

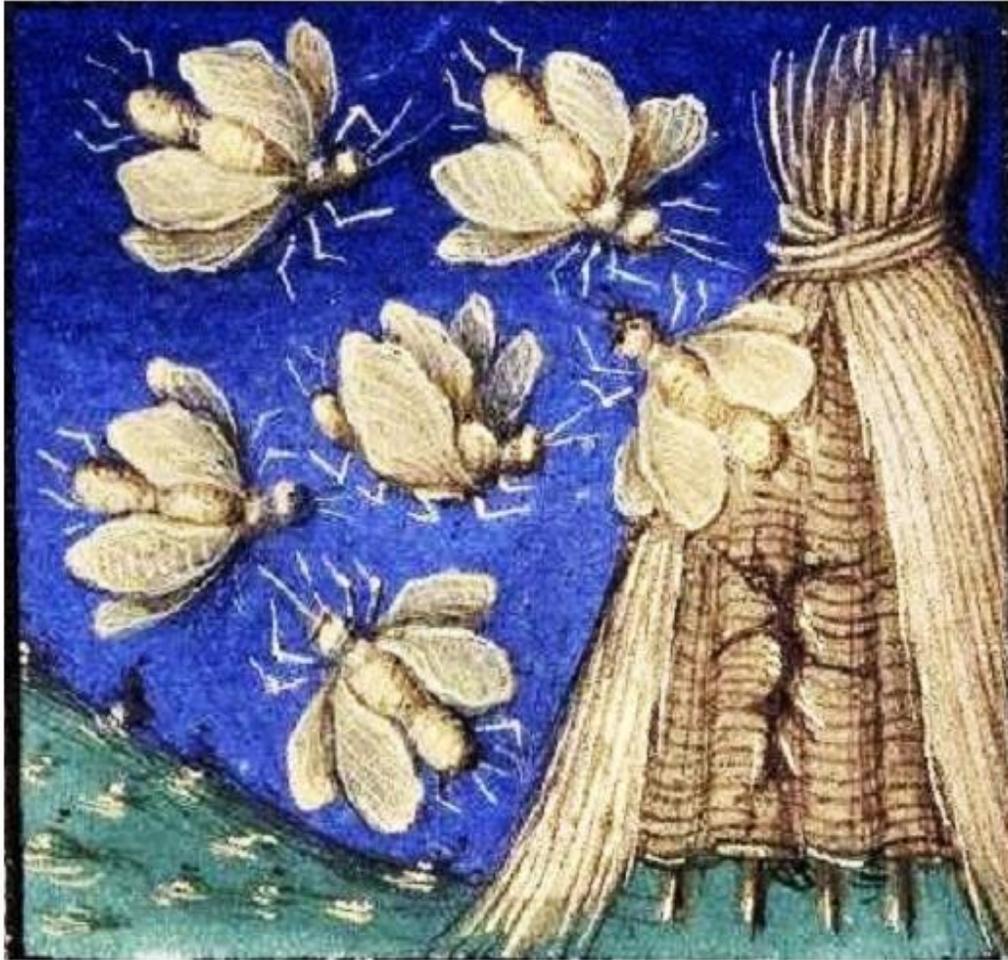


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# BEEHIVES

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The primary tool of the beekeeper



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Kingdom of Caid, Society for Creative Anachronism

2.10.7 Functional/Tools/Other



## Introduction

Honeybees are remarkably adaptable. All they need for an appropriate home is ample space (at least a 5 to 7 gallon volume<sup>1</sup> is best, but smaller spaces were often used in medieval times), protection from the elements, and peace. Modern homeowners have found that bees will inhabit any undisturbed space that fits their needs.

Throughout history beekeepers in any given region have used the resources available to them to make homes for their livestock. Old beehives made of wood or straw are ephemeral things. They can last for several generations if properly maintained, but once discarded in favor of more modern equipment they quickly decay. Thus we have only illuminated manuscripts and woodcuts; few examples of real medieval items remain. There is nothing in the way of first-hand description of the construction of these items from medieval times. Small pockets of traditional “skep beekeeping” persisted into the 20<sup>th</sup> C. so there are modern examples of the ancient methods. . Honeybees, and the equipment used to keep them, changed very little for centuries until the introduction of the modern moveable frame hive so it is reasonably safe to assume that methods recorded in the 18<sup>th</sup> C (and more recently) are not too far off the same tasks performed centuries earlier.<sup>2</sup>



1. Making woven straw hive

2. Modern skep apiary in Germany

3. Harvesting wax and honey

The word “skep” derives from Old Norse, its original meaning was a unit of measure and also the basket used to carry that volume of goods (as we would say “bushel” in modern English. In fact the volume was about half of a modern bushel). The first known use of “skep” as a standalone word meaning a hive of bees appeared in 1584.<sup>3</sup> Thus for most of the medieval period, the word “skep” is not appropriate in this context.

