Building the Past: The Creation and Analysis of a Phytolith Type Collection

By: Thomas C. Hart (Sociology and Anthropology)

Submitted in Partial Fulfillment of the Graduation Requirements for the St. Mary’s Project

May, 2004

St. Mary’s College of Maryland

St. Mary’s City, Maryland
ABSTRACT

Preparing for the Past: The Creation and Analysis of a Phytolith Type Collection of Historically Important Tree Species

Thomas C. Hart

Advisors: Kate Meatyard, Dan Ingersoll, and Henry Miller

Throughout much of the plant kingdom, small inorganic silica bodies known as phytoliths are formed in different types of plant tissues. Small amounts of silica are imported from the soil and deposited in every segment of a plant via the vascular system. This silica then hardens into the shape of the surrounding tissue thereby forming a cast or mold. These casts are known as phytoliths and may be specific to a certain family, genus, or even species. Yet because these silica bodies do not decay over time, they can remain in the soil for very long periods. Because phytoliths resist decay and are relatively plant specific, they prove to be a very useful tool for archaeologists. Archaeologists can use these small microbotanical remains to reconstruct past landscape uses or ecosystems. The purpose of this study was to create a phytolith type collection of tree species that were used in 17th century Maryland. Trees were utilized in almost every aspect of colonial life from ship and home construction, to common household chores. Certain species of trees were used predominately in the construction of a variety of colonial houses such as hole-set framed and cruck structures. The archaeological excavations at the St. Johns site at Historic St. Mary’s City provide an excellent opportunity to discover what types of trees were used in home construction. In order to do that however, this phytolith type collection was needed first. Phytoliths were extracted from the stem and leaf tissues of nine different species of historically important trees. Digital photographs of the samples were taken and a preliminary analysis of diagnostic ability was made. All nine species produced some level of phytoliths. Of these species, only two were deemed to be the most useful diagnostically. Four species were determined to have some diagnostic value while the remaining three had little to no worth. However, the creation of this type collection added to the slowly growing body of knowledge surrounding phytoliths found in the Tidewater region.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>iv-v</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>vii-ix</td>
</tr>
<tr>
<td>LIST OF PLATES</td>
<td>x</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II PHYTOLITH HISTORY AND MORPHOLOGY</td>
<td>4</td>
</tr>
<tr>
<td>III HISTORICAL ARCHITECTURE OF THE TIDEWATER</td>
<td>14</td>
</tr>
<tr>
<td>IV METHODS</td>
<td>30</td>
</tr>
<tr>
<td>V RESULTS AND DISCUSSION</td>
<td>34</td>
</tr>
<tr>
<td>VI CONCLUSIONS</td>
<td>71</td>
</tr>
<tr>
<td>VII REFERENCES</td>
<td>75</td>
</tr>
<tr>
<td>VIII ACKNOWLEDGEMENTS</td>
<td>82</td>
</tr>
<tr>
<td>APPENDIX A</td>
<td>83</td>
</tr>
<tr>
<td>GUIDE TO PLANTS IN APPENDIX A</td>
<td>84</td>
</tr>
<tr>
<td>PLATES 1a-9n</td>
<td>111</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

