cm.

Figure 21 Corer with sledgehammer and board cap in front of hive.

Flotation

Since I had found honey bee stingers in the floating as well as the non-floating particles in the first excavation I decided I would process the soil from the second excavation through a series of finer filters without skimming the floating particles off first. I believe my finest filter will capture any honey bee stingers within the matrix and that, at this point, whether the honey bee stingers float or not is not important – recovery of the stingers (which are smaller than the mandibles) is.

I cut one foot squares of linen and a fine mesh cross-stitch base fabric that I intended to use as my last two filters. We mixed the soil with some water in a bucket to make a slurry and then poured this through the ¼ inch mesh strainer. Once again I had to use a wooden spoon to get the soil to break down enough to go through. This was then put through a kitchen strainer by stirring with the wooden spoon. These first two filters removed any small rocks or tree roots. Then I placed the cross-stitch mesh over the kitchen strainer and filtered the slurry through it. To clean the particles captured by the mesh we took clean water and poured over the particles as we stirred them with the wooden spoon. We did this over a bucket so that small particles that

went through with the dirt could be captured later by putting the slurry through the linen cloth.

However, I found the linen was too fine and it was difficult to get the small silt particles separated from the micro-particles I wanted to analyze. I believed the cross-stitch mesh was fine enough to capture any honey bee stingers present and so after processing the overburden I skipped the linen step.

We found the 41-50cm layer to be dense clay that was almost impossible to breakdown to the point where it would go through our mesh, but eventually we did accomplish it. Because the goal for this excavation was to discover if honey bee remains could be recovered at greater depths than my first excavation I only processed the bottom three layers; 31-40cm, 41-50cm, and 51-60cm. The overburden was processed first as a test of the cross-stitch and linen as filtering materials.

Microscopic recovery

I found honey bee mandibles (See figure 22) and stingers in all three levels that I processed. Even the deepest layer, 51-60cm, had two honey bee stingers and a mandible. Of interest is the fact that this layer also contained honey bee wings, an item that, under normal conditions, should not survive an extended period of deposition. For this reason I believe this layer was also contaminated by rodent and burrowing insect activity. This was disappointing. However, I was pleased that twice now I had been able to recover and identify honey bee mandibles and stingers from soil samples.

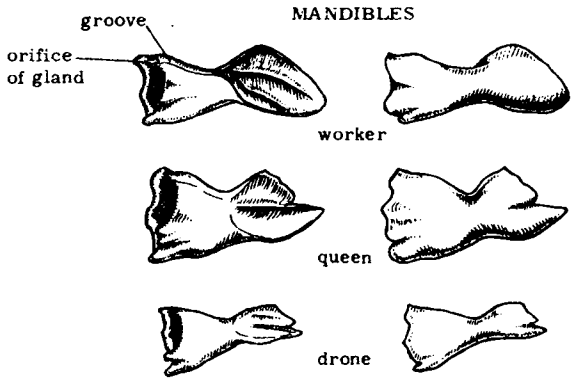

Figure 22 Honey bee mandibles. (Dade, H. A. *Anatomy and Dissection of the Honeybee*. London: Bee Research Association, 1962. International Bee Research Association. www.ibra.org.uk). This picture shows the differences in morphology that allow for cast identification of recovered mandibles.

At a later date I went back through these layers. I was looking for beeswax and identifiable pieces of chitin, other than honey bee mandibles and stingers. The honey bees assigned housekeeping duties toss out tiny bits of wax and these should survive extended periods of deposition.

I found both chitin and beeswax. In all three layers there were abdominal rings and wings. Also present in all the layers were tiny particles of wax.

Conclusion

Honey bee mandibles and stingers are recoverable in soil samples through flotation and filtering (or washing) of particles. They are not dateable, unless you uncover a cache of honey bee remains in your sample, because there is not enough material to use for most dating methods without destroying your sample. You could claim that examples displaying weathering were older than those that did not, but this does not date the material except in a relative manner; this is older than that. Samples taken from sealed contexts, that can be dated, would be the best solution for assigning age to honey bee remains.

Also I should begin looking for beeswax particles even though their presence would not definitively point to the presence of honey bees. Beeswax was imported long before the honey bees in many areas of North America. However, I think it is important that evidence of beeswax be noted when found.

Analysis of Colonial Williamsburg, VA flotation samples

From July 3, 2002 to August 13, 2002, I processed flotation samples from eight different colonial sites around Williamsburg, Virginia, for a total of 18 samples. These samples were chosen on two criteria: a rural context and a manageable volume of matrix. Within these criteria, the samples were picked at random. The samples meeting the criteria and that were the first to be found in the

storage facility were those analyzed. There were no other considerations biasing the sample mix. (See table 3).

There were only two samples from which chitin or other pieces of material that are recognizable as belonging to some species of insect were not recovered: CG 8, Flot A, 50AJ1152, heavy fraction; and Rt 60, Flot 16, 51AF412, light fraction, <2mm, >1mm, FE 1 layer 13.

As my training has prepared me only to recognize *Apis mellifera* L. anatomy in general and their mandibles and stingers in particular, I was unable to identify the entomological material found in the other samples. Two of the samples did include stingers among the items recovered, but neither stinger was from *Apis mellifera* L.

The fact that entomological material was found in 16 of the 18 groupings analyzed would seem to point to the tremendous amount of archaeological information that is currently being ignored. The impact of insects on the environment is well known in other disciplines and it is important that archaeology begin investigating those impacts.

> "The scholarly literature has documented considerable benefits humans derive from invertebrate organisms. Important *ecological* invertebrate values have been extensively described. Major categories of ecological benefits include ecosystem stabilization, energy and nutrient transfer, maintenance of trophic structures, plant pollination, plant protection, and the provision of major habitats for other organisms, among others" (Kellert 1993:846 emphasis in original).