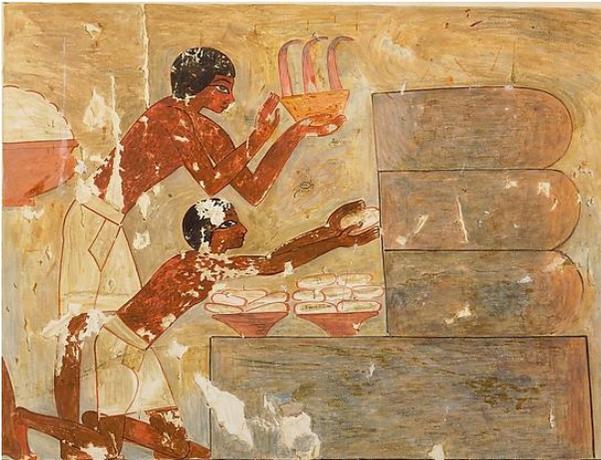
Traditional skep beekeeping has been abandoned in most developed countries for two primary reasons:

1. When bees fill a space such as a basket or jar, the only way to harvest honey and wax is to destroy the hive. The bees are first killed, often by holding the hive over a bowl of burning sulfur<sup>4</sup>, then the comb is cut out for processing. This requires destruction of your livestock in order to collect the produce. Modern removable-frame hives allow one to harvest honey without destroying the colony.

2. Most states and developed countries require that beehives used to produce honey for sale must be inspected for cleanliness and disease. Bees kept in skeps cannot be inspected adequately, and so it is illegal to use skeps in regions that require inspection.

## History of Beehives

**Clay Pots:** Beekeepers have used clay pots, from the ancient Egyptians and Greeks all the way to modern times. Clay pots are easy to obtain, but are fragile and have a major disadvantage in their lack of insulation, particularly against the winter cold. One sees clay pots mostly used in temperate Mediterranean climates.



Egypt, c. 1450 BCE<sup>5</sup>



Malta, modern times<sup>6</sup>

**Hollow Logs:** In nature, honeybees would live in hollow tree trunks. Hollow logs were used historically in northern forest areas,<sup>7</sup> being a natural transition from the wild to captivity. Logs were used for centuries by many societies. They are certainly sturdy, but weight is an obvious disadvantage to this form of beehive. The building material was inexpensive and provided good insulation in cold weather.



Above Left: Austria, 1450.<sup>8</sup>



Middle/Upper: Germany ca. 1375<sup>9</sup>

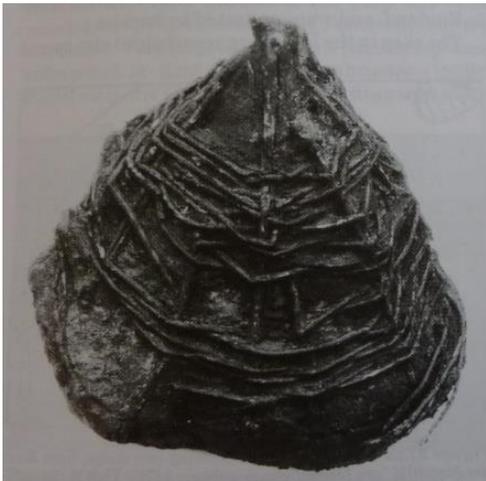
Middle/Lower: Tirol, 1419<sup>10</sup>

Right: Poland ca. 1542<sup>11</sup>



**Wicker Basket Hives:** For centuries the most common practice in Europe was to use wicker baskets. Beekeepers used whatever was available, woody vines and willow branches were favored weaving materials. Bees require a dark and watertight living space, so a simple woven basket would not be acceptable. The traditional method to make a basket light-tight and water-resistant was to coat it with “cloam”, a mortar made of clay, lime and cow dung.<sup>12</sup> A woven basket coated with cloam is sturdy and well-insulated. This type of hive was easily made from natural materials, and was common all over Europe during the middle ages.

See also the Cover Page and pages 5 & 8.