## BY AUTHOR

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td><em>Quercus alba</em> Total Phytolith Distribution</td>
</tr>
<tr>
<td>5.2</td>
<td><em>Quercus alba</em> Known Phytolith Distribution</td>
</tr>
<tr>
<td>5.3</td>
<td><em>Ulmus americana</em> Total Phytolith Distribution</td>
</tr>
<tr>
<td>5.4</td>
<td><em>Ulmus americana</em> Known Phytolith Distribution</td>
</tr>
<tr>
<td>5.5</td>
<td><em>Juglans nigra</em> Total Phytolith Distribution</td>
</tr>
<tr>
<td>5.6</td>
<td><em>Juglans nigra</em> Known Phytolith Distribution</td>
</tr>
<tr>
<td>5.7</td>
<td><em>Robinia pseudoacacia</em> Total Phytolith Distribution</td>
</tr>
<tr>
<td>5.8</td>
<td><em>Robinia pseudoacacia</em> Known Phytolith Distribution</td>
</tr>
<tr>
<td>5.9</td>
<td><em>Fraxinus spp.</em> Total Phytolith Distribution</td>
</tr>
<tr>
<td>5.10</td>
<td><em>Fraxinus spp.</em> Known Phytolith Distribution</td>
</tr>
<tr>
<td>5.11</td>
<td><em>Juniperus virginiana</em> Leaf Sample Phytolith Distribution</td>
</tr>
<tr>
<td>5.12</td>
<td><em>Juniperus virginiana</em> Stem Sample Phytolith Distribution</td>
</tr>
<tr>
<td>5.13</td>
<td><em>Taxodium distichum</em> Leaf Sample Phytolith Distribution</td>
</tr>
<tr>
<td>5.14</td>
<td><em>Taxodium distichum</em> Stem Sample Phytolith Distribution</td>
</tr>
<tr>
<td>5.15</td>
<td><em>Juniperus spp.</em> Leaf Sample Phytolith Distribution</td>
</tr>
<tr>
<td>5.16</td>
<td><em>Juniperus spp.</em> Stem Sample Phytolith Distribution</td>
</tr>
<tr>
<td>5.17</td>
<td><em>Pinus strobus</em> Leaf Sample Phytolith Distribution</td>
</tr>
</tbody>
</table>
5.18 *Pinus strobus* Stem Sample Phytolith Distribution..........................70
## LIST OF TABLES

By Author

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Summary of Dicotyledon Phytolith Content</td>
<td>35</td>
</tr>
<tr>
<td>6.1 Diagnostic Rating of Historic Tree Species</td>
<td>72</td>
</tr>
</tbody>
</table>
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>ILLUSTRATION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. <em>Quercus alba</em> tree (Seiler et al. 2003: <em>Quercus alba</em> fact sheet)</td>
<td>82</td>
</tr>
<tr>
<td>1b. Native range of <em>Quercus alba</em> (Rogers 2004: <em>Quercus alba</em>)</td>
<td>84</td>
</tr>
<tr>
<td>1c. Examples of stem, leaf, acorn, and bark (<em>Quercus alba</em>) (Seiler et al. 2003: <em>Quercus alba</em> fact sheet)</td>
<td>84</td>
</tr>
<tr>
<td>2a. <em>Ulmus americana</em> tree (Seiler et al. 2003: <em>Ulmus americana</em> fact sheet)</td>
<td>85</td>
</tr>
<tr>
<td>2b. Native range of <em>Ulmus americana</em> (Bey 2004: Ulmus americana L)</td>
<td>87</td>
</tr>
<tr>
<td>2c. Examples of stem, leaf, flower, seed, and bark (<em>Ulmus americana</em>) (Seiler et al. 2003: <em>Ulmus americana</em> fact sheet)</td>
<td>87</td>
</tr>
<tr>
<td>3a. <em>Juglans nigra</em> tree (Seiler et al. 2003: <em>Juglans nigra</em> fact sheet)</td>
<td>88</td>
</tr>
<tr>
<td>3b. Native range of <em>Juglans nigra</em> (Williams 2004: Juglans nigra L.)</td>
<td>90</td>
</tr>
<tr>
<td>3c. Examples of fruit, stem, bark (two types), and leaf (<em>Juglans nigra</em>) (Seiler et al. 2003: <em>Juglans nigra</em> fact sheet)</td>
<td>90</td>
</tr>
</tbody>
</table>
4a. *Robinia pseudoacacia* tree (Seiler et al. 2003: *Robinia pseudoacacia* fact sheet).................................................................................................................................91

4b. Native range of *Robinia pseudoacacia*. (Huntley 2004: Robinia pseudoacacia L).................................................................................................................................93

4c. Samples of bark, flower, fruit, leaf, and spines (*Robinia pseudoacacia*) (Seiler et al. 2003: *Robinia pseudoacacia* fact sheet)........................................................................93

5a. *Fraxinus pennsylvanica* tree (USDA, NRCS 2004: Plant profile for *Fraxinus pennsylvanica*) .................................................................................................................................94