Archaeology has an important role to play in discovering how these organisms work in the environment to control, enhance, instigate, and mitigate change. By looking at an exotic species that has invaded all corners of the United States, and in the process must have overwhelmed native insect species and affected the reproduction of native and exotic plant species, archaeologists can help to shed light on how environments evolve and how insects and humans interact.

Unfortunately, I could discover no indication that any of the entomological pieces I recovered were not from a modern context. Additionally, I spent some time

on an excavation in Carter's Grove (CG)[56] and found that there were numerous burrowing insects in the area such as ants, cockroaches, and beetles. For this reason I must suppose that the entomological material I found was of recent deposition.

[56] Carter's Grove is between Route 60 and the James River. Part of the original complex currently is open to the public and includes the archaeological site of Wolstenholme Towne which includes an on site museum and the 18th century mansion Carter's Grove.

Results of microscopic analysis of random 17th and early 18th century flotation samples						
Loc.	Flot #	context		Particle size	Total weight of Particles	Results
CG-8	Flot 'A'	50AJ1152	LF	<2mm, >1mm	6.62g	Structure w/possible stinger
CG-8	Flot 'A'	50AJ1152	LF	<1mm, >0.5mm	13.42g	Lots of ant? pieces
CG-8	Flot 'A'	50AJ1152	HF	all	113.76g	Mostly clam, some gold in color
CG-8	Flot 'A'	50AJ1154	LF	<2mm, >1mm	4.30g	few entomologicals
CG-8	Flot 'A'	50AJ1154	LF	<1mm, >0.5mm	5.50g	few entomologicals
CG-8	Flot 'A'	50AJ1154	HF	all	28.30g	2 ant heads
Rich Neck	Flot 0064	68AW461	LF	<2mm, >1mm	28.15g	several cockroach? heads, 1 ant head, exoskeleton pieces w/ceti
Rich Neck	Flot 0064	68AW461	LF	<1mm, >0.5mm	16.21g	misc. ant and chitin
Rich Neck	Flot 0048	68AW00349	LF	<2mm, >1mm	19.45g	misc. chitin, poss. abdomen
Rich Neck	Flot 0048	68AW00349	LF	<1mm, >0.5mm	7.60g	few entomologicals
CG-10	Flot 0567	50AP001184	LF	<2mm, >1mm	38.62g	lrg non-apis stinger, poss. charred chitin
CG-10	Flot 0567	50AP001184	LF	<1mm,>0.5mm	17.95g	nearly complete bug, very articulated leg/tail, misc. chitin
CG-10	Flot 0472	50AP01112	LF	<2mm,>1mm	5.89g	1 spiky piece chitin, one sec of 2 joined rings of chitin
CG-10	Flot 0472	50AP01112	LF	<1mm, >0.5mm	5.15g	more spiky pieces of chitin
Rt 60	Flot 016	51AF00412	LF	<2mm, >1mm	8.53g FE1 layer13	no entomologicals
Rt 60	Flot 016	51AF00412	LF	<1mm, >0.5mm	5.86g FE1 layer13	complete pink sow bug?, misc. chitin
Rt 60	Flot004	51AF00357	LF	<2mm, >1mm	30.72g FE4 south ½	3 complete (or nearly) bugs, misc. chitin
Rt 60	Flot004	51AF00357	LF	<1mm, >0.5mm	15.04g FE4 south ½	complete pink sow bug?, misc. chitin

Table 3 Results of microscopic analysis of colonial flotation samples. The criteria used for selection of the flotation samples were: volume of material and rural context. Within these boundaries the samples were randomly picked i.e. the first samples found in storage meeting these criteria were those analyzed. CG = Carter's Grove. LF = light fraction. HF = heavy fraction. FE = feature

Analysis of Fort Hoskins Flotation Sample

(F9B area A 35BE15 level 12)

This sample was chosen because it is from a sealed context. All the other soil samples I processed were subject to infiltration of modern chitin due to the activities of rodents, insects, wind, and water. With this sample I plan to discover if entomological material can be recovered after an extended period of deposition.

I had little hope of discovering honey bee remains because of the time period for the sample. Fort Hoskins was in service from 1856 to 1866. The honey bee did not enter Oregon until 1854 at the earliest and that entry took place in Marion County. Fort Hoskins is located at latitude 44.62 longitude 123.3 Kings Valley vicinity, Benton County, Oregon. Not a great distance, but the honey bee population must have been relatively small in Oregon during this ten year period and the chance that a population was established within the three mile foraging radius from this site is minimal. Even more unlikely is the idea that a foraging honey bee died in the area of this sample. However, my goal was to confirm that chitin, not honey bee mandibles and stingers specifically, can survive deposition of at least 140 years.

The sample I processed was one taken from an earlier dig sponsored by Oregon State University and under the direction of Dr. Dave Brauner. It was one of several samples taken from a privy uncovered during excavation.

I used a finely woven tulle to separate the dirt from the particles. I placed around one cup of matrix in the center of a tulle square and then tied it with a rubber-band so no particles could escape. Using a small stream of water I massaged the ball of matrix until the water ran clear. This method worked very well. No particles of the size I desired were lost and the particles were clean.

From these particles I found several pieces of chitin. All showed signs of deterioration and none of them could be identified as belonging to *Apis mellifera* L. The most surprising find was a whole antenna of unidentifiable species. Previous to this I had believed that only the thicker, harder pieces of chitin, such as mandibles and stingers, would preserve more than a couple of years in situ. If I was correct,

then the sample had not come from a sealed context. If I was wrong, then entomological material of all types may preserve for extended time periods in some soils.

Summary

My work has highlighted the possibilities inherent in an area of research currently being ignored by archaeology. With the excavations and soil sample analysis I have done, it is obvious that the information is out there and recoverable using current archaeological techniques.