Preserved wicker hive, Saxony ca. 200 CE.<sup>13</sup>



France, ca. 1270<sup>14</sup>



Switzerland ca. 1545<sup>15</sup>



France, ca. 1445-1450<sup>16</sup>

**Coiled Straw Hives:** The familiar coiled straw hive has been used in Europe since the 4<sup>th</sup> C.<sup>17</sup> Hive makers could use straw from harvested grain in agricultural areas, or sedges and rushes in wetlands, all would give acceptable results. Coiled and wicker hives occurred together in many areas<sup>18</sup>, the beekeeper would make use of whatever materials happened to be available. England’s Domesday Book (ca. 1283) has many entries that differentiate coiled or wicker hives used in various manors.<sup>19</sup> Coiled hives are lightweight, light-tight and water-resistant, and could last over 100 years if properly maintained. Coiled hives were also coated with cloam if they sat out in the open, exposed to the elements. For most of the medieval period, the word “skep” is not appropriate in this context. (see page 2)



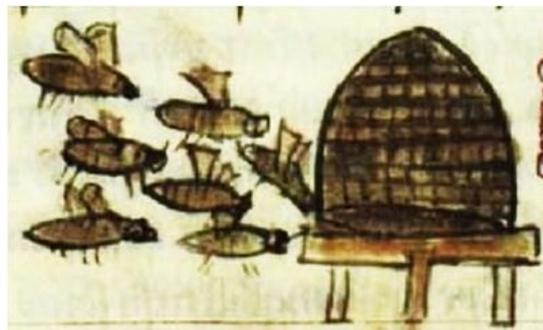
France, 1452 (protected under a roof) <sup>20</sup>



Germany, 1514.<sup>21</sup>



England, ca. 1185<sup>22</sup>



England, 1400-1425 <sup>23</sup>



Germany ca. 1475 <sup>24</sup>



England, 1236-1250<sup>25</sup>

**Cloam:** Described by Charles Butler (1507),<sup>26</sup> “... [T]ake Neats Dung, and harden it with Lime or Ashes, also with Sand and Gravel well tempered together, and with this composition close the ... hives, that there be no Way into them but at the Door...” A mortar made from cow dung, clay and lime on the exterior of the hive provides insulation and waterproofing.



Modern beekeeper applying cloam<sup>27</sup>



The author applying cloam

**The Hackle:** (OE *hacela*, meaning a cloak or mantle) This was a sheath of grass or straw placed atop the hive, to wick away rainwater or provide insulation in cold and snow. The hackle is a cheap and disposable way to protect one's livestock and the hive itself, and would have been used with any style of hive.



Hackles on cloamed wicker hives:

Above: France c. 1551<sup>28</sup>

Right: France, 1530<sup>29</sup>

**See also the cover page.**

In all three illustrations, note that the wicker hives are standing on the stubs of the vertical ribs

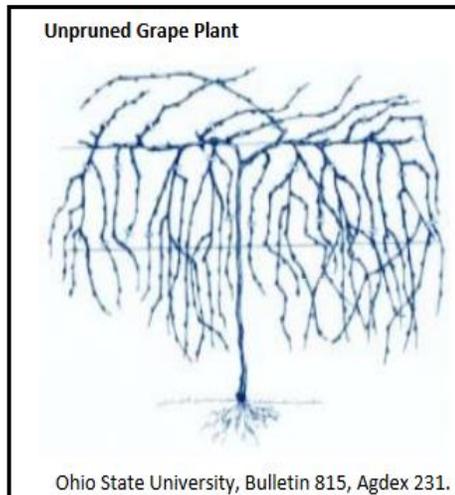


## Materials

The medieval beekeeper would make do with what he had and whatever he could glean or gather. This would have varied by time and locality.<sup>30</sup> No doubt that beekeepers in any given region would have their preferred materials and sources. Fortunately honeybees are not very picky about materials or outward appearance, they only care that the final product is dark and snug. As such, it is not my intent to use optimal materials, or to gather specific materials that would have been used in a specific time or place. Rather it is my intent to show what beekeepers in suburban Caid can do with the materials available to them.



**Rush for coiled hives:** Southern Caid is not particularly known for grain production, so consistent grain straw is not available. An excellent alternative to grain straw is the “rush”, most often found in wetland areas but some varieties are used in suburban landscaping. Since most wetland areas in Southern Caid fall under some sort of legal protection, the amount of rush that I could legally gather from suburban landscaping was limited. Thus my coiled hive will need to be small.



### **Grape and Trumpet Vine for wicker hives:**

Trumpet Vine and Grape are tough and woody. Both are excellent materials for wicker hives. Trumpet vines are straighter and (mostly) unkinked, which makes them easier to use in weaving than grape. Plus it grows in my yard, so Trumpet Vine is my preferred material.

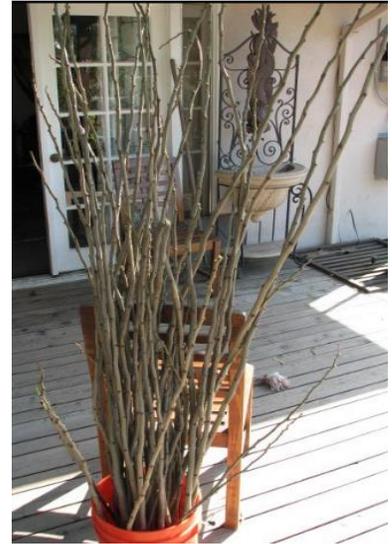


### Mimosa bark and branches:

For both coiled and wicker beehives I needed strips for binding together adjacent rows of material. The ideal binding is supple, can be tied in a knot, is durable long-term, and free. “Modern” writers tell us to use split bramble canes, but brambles are not available to me. Mimosa bark works great, and grows in my yard. The branches, stripped of bark, also served as ribs and splints for making hives.