5c. Examples of bark, seed, leaf, tree, and stem from (*Fraxinus americana*) (Seiler et al. 2003: *Fraxinus americana* fact sheet).....................................................................................95

6a. *Juniperus virginiana* tree (Seiler et al. 2003: *Juniperus virginiana* fact sheet).................................................................................................................................96

6b. Native range of *Juniperus virginiana*. (Lawson 2004: *Juniperus virginiana* L) .................................................................................................................................98
6c. Examples of bark, two types of leaves (*Juniperus virginiana*) (Seiler et al. 2003: Juniperus virginiana fact sheet).................................................................98


7b. Natural range of *Taxodium distichum* (Whilhite and Toliver 2004: Taxodium distichum (L) Rich.)................................................................................................101

7c. Examples of bark, two phases of fruit, and leaf (*Taxodium distichum*) (Seiler et al. 2003: Taxodium distichum fact sheet)..............................................101

8a. *Juniperus spp.* “tree” (Seiler et al. 2003: Juniperus communis fact sheet).........................................................................................................................102

8b. Native range of *Juniperus spp* (Seiler et al. 2003: Juniperus communis fact sheet)........................................................................................................104

8c. Examples of bark, fruit, and two types of leaves (*Juniperus spp.*) (Seiler et al. 2003: Juniperus communis fact sheet).................................................104

9a. *Pinus strobus* tree (Seiler et al. 2003: Pinus strobus fact sheet)............105

9b. Native range of *Pinus strobus* (Wendel and Smith 2004: Pinus strobus L.).........................................................................................................................107

9c. Examples of needles, cones, fruit, and bark (*Pinus strobus*) (Seiler et al. 2003: Pinus strobus fact sheet).........................................................................107
# LIST OF PLATES