What I have done is only a beginning. It is only with continued research and the creation of a dataset that we can begin to understand all of the interactions between the environment, insects, and humans. The honey bee is an excellent subject for this research because it is an extremely successful exotic that humans have failed to domesticate but that has left a huge dataset in the soil, just waiting to be uncovered.

If entomology and historic archaeology do combine forces, and information about entomological material becomes an expected part of any site report, then future archaeologists can use that information to support or disprove my thoughts on the impact of the honey bee on the United States culture. With a dataset the path of the honey bee as it moved across North America, currently known only through historical documentary sources, can be verified, expanded, or disputed. Unimagined connections between the honey bee and other species, environmental shifts, or ideological changes may be uncovered. It is impossible to say what the future may bring, but a wider knowledge base from which to make theories is always a positive outcome in and of itself.

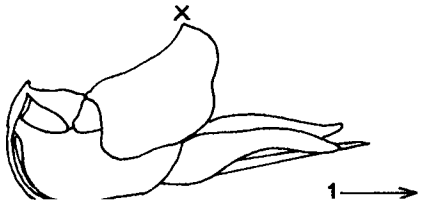

Figure 24 Side view of honey bee stinging apparatus. (Dade, H. A. *Anatomy and Dissection of the Honeybee*. London: Bee Research Association, 1962. International Bee Research Association. www.ibra.org.uk). Normal position.

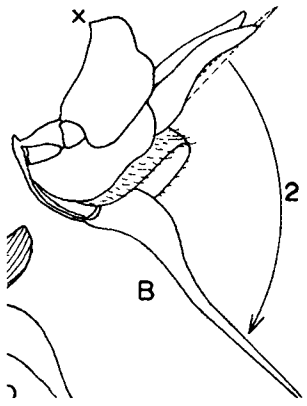

Figure 23 Honey bee sting apparatus with exposed stinger. (Dade, H. A. *Anatomy and Dissection of the Honeybee*. London: Bee Research Association, 1962. International Bee Research Association. www.ibra.org.uk).

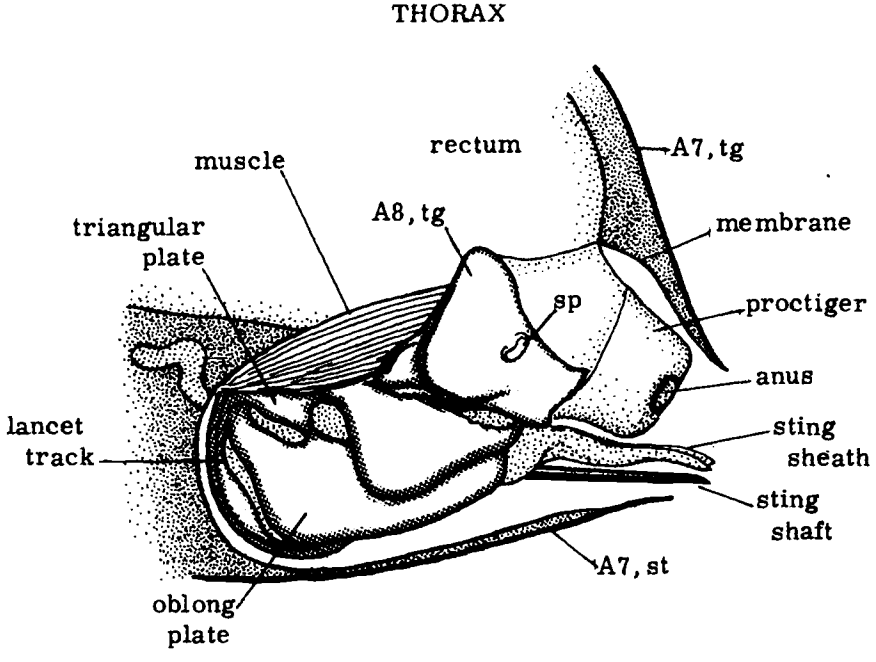

Figure 25 Side view of the sting chamber. (Dade, H. A. *Anatomy and Dissection of the Honeybee*. London: Bee Research Association, 1962. International Bee Research Association. www.ibra.org.uk).

Points of Interest

It is clear that honey bees have impacted the United States culture and environment. Following are glimpses into three arenas of influence for the honey bee; these are meant only to highlight areas where future studies are needed. The section on clover exemplifies one impact, out of thousands, the honey bee has had on the North American environment. The economic section is a brief summary showing how honey bees support the theory that capitalism was in existence from the inception of the United States and showing the way cottage industries have changed over time. Tanging is a minimal look at the ideology attached to the honey bee and this section illustrates how looking at the honey bee can help us to understand the methods of, and reasons for, cultural change.

Clover

> "Swarms, both wild and tame, when they leave the parent hive, almost always take a western direction. The reason of this I never could discover. Do they observe the course of migration of mankind? Are they fond of his society, though not of his controul? Or is it that they are in search of a new supply of flowers, succeeding, under the hand of cultivation, to the useless weeds of the desert" [Dodderidge 1813:12]?

It is well known that many plants entered North America with European colonists, some intentionally and others unintentionally. English grasses, usually meaning white clover and bluegrass, were brought in as much by the forage brought over with the cattle as by seeds meant for planting in fields (Bidwell and Falconer 1925:159). By the last half of the 17th century English grasses were fairly common from New England southward through the English Colonies, but it was only after the American Revolution that intentionally planted fields of English grasses became common (Bidwell and Falconer 1925:104).