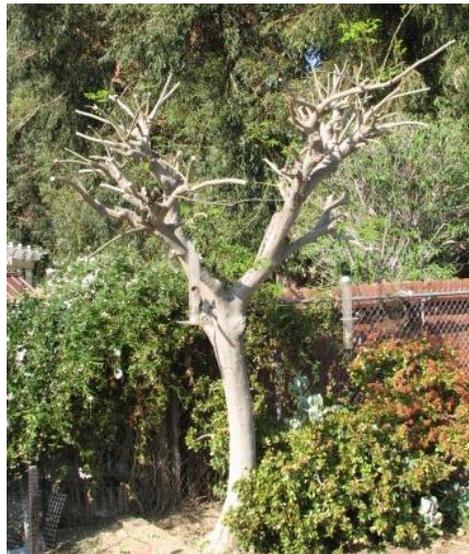
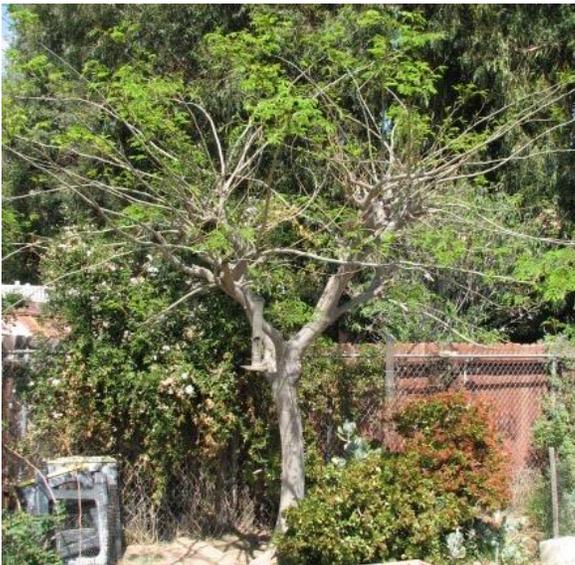
Right: Branches harvested in winter, sitting in water to keep the bark supple.

Left: strip of bark to use as binding



### Wood-pasture technique to produce mimosa branches and bark.<sup>31</sup>

My backyard mimosa tree is maintained using a technique called “pollarding”, which was widely used in medieval Europe to produce straight and uniform branches used for a variety of purposes. Each winter, the past year’s growth is cut back, yielding the harvest of branches shown above. The tree itself is reduced to not much more than the bare trunk. During the growing season the trunk puts out long straight first-year growth, which is again cut back that winter. The harvested wood has been used as garden poles and to build a trellis for beans and peas, as well as in the making of beehives.



Left: Mimosa tree in winter, before harvest.

Right: Pollarded mimosa tree, after harvest.

## Making Wicker Hives #1:



← Wicker hives, France, early 15<sup>th</sup> Century.<sup>32</sup>

### Materials:

Branches from Mimosa tree (*Albizia julibrissin*) .

Lengths of Trumpet Vine (*Distictis buccinatoria*) and grape vine (*Vitus sp.*)

Mimosa and Trumpet Vine would not likely have been used by medieval European beekeepers, but in the spirit of “using whatever materials are available” they illustrate the fact that there are many potential sources for the basic raw materials. There are no extant medieval-period instructions to follow. We can only look at a few artifacts and period illustrations, and attempt to reverse-engineer the process.

### Tools:

Knife for cutting vines, hand-saw for trimming the ribs.



**Step 1:** tie ribs to a shaped log to establish the diameter at the base.



**Step 2:** tie off the apex, trim the tops of the ribs and begin weaving.



**Step 3:** Add extra ribs as the diameter of the basket increases



**Step 4:** Remove from the base and continue weaving



**Step 5:** Finished.

**Step 6:** A layer of cloam to seal the sides.



Many illustrations I have seen of this type of hive leave short stubs of the ribs protruding below (see Cover Page and also pages 3, 5 & 8). This would cause the hive to stand on the stubs, leaving a small gap below the weave for bees to come and go. This might have the advantage of keeping the bottom of the hive dry in wet weather, but also might tend to lose heat in the winter. If it was desired to have a solid bottom (see pages 3 & 11), that would be easy enough to do by wrapping a binding around the bottom layers and trimming off the excess ribs. In that case one would need to cut a hole through the cloam and vines for an entrance.