By Author

<table>
<thead>
<tr>
<th>PLATE</th>
<th>Species</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td><em>Quercus alba</em></td>
<td>111</td>
</tr>
<tr>
<td>1b</td>
<td><em>Quercus alba</em></td>
<td>112</td>
</tr>
<tr>
<td>1c</td>
<td><em>Quercus alba</em></td>
<td>112</td>
</tr>
<tr>
<td>1d</td>
<td><em>Quercus alba</em></td>
<td>113</td>
</tr>
<tr>
<td>1e</td>
<td><em>Quercus alba</em></td>
<td>113</td>
</tr>
<tr>
<td>1f</td>
<td><em>Quercus alba</em></td>
<td>114</td>
</tr>
<tr>
<td>1g</td>
<td><em>Quercus alba</em></td>
<td>114</td>
</tr>
<tr>
<td>1h</td>
<td><em>Quercus alba</em></td>
<td>115</td>
</tr>
<tr>
<td>1i</td>
<td><em>Quercus alba</em></td>
<td>115</td>
</tr>
<tr>
<td>1j</td>
<td><em>Quercus alba</em></td>
<td>116</td>
</tr>
<tr>
<td>1k</td>
<td><em>Quercus alba</em></td>
<td>116</td>
</tr>
<tr>
<td>2a</td>
<td><em>Ulmus americana</em></td>
<td>117</td>
</tr>
<tr>
<td>2b</td>
<td><em>Ulmus americana</em></td>
<td>118</td>
</tr>
<tr>
<td>2c</td>
<td><em>Ulmus americana</em></td>
<td>118</td>
</tr>
<tr>
<td>2d</td>
<td><em>Ulmus americana</em></td>
<td>119</td>
</tr>
<tr>
<td>2e</td>
<td><em>Ulmus americana</em></td>
<td>119</td>
</tr>
<tr>
<td>2f</td>
<td><em>Ulmus americana</em></td>
<td>120</td>
</tr>
<tr>
<td>PLATE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>2g</td>
<td>Ulmus americana 120</td>
<td></td>
</tr>
<tr>
<td>2h</td>
<td>Ulmus americana 121</td>
<td></td>
</tr>
<tr>
<td>2i</td>
<td>Ulmus americana 121</td>
<td></td>
</tr>
<tr>
<td>2j</td>
<td>Ulmus americana 122</td>
<td></td>
</tr>
<tr>
<td>2k</td>
<td>Ulmus americana 122</td>
<td></td>
</tr>
<tr>
<td>2L</td>
<td>Ulmus americana 123</td>
<td></td>
</tr>
<tr>
<td>2m</td>
<td>Ulmus americana 123</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Juglans nigra 124</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>Juglans nigra 125</td>
<td></td>
</tr>
<tr>
<td>3c</td>
<td>Juglans nigra 125</td>
<td></td>
</tr>
<tr>
<td>3d</td>
<td>Juglans nigra 126</td>
<td></td>
</tr>
<tr>
<td>3e</td>
<td>Juglans nigra 126</td>
<td></td>
</tr>
<tr>
<td>3f</td>
<td>Juglans nigra 127</td>
<td></td>
</tr>
<tr>
<td>3g</td>
<td>Juglans nigra 127</td>
<td></td>
</tr>
<tr>
<td>3h</td>
<td>Juglans nigra 128</td>
<td></td>
</tr>
<tr>
<td>3i</td>
<td>Juglans nigra 128</td>
<td></td>
</tr>
<tr>
<td>3j</td>
<td>Juglans nigra 129</td>
<td></td>
</tr>
<tr>
<td>3k</td>
<td>Juglans nigra 129</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td>Juglans nigra 130</td>
<td></td>
</tr>
<tr>
<td>PLATE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>3m</td>
<td><em>Juglans nigra</em> .................................................................130</td>
<td></td>
</tr>
<tr>
<td>3n</td>
<td><em>Juglans nigra</em> .................................................................131</td>
<td></td>
</tr>
<tr>
<td>3o</td>
<td><em>Juglans nigra</em> .................................................................131</td>
<td></td>
</tr>
<tr>
<td>3p</td>
<td><em>Juglans nigra</em> .................................................................132</td>
<td></td>
</tr>
<tr>
<td>3q</td>
<td><em>Juglans nigra</em> .................................................................132</td>
<td></td>
</tr>
<tr>
<td>3r</td>
<td><em>Juglans nigra</em> .................................................................133</td>
<td></td>
</tr>
<tr>
<td>3s</td>
<td><em>Juglans nigra</em> .................................................................133</td>