Before the American Revolution clover was usually opportunistically established and was found in patches. Christopher Gist wrote in 1751 when near the present site of Circleville "all the way from Licking Creek to this Place is fine rich level Land, with large Meadows, Clover Bottoms & spacious Plains covered with Wild Rye" and west of the Alleghenies "the first arrivals found white clover and Kentucky bluegrass" (Bidwell and Falconer 1925:157). It is possible that the French missionaries and traders from Canada, through seeds attached to their livestock and wagons, the dung scattered by their cattle, or in bags meant for sowing, spread the white clover in this area (Bidwell and Falconer 1925:159).

An 18th century practice that helped to increase the spread of clover was the planting of a crop or grass in orchards, which were numerous. For this reason trees were planted in rows up to sixty feet apart[57] so that the crops could be harvested with ease (Ayres 1990:43). In 1763 and 1765 "George Washington sowed turnips, spelts, and wheat in his peach and apple orchards" and in 1791 "Thomas Jefferson had white clover sown in one of his orchards" (Ayres 1990:43).

By the 19th century white clover was prevalent across the United States and apiarists wrote,

> "Of all the resources of bees, nothing can equal the white, or Dutch clover, that abounds to a greater or less extent, throughout the whole country; I may almost say, that without the existence of this flower, it would be useless to attempt to establish an apiary; yet there is no section of the country where it does not exist; consequently, there is nothing to fear on that point" [Miner 1857:241].

The speed at which clover appeared in areas cleared for cattle was amazing (Bidwell and Falconer 1925:159-161). It was well known that clover was one of the best plants for honey bees (Ambrosoli 1997:105; Belknap 1792; Fell and Fell; Root 1888[58]; Miner 1857:241 & 243; Quinby 1864:113; Shuckard 1866:15; Wildman 1778:81) and Huish, (1844:424) claimed that white clover was commonly called "cow-grass." This intertwining of cattle, clover, and honey bees became so common

[57] The average was 40 feet apart for trees in an orchard (Morse & Calderone 2000:6).
[58] This is from Mason 1998:533.

that a saying developed, "Cattle thrive best where there are most bees" and Paling (1924:109) questioned whether the old saying was still true. It was thought that the honey bees might be sucking something harmful to cattle from the clover, but Paling (1924:109) thought that the honey bee increased the clover crop and thereby benefited the cattle.

It is a proven fact that honey bee pollination greatly increases seed production in white clover. In McGregor's study, white clover plants in cages excluding honey bees[59] produced less than three seeds per head on average while those that were pollinated by honey bees produced 90 (McGregor 1976 ch.3 White Clover).

There are three conditions that determine the amount of pollination any plant community will receive (Burgett 2002):

> 1) Attractiveness of the plant species – quantity and quality of nectary, flowering habit, the number of flowers per unit area, and the time of bloom
> 2) Plant competition – what are the plant species in the area and will any of them be more attractive
> 3) Condition of the colony – presence of young adults and larva, a young queen, if colonies are being fed, and the size of the colony

The greater the number of young adults and larva in the colony the more pollen is needed to feed them. A healthy colony of honey bees will use from 50 to 75 pounds of pollen a year. Clover is also a plant that produces sufficient quantities of nectar during the summer months to be considered a honey plant. During a clover flow (the period when nectar is available) a colony can increase the amount of honey in the hive by five to ten pounds a day (Burgett 2002).

It is true that wild bees were also energetic pollinators of white clover (McGregor 1976 ch.3, White Clover), but honey bees collect a greater volume of pollen and nectar than any one other insect species and since white clover is not monophilic the honey bee is its greatest pollinator. Together white clover and the

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[59] Only honey bees were denied access. Other insect pollinators were allowed to interact with the blossoms.

honey bee raced ahead of the colonists, in a symbiotic partnership that allowed each species to advance westward ahead of many other English immigrants.

The fact that the environment was in flux opened the door to change. The author of *The Planter's Plea* in 1630 wrote that large areas of New England were void ground,

> "enough to receive more people then this State can spare, and that not onely wood grounds, and other, which are unfit for present use; but, in many places, much cleared ground for tillage, and large marshes for hay and feeding of cattle, which comes to passé by the desolatio hapning through a three yeeres Plague, about twelve or sixteene yeeres past, which swept away most of the Inhabitants all along the Sea coast, and in some places utterly consumed man, woman & childe, so that there is no person left to lay claime to the soyle which they possessed'" [Bidwell and Falconer 1925:7].

The environment was going through radical changes. Areas that had been managed by Native populations through fire and agriculture had been left unattended as epidemic diseases brought to North America by European colonists swept through Native communities. Additionally, confrontations over land and natural resources had led to massacres of many Native American populations by the colonists. "The disappearance of the native grasses with the progress of clearing and cultivation was a matter of frequent comment. The white clover and Kentucky bluegrass spread or 'volunteered' in the new region with remarkable rapidity" (Bidwell and Falconer 1925:160-161).

I argue that the spread of white clover would have been greatly reduced in the range it achieved and the speed at which it spread across the continent, without the honey bee. In order for a seed to impact an environment it must be fertilized and as McGregor's study, mentioned above, shows white clover exposed to honey bee pollination produces 30 times the number of viable seeds as those that are denied access by honey bees. Simultaneously, the increased white clover population would have supported larger honey bee populations, each species unintentionally affecting the other.

I have used white clover as one example of how the honey bee impacted the North American environment. There are many more. As the native grasses gave way to English grasses there would have been insect, as well as plant, population shifts and possibly extinctions. The honey bee became a competitor for the same resources used by many native insect species, causing ripples in the environment that we really do not understand. Future archaeological, entomological, and ethnobotanical studies will hopefully focus on some of these connected changes.