## Making Wicker Hives #2:



← Lithuanian wicker beehive, believed to be over 100 years old.<sup>33</sup>  
Rather than starting with individual ribs, this hive starts with a multi-forked branch to begin the skeleton. I will try the same approach with a pine tree trunk.

### Materials:

Monterey Pine (*Pinus radiata*) used as a Christmas tree (2015).  
Lengths of Trumpet Vine (*Distictis buccinatoria*) and Grape vine (*Vitis sp.*)  
Strips of bark from mimosa branches (*Albizia julibrissin*).

### Tools:

Knife for cutting vines and branches, hand-saw for cutting the trunk.



**Step 1:** Top of tree removed exposing a whorl of branches.



**Step 2:** strip the needles off the whorled branches and begin weaving



**Step 3:** As the diameter of the basket increases, incorporate additional branches not included in the original whorl.



**Step 4:** Completed basket, rim bound with mimosa bark to prevent unravelling. Still on the trunk.



**Step 5:** Removed from trunk. All it needs now is a layer of cloam to seal up the walls.

While the end product is certainly functional, this method ended up being more difficult to make than Wicker Hive #1. The natural (and irregular) spacing of the ribs made weaving more complicated. Overall I would rely on process #1 for routine production.

## Tools for Making Coiled Rush Hives:



### The Girth:

This is a cylinder made of leather, about one inch diameter (or greater if you want a thicker coil), and about three inches long.

The girth is used to control the thickness of the coil. More rushes are added to the open end of the girth as I work along the weave.



A

B



### The Awl:

As the coil of rush expands, it is necessary to pass the binding through the previously wrapped coil. To push through the tightly packed rushes a sharp-pointed awl is used to make a hole for the binding. I tried two styles of awl. In practice the one on the left (A) was most useful. Both awls were handmade from pieces of antler.

## Wooden mallet, knife, tweezers

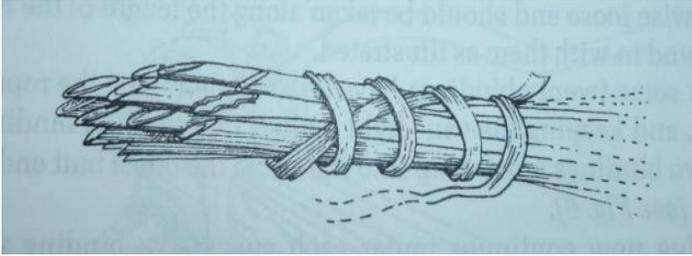


Mallet is hand-made from an oak tree removed from my yard. Knife is a simple paring knife. Brass tweezers was purchased, and is similar to medieval items



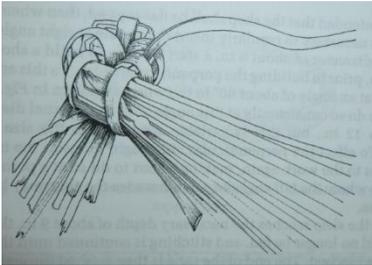
documented in the British "Portable Antiquities Scheme" website<sup>34</sup>:

## Making a Coiled Rush Hive:



**Step 1:** Bind about a dozen rushes into a sheaf with the cut ends staggered.

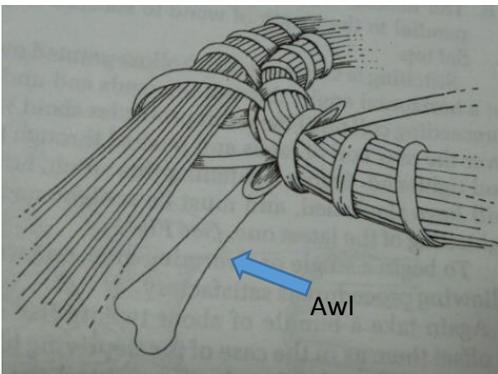
Drawings at left: <sup>35</sup>



**Step 2:** Coil the sheaf back on itself and tie it in place.



**Step 3:** Expand the circle by adding more rushes. Due to the wiry/springy nature of the rushes I need to use a lot of binding to hold it in place and prevent the tension from causing my coil to explode.



**Step 4:** The basic stitch is made by passing the awl through the preceding coil, underneath a loop of binding. The new binding is then fed through the awl, everything is tightened up and the awl removed. This same stitch is repeated over and over (and over)

until the desired depth is reached. The turkey leg awl in the illustration is being used in the same way that I use awl "A".

Unfortunately at this point my camera died. Thus I lost all pictures of completing the hive, and of the completed hive itself (before adding the layer of cloam).



## Add Bees to the Coiled Rush Hive:

A wild honeybee colony was rescued from a suburban neighborhood, and packaged into my bee boxes:



The coiled rush hive was placed on top of the main bee-boxes, to encourage the bees to build comb in it. (I had seeded the rush hive with some melted wax to make it inviting.) When they had built in some comb it was removed. I wanted to discourage the storage of honey in the new comb because that would make a mess when I use the hive for demonstration purposes. Given enough time, they would fill the entire basket with comb (see page 1, #3).