<td></td>
</tr>
<tr>
<td>3t</td>
<td><em>Juglans nigra</em> .................................................................134</td>
<td></td>
</tr>
<tr>
<td>3u</td>
<td><em>Juglans nigra</em> .................................................................134</td>
<td></td>
</tr>
<tr>
<td>4a</td>
<td><em>Robinia pseudoacacia</em> .........................................................135</td>
<td></td>
</tr>
<tr>
<td>4b</td>
<td><em>Robinia pseudoacacia</em> .........................................................136</td>
<td></td>
</tr>
<tr>
<td>4c</td>
<td><em>Robinia pseudoacacia</em> .........................................................136</td>
<td></td>
</tr>
<tr>
<td>4d</td>
<td><em>Robinia pseudoacacia</em> .........................................................137</td>
<td></td>
</tr>
<tr>
<td>4e</td>
<td><em>Robinia pseudoacacia</em> .........................................................137</td>
<td></td>
</tr>
<tr>
<td>4g</td>
<td><em>Robinia pseudoacacia</em> .........................................................138</td>
<td></td>
</tr>
<tr>
<td>4h</td>
<td><em>Robinia pseudoacacia</em> .........................................................138</td>
<td></td>
</tr>
<tr>
<td>4i</td>
<td><em>Robinia pseudoacacia</em> .........................................................139</td>
<td></td>
</tr>
<tr>
<td>4j</td>
<td><em>Robinia pseudoacacia</em> .........................................................139</td>
<td></td>
</tr>
<tr>
<td>4k</td>
<td><em>Robinia pseudoacacia</em> .........................................................140</td>
<td></td>
</tr>
<tr>
<td>PLATE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>4L</td>
<td>Robinia pseudoacacia.................................140</td>
<td></td>
</tr>
<tr>
<td>4m</td>
<td>Robinia pseudoacacia.................................141</td>
<td></td>
</tr>
<tr>
<td>5a</td>
<td>Fraxinus spp.............................................142</td>
<td></td>
</tr>
<tr>
<td>5b</td>
<td>Fraxinus spp.............................................143</td>
<td></td>
</tr>
<tr>
<td>5c</td>
<td>Fraxinus spp.............................................143</td>
<td></td>
</tr>
<tr>
<td>5d</td>
<td>Fraxinus spp.............................................144</td>
<td></td>
</tr>
<tr>
<td>5e</td>
<td>Fraxinus spp.............................................144</td>
<td></td>
</tr>
<tr>
<td>5f</td>
<td>Fraxinus spp.............................................145</td>
<td></td>
</tr>
<tr>
<td>5g</td>
<td>Fraxinus spp.............................................145</td>
<td></td>
</tr>
<tr>
<td>5h</td>
<td>Fraxinus spp.............................................146</td>
<td></td>
</tr>
<tr>
<td>5i</td>
<td>Fraxinus spp.............................................146</td>
<td></td>
</tr>
<tr>
<td>5j</td>
<td>Fraxinus spp.............................................147</td>
<td></td>
</tr>
<tr>
<td>5k</td>
<td>Fraxinus spp.............................................147</td>
<td></td>
</tr>
<tr>
<td>5L</td>
<td>Fraxinus spp.............................................148</td>
<td></td>
</tr>
<tr>
<td>5m</td>
<td>Fraxinus spp.............................................148</td>
<td></td>
</tr>
<tr>
<td>5n</td>
<td>Fraxinus spp.............................................149</td>
<td></td>
</tr>
<tr>
<td>5o</td>
<td>Fraxinus spp.............................................149</td>
<td></td>
</tr>
<tr>
<td>6a</td>