Economics

> "Heaven, all munificent to man, has given to no one portion of the globe a full supply of ALL the productions of the earth, but a surplus of certain articles, and a scarcity of others. Let the sea and rivers produce fish and fowl. Let the level, fertile countries produce bread, meat, and cloathing. Let the mountains, wilderness, and barrens, produce honey and wax. The necessity of exchange invites to social intercourse, good neighbourhood, and harmony. By making it, the inhabitants of the different regions may mutually support and comfort each other" [Dodderidge 1813:32].

Because beekeeping was practiced by all levels of society the honey bee can help us to understand the development of capitalism and the changing role of cottage industries in the United States. By looking at who the beekeepers were at different time periods (social, ethnic, and gender differences) we can gain a better understanding of the changes experienced by the evolving United States culture.

How capitalism developed in the United States is still being debated today. Currently there are two theories about the transition from capitalism in the Chesapeake Bay area during the 17th and 18th centuries (McWilliams 2002:135):

1) 17th century settlers were 'pre-industrial yeomen,' for whom the "maximization of profit was less important...than the meeting of household needs and the establishment of social relationships within the community." It was the 18th century colonist who "ushered in an elite merchant and planter class, embraced generous overseas credit extensions secured by profitable staple

crops, and dove headlong into the expanding transatlantic economy in a quest to match or even exceed metropolitan levels of wealth."

2) There was a capitalistic mind-set, if not the actual social constructs, from the beginning. Individualism and self-aggrandizement were displayed by the earliest colonists. "Capitalism, in short, was present at the creation."

McWilliams (2002:137; emphasis in original) supports "the premise that capitalism can only be said to have intensified when *increasing numbers of settlers enjoyed the freedom to pursue profit through entrepreneurial activity.*" Greater wealth for a few generated by a minority of settlers is instead a consolidation of capitalism. After 1700, in Virginia and Maryland, political positions were based more on "wealth, family connections, and status as native creoles" than before when politics were participated in by anyone with a wish to protect their interests (McWilliams 2002:145).

The honey bee industry during this time period is a good example of how capitalism was present from the conception and intensified as time went on. Beekeeping is one of the few agricultural activities that anyone could afford to practice. The most basic equipment needed was a log beehive acquired by sawing off the portion of the tree that contained the hive and carrying it home. After that you simply waited for the honey bees to create a profit for you from the pollen and nectar plentifully supplied by nature. If you owned some land and there were honey bees in any of the trees then all you had to do was wait for late summer or early fall and then harvest the hive.

The fact that all levels of society were able to participate in beekeeping, a purely profit business since no expense was incurred for the honey bees' care or acquisition,[60] created an environment where anyone could be an entrepreneur and thereby improve their social position. In the section on settlement patterns I tell the story of George Pelton, who came to Virginia in 1622 as a landless tenant owning

[60] This is beekeeping at its most basic definition. See this paper, the section on material culture, the portions on log and straw hives for more information about minimal beekeeping.

only "3 barrells of corne and 1 peece" in 1624 (Jester 1964:36). By 1648 he had an Apiary that was so successful another Virginia resident sent a letter to England bragging of Pelton's success (Goodwin 1956; Maxwell 1849:76; Riley 1956).

There was a ready market for honey and beeswax. Virginia supplied other colonies with livestock, grain, and honey bees from the mid 17th century through the 18th century. And by the 18th century a new market was found in the West India Island sugar plantations, which were practicing specialized agriculture. The sugar crop was so valuable that land could not be spared to grow foodstuffs (Bidwell and Falconer 1925:42). This created a market for the surpluses raised in Virginia and I have described[61] how large amounts of beeswax were exported to the sugar plantations.

Honey bees have been one of the most successful agricultural cottage industries in the history of the United States and Mason (1998:3) mourns its passing,

> "one could argue persuasively that we are at this time witnessing the disappearance in this country of the last agricultural cottage industry, beekeeping for honey production, and that the disappearance is occurring at a rate consistent with the bewildering acceleration of changes in the environment from which our honey bees are not exempt."

Because there was very little needed in the way of investment to become a beekeeper, it was a cottage industry available to all who had the interest, including women.[62] Richard Parkinson[63] in the early 19th century wrote,

> "Honey-Bees are worth every person's attention; as their produce arises from a part of the produce of the land which cannot be made profitable by any other means (viz. the blossom of every plant in the meadow, the blossom of every sort of grain, and the flowers in the garden) and might be brought to a very comfortable value ...." [Pryor 1983:8].

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[61] See the section on Settlement Patterns

[62] Women have been beekeepers at various times throughout history. The first woman to publish a book on beekeeping in the United States was Lizzie E. Cotton in 1880 *Bee Keeping for Profit. A New System of Bee Management* (Mason 1998:126-127).

[63] Richard Parkinson worked for George Washington at Mount Vernon in the early 19th century and is considered "one of the best practical writers on agriculture to the time in which he lived" (Wilson and Fiske).

The fact that beekeeping became more than small cottage industries, while still retaining the ability to be practiced on a smaller scale and make a profit, is due to the mid 19th century innovations of bee space, frame extractors, stamped and machine rolled beeswax foundations, and the bellows smoker, all of which made large apiaries possible. Quinby was, perhaps, the first person to exploit this potential. From 1853 to 1875, when he passed away, honey production was his sole support (Mason 1998:484).

As the United States grew so did its agriculturally based economy. New technologies and maximization of honey bee pollination allows us to produce greater quantities on less land. The population of the United States continues to grow and in the last ten years it has grown approximately 10%, which in turn created a 10% increase in agricultural production, requiring an increase of 200,000 colonies of honey bees for pollination purposes. In 1998 there were an estimated 2,500,000 colonies rented for pollination purposes, most of which were rented for two crops and some were rented for three. In 2000 the value of the increased yield and quality achieved through pollination by honey bees alone is $14.6 billion[64] (Morse and Calderone 2000:2).