## Cloam: Raw Materials



**Neat's Dung:** "Neat" is an archaic term for domestic cattle. Patches and Freckles at the Orange County Fairground Centennial Farm kindly donated a bucket full.

**Clay:** A local eroded hillside provided all I need.

**Making Hydrated Lime:** This basic method has been used since ancient times to make lime for cement and concrete.<sup>36</sup> My starting material was oystershells. (I could have used limestone, but limestone doesn't go as well with tartar sauce and a cold beer.)



Chemistry:

- Seashells and limestone are made of calcium carbonate.
- Calcium carbonate when heated (to 900 degrees Celsius) will convert to calcium oxide (aka "Quicklime").
- Quicklime mixed with water converts to calcium hydroxide (aka "Lime" or "Slaked/Hydrated Lime")



The kiln is a simple brick chimney, with an air pipe coming in through the bottom. I used a paint dryer (a heavy-duty version of the hair dryer) to blow air into the kiln. In period this would be done with bellows. The lower third of the kiln was filled with charcoal. The middle third held about one pound of oyster shells. The top third was filled with more charcoal. The burning required about 30 minutes, then the kiln was dismantled.



The roasted shells were removed and allowed to cool. They are now "quicklime" (calcium oxide). Contact with water must be avoided, handle quicklime with gloves or tongs. Quicklime mixed with water converts to calcium hydroxide and releases heat (called an "exothermic reaction"). Yes, the pot is boiling from the heat of the reaction, there is no external heat source. After the reaction cools down you have "hydrated" lime (calcium hydroxide).

**Cloam: Mix cloam and apply to the hive**

**Mix:** 12 parts dung, one part hydrated lime and one part clay plus a little water to make a stiff mortar.<sup>37</sup>

**Apply:** First, insert spleets (for coiled hive only). Spleets are forked sticks to help the coiled structure to maintain its shape under the weight of comb and honey.<sup>38</sup> Wicker hives are sturdier and do not require spleets.

Apply cloam to the outside only.

**Dry:** The cloam layer was completely dry in about two weeks.



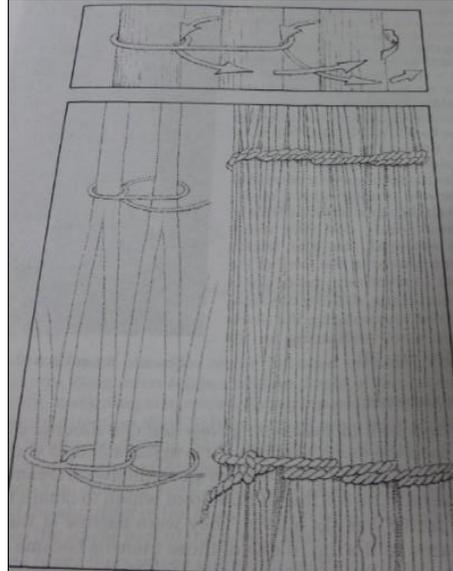
Complete layer of cloam on coiled hive.



Partial layer of cloam on wicker hive.

**Hackle:**

The stalks of Fountain Grass (*Pennisetum setaceum*) were too brittle to withstand the bending necessary for making a coiled hive. But in keeping with the theme of “using whatever materials are available” I used Fountain Grass for the hackle. The hackle is intended to be simple to make, and disposable after a year or two.



The basic stitch for making a hackle is as shown in this drawing.<sup>39</sup> Bundles of straws are wrapped with cord. Each successive loop runs through the previous loop to draw everything together. Farther down the straws, the same pattern is followed, but here each bundle is made up of half of each of the two adjacent bundles. This interlocks the

bundles and makes a tight, but expandable network.

I made this hackle in two layers. The inner layer was made of straight straws (left), then a thick outer layer was added using the same basic stitch (below).





Cover Page: Bartholomeus Anglicus, France, ca. 1445-1450, *De Proprietatibus rerum, Artificiosae Apes*  
Bibliothèque Nationale de France (Fr. 136, fol. 16). Accessed Nov. 13, 2016  
<http://visualiseur.bnf.fr/ConsulterElementNum?O=IFN-7826026&E=JPEG&Deb=1&Fin=1&Param=C>

<sup>1</sup> Butler, Charles. (1507, original in Latin translated to English in 1701 by “W.S.”) *The Feminine Monarchy; or the history of bees; shewing their admirable nature and property*. A reproduction of the original in the British Library published by ECCO Print Editions, Andover, England, 37.