<td>Juniperus virginiana.................................150</td>
<td></td>
</tr>
<tr>
<td>6b</td>
<td>Juniperus virginiana.................................151</td>
<td></td>
</tr>
<tr>
<td>PLATE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>6c</td>
<td><em>Juniperus virginiana</em></td>
<td>151</td>
</tr>
<tr>
<td>6d</td>
<td><em>Juniperus virginiana</em></td>
<td>152</td>
</tr>
<tr>
<td>6e</td>
<td><em>Juniperus virginiana</em></td>
<td>152</td>
</tr>
<tr>
<td>6f</td>
<td><em>Juniperus virginiana</em></td>
<td>153</td>
</tr>
<tr>
<td>6g</td>
<td><em>Juniperus virginiana</em></td>
<td>153</td>
</tr>
<tr>
<td>6h</td>
<td><em>Juniperus virginiana</em></td>
<td>154</td>
</tr>
<tr>
<td>6i</td>
<td><em>Juniperus virginiana</em></td>
<td>154</td>
</tr>
<tr>
<td>6j</td>
<td><em>Juniperus virginiana</em></td>
<td>155</td>
</tr>
<tr>
<td>6k</td>
<td><em>Juniperus virginiana</em></td>
<td>155</td>
</tr>
<tr>
<td>6L</td>
<td><em>Juniperus virginiana</em></td>
<td>156</td>
</tr>
<tr>
<td>6m</td>
<td><em>Juniperus virginiana</em></td>
<td>156</td>
</tr>
<tr>
<td>7a</td>
<td><em>Taxodium distichum</em></td>
<td>157</td>
</tr>
<tr>
<td>7b</td>
<td><em>Taxodium distichum</em></td>
<td>158</td>
</tr>
<tr>
<td>7c</td>
<td><em>Taxodium distichum</em></td>
<td>158</td>
</tr>
<tr>
<td>7d</td>
<td><em>Taxodium distichum</em></td>
<td>159</td>
</tr>
<tr>
<td>7e</td>
<td><em>Taxodium distichum</em></td>
<td>159</td>
</tr>
<tr>
<td>7f</td>
<td><em>Taxodium distichum</em></td>
<td>160</td>
</tr>
<tr>
<td>7g</td>
<td><em>Taxodium distichum</em></td>
<td>160</td>
</tr>
<tr>
<td>8a</td>
<td><em>Juniperus spp.</em></td>
<td>161</td>
</tr>
<tr>
<td>PLATE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>8b</td>
<td>Juniperus spp</td>
<td>162</td>
</tr>
<tr>
<td>8c</td>
<td>Juniperus spp</td>
<td>162</td>
</tr>
<tr>
<td>8d</td>
<td>Juniperus spp</td>
<td>163</td>
</tr>
<tr>
<td>8e</td>
<td>Juniperus spp</td>
<td>163</td>
</tr>
<tr>
<td>8f</td>
<td>Juniperus spp</td>
<td>164</td>
</tr>
<tr>
<td>8g</td>
<td>Juniperus spp</td>
<td>164</td>
</tr>
<tr>
<td>8h</td>
<td>Juniperus spp</td>
<td>165</td>
</tr>
<tr>
<td>8i</td>
<td>Juniperus spp</td>
<td>165</td>
</tr>
<tr>
<td>8j</td>
<td>Juniperus spp</td>
<td>166</td>
</tr>
<tr>
<td>8k</td>
<td>Juniperus spp</td>
<td>166</td>
</tr>
<tr>
<td>8L</td>
<td>Juniperus spp</td>
<td>167</td>
</tr>
<tr>
<td>8m</td>
<td>Juniperus spp</td>
<td>167</td>
</tr>
<tr>
<td>8n</td>
<td>Juniperus spp</td>
<td>168</td>
</tr>
<tr>
<td>8o</td>
<td>Juniperus spp</td>
<td>168</td>
</tr>
<tr>
<td>9a</td>
<td>Pinus strobus</td>
<td>169</td>
</tr>
<tr>
<td>9b</td>
<td>Pinus strobus</td>
<td>170</td>
</tr>
<tr>
<td>9c</td>
<td>Pinus strobus</td>
<td>170</td>
</tr>
<tr>
<td>9d</td>
<td>Pinus strobus</td>
<td>171</td>
</tr>
<tr>
<td>9e</td>
<td>Pinus strobus</td>
<td>171</td>
</tr>
<tr>
<td>PLATE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>9f</td>
<td>Pinus strobus</td>
<td>172</td>
</tr>
<tr>
<td>9g</td>
<td>Pinus strobus</td>
<td>172</td>
</tr>
<tr>
<td>9h</td>
<td>Pinus strobus</td>
<td>173</td>
</tr>
<tr>
<td>9i</td>
<td>Pinus strobus</td>
<td>173</td>
</tr>
<tr>
<td>9j</td>
<td>Pinus strobus</td>
<td>174</td>
</tr>
<tr>
<td>9k</td>
<td>Pinus strobus</td>
<td>174</td>
</tr>
<tr>
<td>9L</td>
<td>Pinus strobus</td>
<td>175</td>
</tr>
<tr>
<td>9m</td>
<td>Pinus strobus</td>
<td>175</td>
</tr>
<tr>
<td>9n</td>
<td>Pinus strobus</td>
<td>176</td>
</tr>
</tbody>
</table>
Chapter I- Introduction