According to the August 2003 USDA National Honey Report, the total honey exports, from January to August 2003, were 1,173,567 kilograms worth $2,326,651. The totals for domestically consumed honey, January to August 2003, were 1,478,123 kilograms worth $2,868,715 (USDA). This means that the value of honey produced in the United States in an eight month period equaled $5,195,366.

I believe the role the honey bee played in the development of the agriculturally based economy of the United States is highly under-rated. Most of the

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[64] This takes into account increases due to greater yields and superior quality. One example of how honey bees affect the quality of a crop is the apple. "Apple blossoms not adequately pollinated produce fruit that is lopsided and less valuable for the grower" (Morse & Calderone 2000:7).

crops brought over from England were ones the honey bees were familiar with and great pollinators of. Additionally there were native plants that were very attractive to the honey bee, such as sunflowers which are 100% pollinated by insects and honey bees now perform 90% of that pollination (Morse and Calderone 2000:3-4). I do not believe the United States agriculture would have been as successful if the honey bee had never been imported along with the English crops.

Tanging

> "...the creatures are as a bright glass, wherein we may behold our God; for as God is a glass in heaven, wherein all his creatures are seen, so are the creatures a glass upon earth, wherein we may behold and know our God. They are trumpets of his honour – witnesses of his worth – bellows of our love – spurs to our dulness – and judges of our unthankfulness...for Christians may climb by the stairs of these inferior creatures, to contemplate the glorious power of the Creator...Thus do these unreasonable creatures teach reasonable men, by their continued care and providence, and laborious pains-taking to increase their little" [Purchas 1657:x, xi, 69, & 107).

Without an understanding of the ideology and symbolism that the English colonists brought with them, we can have no true understanding of any of the roles the honey bee played in the development of the United States culture. I contend that many honey bee significations are still present although we have lost all understanding of where they originated. Others, like tanging, were abandoned after more than 200 years in the United States, victims to changing ideologies and cultural needs.

"Of late year the convenient word 'tang' has been used to denote the custom of beating pans, kettles, and other metal articles when the bees are swarming. It is an old word formerly used locally [Wiltshire and Shropshire], and meaning to emit a sharp and loud ringing or clanging noise" (Ransome 1937:225). There is some

dispute as to why this practice was begun and perhaps even more about why it continued into the 20th century in the United States.[65]

Betts (1923:112) suggested that in ancient times the constellation of Orion was not pictured as a hunter. Instead he was a priest dancing with cymbals, i.e. tanging his priestesses. This may not be as unbelievable as it seems at first glance. The symbol of Diana, another hunter, was the honey bee (Frost 1937:81). Demeter's and Artemis' priestesses were called Melissae, i.e. bees. Additionally, Artemis' priests were called Essenes, i.e. king-bees (Betts 1922:52).

An ancient origination for the act of tanging is supported by the fact that so many countries practiced it – Sweden (Betts 1937:90), the Roman Empire (Ransome 1937:225), England (Ransome 1937:225-226; Goodwin 1956; Purchas 1657:34; Simpson and Roud 2000:20; Sooder 1946:27), Scotland (Jardine 1843:198); France (Ransome 1937:237), Central Europe (Ransome 1937:151 & 175), South Africa (Sooder 1946:27), and the United States (Betts 1937:91; Dodderidge 1813:18; Huish 1844:194-195; Miner 1857:268-269; Quinby 1864:209; Sooder 1946:27; Wildman 1778:129; Williams 1975:34-35). There may be more cultures that practice(d) tanging in some form, but I am unaware of them.

There were so many court cases involving ownership of swarms during the 9th century in Wessex that King Alfred created a law saying all swarms must be followed by the owner who had to create a noise that would precede him and proclaim his ownership of the fleeing swarm. Beekeeping was an important activity at this time for the Church required great quantities of beeswax for candles[66] and the king used beeswax candles for measuring time (Ransome 1937:198). Many have suggested that this law may have been the true beginning of tanging (Betts 1937:91; Ransome 1937:226; Simpson and Roud 2000:20; Sooder 1946:27).

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[65] See this paper, the section on material culture for more information on the practice of tanging.

[66] "That the chief church of Wittenburg before the Reformation used thirty-five thousand pounds of wax shows what an amount was wanted. Every monastery and abbey, therefore, had apiaries; for instance, at Kloster Neustadt alone was a bee-house with three hundred stocks of these 'industrious creatures of God.' Many peasants had hives of their own; those who held land under a monastery often had to pay a yearly rent in the form of wax...as early as 783" (Ransome 1937:147).

In the United States, Wildman recommended tanging, while at the same time tossing sand or water over the honey bees, to settle a swarm.

> "Whenever the bees of a swarm fly too high, they are made to descend lower, and disposed to settle, by throwing among them handfuls of sand or dust; probably the bees mistake this for rain. It is usual at the same time to beat on a kettle or frying pan; perhaps from its being observed that the noise of thunder prompts such bees as are in the fields to return home" [Wildman 1778:129].

Quinby (1864:209) tells of "one old lady who knew drumming on a pan did good, for she had tried it."

"To put a stop to their [the honey bees'] flight, the common practice is to make all sorts of noises, ringing of bells, beating of pans and other sonorous vessels" (Jardine 1843:198). The 19th century apicultural authors decried this practice, claiming it did no good and in fact caused the honey bees to become more excited and harder to manage. Additionally tanging disturbed your neighbors (Dodderidge 1813:14-15 & 18; Huish 1844:195; Miner 1857:268-269; Quinby 1864:209).

Tanging is just one example of an ancient honey bee practice that had lost its original meaning by the time it was imported into Virginia. Possibly it began in the Mediterranean region as a way to call the priests and priestesses to worship or as part of a ceremony. The identification of priests and priestesses with bees was lost as time went by and religions changed or the practice diffused into other countries and cultures. The idea of tanging to call the bees may have been all that remained. Perhaps King Alfred of Wessex got the idea of requiring tanging from a practice that was already well established for diligent beekeepers who watched for swarms.