Note: Butler (correctly) identifies bee society as a feminine monarchy. Most references from the middle ages refer to the one large bee as the King. The largest bee in the hive was not identified by science to be female until the 18<sup>th</sup> century.

<sup>2</sup> IWF Göttingen (1961, 1978-1979, 1983 ). *Traditional Skep Beekeeping in the Heathlands of Northern Germany - The Skep Beekeeper's Management Tasks through the Year*. A series of online videos from an IWF (*Institut für den Wissenschaftlichen Film*) documentary on traditional skep beekeeping in Germany. With the exception of a few modern tools these videos are an excellent description of how beehives were managed in medieval Europe.

1. <https://www.youtube.com/watch?v=TwLTi0i83tM> runtime 9:26 Accessed Nov. 13, 2016
2. <https://www.youtube.com/watch?v=Ux9oL6yfsAY> runtime 2:01 Accessed Nov. 13, 2016
3. <https://www.youtube.com/watch?v=yIfhM0kNr5o> runtime 0:45 Accessed Nov. 13, 2016

<sup>3</sup> Oxford English Dictionary Online. <http://www.oed.com/viewdictionaryentry/Entry/180751> Accessed June 21, 2016.

<sup>4</sup> Fraser, Malcom H. (1958) *History of Beekeeping in Britain*. London: Bee Research Association, 25.  
Court records provide the earliest known reference to the use of burning sulfur, in 1457.

<sup>5</sup> wall painting of the tomb of Rekhmire (c. 1450 BCE) in Egypt, depicting horizontal beehives. Metropolitan Museum accession number 30.4.88 Accessed March 5, 2017 <http://www.metmuseum.org/art/collection/search/544626>

Kritsky, Gene. (2015) *The Tears of Re: Beekeeping in Ancient Egypt*. Oxford, UK: University Press, Plate 6..

<sup>6</sup> <https://vassallohistory.wordpress.com/bee-keeping/> Accessed July 7, 2016.

<sup>7</sup> Hill, Thomas F. (1574, reprinted 1608) *The strange government, property and benefite of Bees* in *The Arte of Gardening, Whereunto is added much necessarie matter with a number of secrets*. London: Edward Allde. 17.

<sup>8</sup> Ulrich von Lilienfeld. Austria 1350, *Concordantiae caritatis*, Stiftsbibliothek St. Gallen, Switzerland (151, Fol. 81v), Accessed Nov. 14, 2016. <http://www.larsdatter.com/beehives.htm>

<sup>9</sup> Crane, Eva. (2013) *The world history of beekeeping and honey hunting*. NY: Routledge, 227.

<sup>10</sup> Hans Vintler. Tirol, 1419, *Die Pluemen der Tugent*, Österreichische Nationalbibliothek, Vienna, Austria (12819, p. 42) Accessed Nov. 14, 2016. [http://archiv.onb.ac.at:1801/view/action/nmets.do?DOCCHOICE=2810198.xml&dvs=1489427614357~266&locale=en\\_US&search\\_terms=&adjacency=&VIEWER\\_URL=/view/action/nmets.do?&DELIVERY\\_RULE\\_ID=1&divType=&usePid1=true&usePid2=true](http://archiv.onb.ac.at:1801/view/action/nmets.do?DOCCHOICE=2810198.xml&dvs=1489427614357~266&locale=en_US&search_terms=&adjacency=&VIEWER_URL=/view/action/nmets.do?&DELIVERY_RULE_ID=1&divType=&usePid1=true&usePid2=true)

<sup>11</sup> Crane 230

<sup>12</sup> Butler, 37-8.

Dalby, Andrew. (2011) *Geoponika. A modern translation of the Roman and Byzantine Farming Handbook*. Devon, UK: Prospect Books, 300.

This compendium of Roman and Byzantine farming advice discusses the keeping of honey bees, but makes no mention of the construction of beehives.

<sup>13</sup> Crane, Eva & Walker, Penelope. (1999) “Early English beekeeping: the evidence from local records up to the end of the Norman period.” *The Local Historian* 29, 1-22, p. 2.

<sup>14</sup> Unknown Author, France ca. 1270. *De Natura animalium*. Bibliothèque Marceline Desbordes-Valmore (ms. 711, fol. 37r) <http://discardingimages.tumblr.com/post/118601406993/bees-de-natura-animalium-cambrai-ca-1270-douai>

<sup>15</sup> Crane, 238.