Recently, the use of scientific techniques and equipment has found its way into many archaeological investigations and projects. Within these projects, geoarchaeologists, zooarchaeologists, and paleoethnobotanists, use some of the most up to date technology and methods to gather new and exciting information. This information is used to reconstruct past landscape formations and usage. Paleoethnobotanists utilize a host of botanical remains such as pollen, charcoal, seeds, etc. to infer specific relationships between past cultures and their environments. However, within the past thirty years, archaeologists have begun analyzing a previously unfamiliar plant remain called a phytolith.

Phytoliths are microscopic silica bodies that form within the tissues of a large number of plants. These small, mineralized structures are important because they create casts or molds of their surrounding plant tissues and are not subject to the processes of organic decay. Some of the molds that are formed are unique shapes that are characteristic of the plants family, genus, or even species. After a plant dies, it will completely decay, leaving behind the inorganic phytoliths. Once in the soil, these phytoliths can rest undisturbed for hundreds, or even thousands of years until archaeologists excavate the soil. Because of the close link between phytolith morphology and plant taxa, the recovered phytoliths can then be used to gain information related to subjects such as crop usage, building material, surrounding ecosystem, etc. It is the combination of the long-lasting durability with plant specificity that makes these silica bodies so valuable. An excellent example of the potential use of phytoliths in archaeology can be seen at the St. John’s Site at Historic St. Mary’s City, Maryland.
Excavations at the St. John’s Site at Historic St. Mary’s City are centered upon the unearthing of a seventeenth-century house and surrounding property. The excavations have been continuing on and off since the 1970s and have revealed most of the main house and its associated side buildings. Thousands of artifacts have been recovered providing invaluable data pertaining to colonial life. Yet the finding of a unique feature on the north side of the house holds the potential for a wonderful phytolith project. In this unit, an oval shaped brown feature was discovered close to the bottom strata. This feature lacked almost any artifacts and was completely devoid of macrobotanical remains. The sequence of the layer and the few artifacts found indicated that the feature dates to the early construction of the house in the late 1680s. One of the most prominent theories holds that the feature was actually a saw pit used for the creation of timbers for the house (Mitchell 2004:1,2). The lack of any artifacts or macrobotanical remains would require that other techniques be used to test this theory. This unit presents the perfect opportunity for a phytolith study because, if it was a saw pit, then the phytoliths of the cut trees would still be in the soil. However, because there is no standing type collection of historic trees at St. Mary’s City, the first step of the project would be to create such a collection.

Aside from Catrina A. Trainor’s study of phytoliths found in eighteenth century garden herbs, there are no other comparative collections in the Maryland area. Hence, the primary goal of this project was to create a comparative phytolith type collection of trees present in the environmental record that may have been used in seventeenth century house construction in Maryland. In order to create this collection, a series of questions were asked. One of the first questions I asked when creating a type collection was: Do the trees studied produce phytoliths? This is an important question because it is necessary to
find out which plants may or may not be represented in the soil context. However, even if a plant does produce phytoliths, it does not guarantee that the silica bodies are species specific (Pearsall 2000:356). Therefore, the second question asked was: If the selected species do produce phytoliths, do they have any diagnostic value? In order to answer these questions, a specific protocol was created and followed.

The project began with the creation of a list of tree species that were possibly used in the construction of colonial Tidewater houses. After narrowing the list down to a manageable nine species, leaf and stem samples were collected from local trees during the fall and winter months. Once collected, small samples of each specimen were weighed, cleaned, and ashed to remove all extraneous material such as carbon and detritus. The samples were then mounted onto slides for examination. Scanning procedures similar to those outlined by Pearsall were used to collect data concerning the types and quantities of phytoliths found. The information was then entered into a database for further analysis. The report contains not only pictures and graphs of the comparative type collection, but also supplemental data related to phytolith morphology and history as well as a brief history of the St. Johns site.
Chapter II- Phytolith History and Morphology

The term phytolith, a Greek word meaning “plant stone”, is used to describe two different types of mineral concretions which form diagnostic shapes within plant systems (Piperno 1988:11). Calcium phytoliths are composed of calcium oxalate crystals that are produced in almost every section of a plant. These phytoliths exist in a variety of plant species such as olives and grapes yet are also found sporadically in soil contexts. Because these phytoliths occur infrequently in the soil and are very hard to extract, most phytolith research has focused on phytoliths composed of silica (Pearsall 2000:356; Rapp and Mulholland 1992:2).

The first stage of opal silica phytolith research began with the discovery of the previously mentioned calcium phytoliths during the early years of light microscopy in 1675 by Loeuwenhoek (Rapp and Mulholland 1992:4). Many years passed without any advances until in 1835, a German botanist with the last name of Struve observed silica phytoliths in living plant tissue. One year later, another German scientist named C.G. Ehrenberg began his study of phytoliths in plants and soil sediments. In his reports, he developed the first classification system and recognized differences in phytolith morphology in relation to plant families (Piperno 1988:3). However, aside from these initial discoveries, phytolith research was sporadic until the turn of the 19th century.