The scientific revolution during the 17th century may have changed the mystical connotations of tanging to more practical ones. Instead of calling the honey bees tanging became a method to drown out the calls of the queen or to replicate the sound of thunder.

However, these more mundane explanations were based only on analogy. Even as late as the 19th century it was unknown if honey bees had the ability to hear. Huish (1844:41) defended the position that honey bees could hear, while Baron

Avebury [formerly known as John Lubbock] in 1883 claimed that honey bees did not have the ability to hear (Mason 1998:64).

There are many other honey bee significations and practices that are a part of our culture. All of these were imported just like the insect they are attached to. In order to truly understand the honey bee's place in the development of our culture we must have an understanding of the historical context of which they are a part of.

Conclusion

Francis Bacon's *NOVUM ORGANUM*, Book One (1620) XCV:

> "The men of experiment are like the ant, they only collect and use; the reasoners resemble spiders, who make cobwebs out of their own substance. But the bee takes a middle course: it gathers its material from the flowers of the garden and of the field, but transforms and digests it by a power of its own. Not unlike this is the true business of philosophy; for it neither relies solely or chiefly on the powers of the mind, nor does it take the matter which it gathers from natural history and mechanical experiments and lay it up in the memory whole, as it finds it, but lays it up in the understanding altered and digested" [Nickles, Tom].

I believe the history of the honey bee in America is "a history which extends its boundaries beyond human institutions – economics, class and gender systems, political organizations, cultural rituals – to the natural ecosystems which provide the context for those institutions" (Cronon 1983:vii). Archaeology's multi-disciplinary approach to research enables it to find connections where others see none. By incorporating entomological data with historic archaeology it is possible to expand our understanding of interactions between the environment and humans and gives us a way to look at how human choices affect not only human systems but ecosystems as well.

I chose to use the honey bee (*Apis mellifera* L.) to prove the value of meshing entomology with historic archaeology. The long period of co-evolution between the honey bees and humans means that associations and interactions between the two species have affected language, social structure, belief systems, medicine, economy, political structures, and basically any and all aspects of human culture. The fact that the honey bee was an exotic deliberately introduced into North America gives a stage from which to view the effects of an introduction of an alien species over a several hundred year time span.

I began by looking for evidence of the honey bee's arrival in the written record and for proof that archaeological methods could retrieve information about

the honey bee. The processes I used and the data I uncovered are described in the proceeding chapters. But what does it tell us?

I discovered that there are many reliable sources who claimed that the honey bee was an exotic species for North America. Additionally, the Native American population had no familiarity with the honey bee and only the groups with access to sugar maples in the north or the stingless bee (Meliponinae) in the tropical regions of Meso and South America had sweeteners other than fruits. Trade routes probably provided small quantities of honey from stingless bees and Ferdinando de Soto during his travels in Florida in 1540 found "a pot full of honie of bees"[67] (Belknap 1792). However, the most common sweetener used by Native Americans was Quiddony – a thick fruit syrup or jelly made from cooked fruit into a bread, and dried (Spencer 2000:96-97). The fact that Native Americans had no words for the honey bee previous to immigration by European colonists and the fact that no honey bee products were included in their imagery, technologies, stories, or foods is another proof that the honey bee was an alien species.

This paper has shown how the written record for the diffusion of the honey bee can at times be confusing and needs confirmation that only archaeology can provide. There are two entry dates for the honey bees' arrival in Kentucky: 1780 and 1793. And the recollections of many Oregon pioneers familiar with Tabitha 'Grandma' Brown's bee tree claim an entry for honey bees to Oregon that is five years ahead of many other official reports (Williams, 1975:34).

Did the honey bee really keep ahead of the settlers? If so, how far ahead were they and how fast was their spread? From letters, diaries, and surveys we can get a feel for the answers to these questions, but with archaeological data we can get a more precise answer.

My excavations and soil sample analysis has proven that archaeology is capable of retrieving information about honey bees. It is a difficult medium to

[67] The honey was found on the Chiaha, an upper branch of the Mobile.

analyze for several reasons: small sample size, limited diagnostic components, and the fact that it is time consuming and therefore expensive.

The exoskeleton of the honey bee is composed of a two layer cuticle – the exocuticle composed of sclerotin[68] and a small amount of chitin and the endocuticle that is softer and mainly chitinous. These layers are covered by the epicuticle, a greasy, waterproof substance, which helps the insect retain moisture and its blood (Dade 1962:16). This three layer material is what the honey bee mandible and stinger is composed of. Because it is a protein, it preserves better under some conditions than others and the optimal conditions would be anaerobic environments such as swamps, marshes, or peat bogs.

Conversely, processes that occur before deposition can also affect its preservation. Charring would preserve the identifiable form of the honey bee remains and there are numerous opportunities for entomological material to become charred: lightening can strike a bee tree and burn the hive; forest fires can burn down many bee trees at a time; an apiary can burn down;[69] and even with modern concerns about sanitation there are insect parts in the foods we eat, some of which can become charred during cooking.

The small sample retrieved[70] under most conditions makes it difficult if not impossible to date the insect remains. This is a big problem. Unless the honey bee remains are associated in situ with datable materials in a context that is free from disturbance there is very little you can say about the age of any retrieved remains. Weathering of the material alone only enables you to say that the weathered mandible or stinger is likely to be older than any unweathered mandibles or stingers in the same site, which is not very helpful.

Carbon-14, radiocarbon dating would require several grams of honey bee remains and unless the archaeologist was lucky enough to find a cache of remains in

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[68] This is a tanned protein (Dade 1962:16).

[69] This is what happened to George Pelton's apiary in 1648. See this paper, the section on settlement patterns for more information.