<sup>16</sup> Bartholomeus Anglicus, France, ca. 1445-1450, *De Proprietatibus rerum*, Bibliothèque Nationale de France (Fr. 339, fol. 155v). Accessed Nov. 13, 2016 <http://www.photo.rmn.fr/archive/03-012287-2C6NU04P5LMW.html>

- <sup>17</sup> Alston, Frank. (1987) *Skeps, Their History Making and Use*. Hebden Bridge, UK: Northern Bee Books, 12.
- <sup>18</sup> Butler, 28. See also Hill, 17.
- <sup>19</sup> Fraser, 18-21.
- <sup>20</sup> *Book of simple medicines*, France, 1452, Bibliothèque nationale de France (NAF 6593, fol. 137v). Accessed Nov. 13, 2016 <http://visualiseur.bnf.fr/ConsulterElementNum?O=IFN-08101681&E=JPEG&Deb=193&Fin=193&Param=C>
- <sup>21</sup> Albrecht Durer, “*Cupid the Honey Thief*” watercolor, Kunsthistorisches Museum, Vienna. Accessed Nov. 13, 2016 <http://www.wga.hu/frames-e.html?/html/d/durer/2/16/2/11cupid.html>
- <sup>22</sup> Bestiary, England, ca. 1185, Morgan Library, MS M.81 fol. 58r  
Accessed Nov. 21, 2016, <http://ica.themorgan.org/manuscript/page/64/77019>
- <sup>23</sup> Bestiary of Anne Walshe, England, 1400-1425. ,Kongelige Bibliotek, Denmark. Gl. kgl. S. 1633 4°, Folio 47r  
Accessed Nov. 21, 2016 <http://bestiary.ca/beasts/beat260.htm>
- <sup>24</sup> Crane, *Beekeeping and honey hunting*, 242
- <sup>25</sup> Bestiary, England, ca. 1236-1250, British Library, Harley MS 3244 fol. 57v  
Accessed Nov. 21, 2016, [http://http://www.bl.uk/manuscripts/Viewer.aspx?ref=harley\\_ms\\_3244\\_f057v](http://http://www.bl.uk/manuscripts/Viewer.aspx?ref=harley_ms_3244_f057v)
- <sup>26</sup> Butler, 37-8.
- <sup>27</sup> IWF Göttingen. *Traditional Skep Beekeeping in the Heathlands of Northern Germany* Accessed Nov. 13, 2016  
Preparations for the Swarming Period [https://www.youtube.com/watch?v=k9dl\\_8tKqBo](https://www.youtube.com/watch?v=k9dl_8tKqBo) time stamp 12:18
- <sup>28</sup> Crane, *Beekeeping and honey hunting*, 247.
- <sup>29</sup> François de Rohan, France, 1530. Bibliothèque National de France. *Fleur de vertu* F. 42v  
Accessed Nov. 21, 2016 <http://gallica.bnf.fr/ark:/12148/btv1b105073318/f90.image>
- <sup>30</sup> Crane, Eva & Walker, Penelope. (1984) “Evidence on Welsh Beekeeping in the past.” *Folk Life*, 23:21-48.
- <sup>31</sup> Jorgensen, Dolly & Quelch, Peter. (2014) “The origins and history of medieval wood-pastures” in *European wood-pastures in transition, a socio-ecological approach*. Tibor Hartel & Tobias Plieninger eds. London: Routledge, 55-69.
- Hoffmann, Richard C. (2014) *An environmental history of medieval Europe*. Cambridge, UK: University Press, 185.
- <sup>32</sup>. Unknown Author. *Enluminures des Bucoliques*, France, Early 15th century. Bibliothèque Municipale de Lyon, Ms 27.  
Accessed Nov. 21, 2016 <https://www.pinterest.com/pin/332914597431397331/>
- <sup>33</sup> Lithuanian Museum of Ancient Beekeeping. Personal communication. Photograph of wicker beehive in the museum collection.
- <sup>34</sup> British Portable Antiquities Database. Accessed July 21, 2016. <https://finds.org.uk/database>  
Record ID: GLO-C5EF08 TWEEZERS (copper alloy) Roman, Gloucestershire  
Record ID: SWYOR-82780C TWEEZERS (copper alloy) Roman to Medieval, AD 43 - 1500, Lincolnshire
- <sup>35</sup> Alston, 21, 23, 31.
- <sup>36</sup> Lucas, A. & Harris, J. (2012) *Ancient Egyptian Materials and Industries*. Mineola, NY: Dover, 79.
- Boynton, Robert S. (1980) *Chemistry and technology of lime and limestone* 2nd ed. NY: John Wiley, Chapter 1.
- <sup>37</sup> Mancke, Gunther (2013) *The Sunhive - how to cover a skep beehive*. Accessed Nov. 14, 2016.  
<https://www.youtube.com/watch?v=Jn-VkR0nQXw>
- Although Butler (endnote 18) gives us a general outline for making cloam, he does not give us detailed proportions. This modern video does, and I have adapted my recipe based on the recommendation of the video. The video used wood ash. Butler said to “*harden it with Lime or Ashes*”. I chose to use lime.
- <sup>38</sup> Butler, 32-3.
- <sup>39</sup> Alston, 31.