[70] The worker honey bee averages 11 to 15 mm in length and the stinger is much smaller. Additionally, most soil samples will only provide a few, if you are lucky, stingers.

the soil sample the small amount of retrieved remains alone would rule out this dating technique. A second problem with carbon-14 dating of colonial material is the large standard deviation for recently deposited items. AMS, accelerator mass spectrometry, uses a much smaller sample for dating making this a more attractive option for dating of honey bee remains, although this dating process also has a problem with fairly recent dates.

The presence of honey bees can be proven even without finding a datable mandible or stinger. Evidence of beekeeping can be seen in the material culture associated with the activities necessary to manage or harvest honey bees and their products. In the section on material culture, I have described these as completely as possible including beehives, beehive covers, honey and beeswax extraction equipment, pest control methods, bee hunting methods, etc. The problem this data set presents is that there is little consistency or specialization in equipment and tools used before the mid 19th century. The most recognizable, probably, would be the beehive, but even this offers many variations in form, size, and the material it is constructed from. Familiarity with common forms will help archaeologists to recognize some of the more unusual forms of beehive.

The tools used are mainly ones that any agricultural holding would possess – knives, sieves, cloth, coppers, bowls, pots, barrels, etc. All of the items are used for many different activities and only finding the residue of beeswax or honey would point to its use in beekeeping. However, it is important to remember that beeswax was a commonly used material to make candles, harness and wood polish, and cosmetics so many households that did not own honey bees still had beeswax or beeswax products present.

This thesis is based on the premise that honey bees are the unacknowledged catalyst, which enabled the United States to become a successful agriculturally based society during the 17th and 18th century and that archaeology has an important role to play in understanding the transition from distant colonial outpost to world power. The information in this paper points to this conclusion and I believe that future

studies will only strengthen the evidence for the importance of the honey bee to whom we are today.

I gave brief glimpses into three areas needing future study – environmental impact using white clover as an example, economic impacts, and symbolism/belief systems using tanging as an example. There are many different aspects of each of theses areas that would reward the researcher.

Another area to investigate is who the beekeepers were. This is one of most interesting questions, because the answer is dynamic and it depends on the area and time period you are looking at. The population of the 17th century American colonies changed over time from adventurers to settlers, from upper-class to yeoman, from all male to mixed male and female, and from English to various European, Scandinavian, and African groups. As the United States grew the development of its culture changed to reflect that growth and this means that who the beekeeper was changed as well. In 1648 when the population in Virginia was approximately 6 to 1 in favor of males (Spencer 2000:57-58), George Pelton, who came to Virginia a landless immigrant, was a very successful beekeeper. In 1769 Mary Cooper, 55 years old and living on Long Island, was from a family who owned most of Cove Neck and at various times had four slaves. In her diaries she wrote of her chores which included "taking care of honeybees" (DeWan). Many of the African tribes kept honey bees and would have brought this knowledge as well as the culture and images surrounding African beekeeping to America with them.[71]

The honey bee not only impacted the environment, it reflected the changing views of nature held by humans. An active nature became passive and nature as a living thing, an organism, became mechanized after the 17th century ushered in the scientific revolution (Burke 1997:112-114). There was a common belief that humans could improve upon nature. Samuel Deane, 1822 author of *The New England Farmer; Or, Georgical Dictionary. Containing a Compendious Account of the Ways and Methods in Which the Most Important Art of Husbandry, In All Its Various*

[71] The African practice of tanging is mentioned in this paper, the section on Points of interest, the portion about tanging.

Branches, Is, Or May Be, Practised to the Greatest Advantage in This Country, described farming as "one of the noblest employments to assist nature in her bountiful productions" (Mason 1998:151). Shuckard (1866:8) had what appears to be an alternate view in which nature was a force that human actions could not affect, "her courses are so sure that they are ever eventually successful...and she is as indifferent to the seconds of time whereby man's brevity is spanned, as she is to the wastefulness of her own exuberant resources, knowing that neither is lost to the result at which she reaches." But in actuality this idea was an extension of the belief that nature could be manipulated by humans without suffering any ill effects.

I have used the honey bee to show the potential inherent in historical entomological archaeology, but any other insect would also be worth studying. Previously most historical research involving insects has revolved around the role they play as vectors for disease of plants, animals, or humans. There are other effects of equal importance that need to be investigated and historical archaeology could shed much light on these inquiries.

Initiating a new specialized field of investigation in any discipline is difficult. My hope is that with this paper I have shown that historic archaeology is not only capable of including entomological information, but that both fields would benefit by its inclusion.

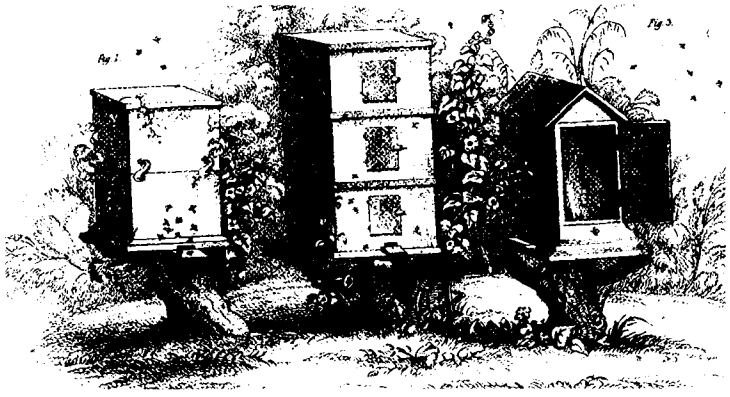

Figure 26 Wooden hives. (Jardine, Sir William, Bart. Ed. *The Naturalist's Library* Vol. XXXVIII. Edinburgh, 1843).

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