The beginning of the 20th century brought with it the study of plant anatomy and physiology in relation to phytolith production. From 1900 until 1936, German scientists such as Netolitzky dominated the field of phytolith studies (Rapp and Mulholland 1992:4) and produced many reports relating to production, taxonomy, intraspecific variation, and dispersion techniques. Most of their studies involved the analysis of
phytoliths in the grass family as well as a few other monocotyledons. It was also during this time that large numbers of tables and charts of silica producing plants were tabulated. However, the onset of World War Two halted phytolith research in Germany and the rest of Europe (Piperno 1988:4-5). The third phase of phytolith research did not begin until sometime after the end of the Second World War.

Piperno describes this third stage as “The Period of Ecological Phytolith Research” where, from the mid 1950s until 1975, botanists, soils scientists, and others used phytoliths in soils to index past environmental histories. The focus of phytolith research had shifted out of Germany and was now centered in the United Kingdom, the United States, and Japan. This renewed interest in phytoliths lead to a series of important discoveries. The previous view that phytoliths lasted only 1000 years and that they could only be found in certain contexts was disproved by a number of studies. These studies illustrated that silica bodies lasted over millions of years. In addition, they were found in varied contexts, for example, Wisconsin-age loess and till, deep sea cores, and atmospheric dusts. Studies during this time also included investigations into the chemical and physical properties of phytoliths. Finally, in their attempt to investigate past ecosystems, scientists expanded their research into nonmonocotyledenous species such as those of the coniferous and deciduous trees (Piperno 1988:6-8). However, by the mid 1970s the focus of phytolith research was shifting once again in a new, more archaeological based direction.

Modern phytolith research, dating from the mid 1970s to the present, has focused on the creation and application of phytolith typologies for archaeological and paleoecological use. Paleoethnobotanists were particularly interested in areas of the
world where other archaeobotanical data, such as pollen and seeds, was lacking. Consequently, detailed classification systems have emerged from studies in Eastern North America and the tropics. The proper application of these studies permitted phytoliths to emerge as a major tool in archaeobotanical reconstruction. This reconstruction is partly due to the unique depositional process of phytoliths.

Opal silica phytoliths are deposited into the soil in one of three different ways. A large percentage of phytoliths are deposited directly into the ground after a plant dies and decays. Secondly, some phytoliths are deposited when plants are burned. This process sometimes allows phytoliths to be transported great distances because of the ash and air currents created by fires (Rapp and Mulholland 1992:3). Finally, some phytoliths are deposited into the soil with the waste products of the original digested plant material. These depositional patterns, in conjunction with other phytolith characteristics, make silica bodies extremely useful in archaeological studies.

Contrary to calcium phytoliths, opal silica phytoliths occur frequently in the soil and are relatively easy to remove from soil matrices (Pearsall 2000:356). These phytoliths are exact three-dimensional opaline silica casts of plant cells, hairs, etc. that are formed throughout a plant's lifecycle (Powers 1989:46). When examined under a light microscope, they range in size from two micrometers to one hundred micrometers in length, and clear to opaque black in coloration (Fox 1994:29; Kondo 1977:199). Phytoliths are fundamentally comprised of silicon dioxide (SiO₂) and anywhere from five to fifteen percent water. Trace amounts of other elements such as magnesium, calcium, potassium, manganese, iron, aluminum, and organic carbon may also be present (Fox...
The combination of all of these minerals and elements in the formation of phytoliths was made possible by the complex plant vascular system.

Opal phytoliths are created through the build up of monosilicic acid along plant cells and walls. Silica from the soil is dissolved in water to form monosilicic acid and is acquired by the plant via the root system (Pearsall and Trimble 1984:120, Wilson 1982:6). The availability of monosilicic acid in the soil is related to the effect of the climate, topography, bedrock character, and amount of groundwater upon the weathering of silicate minerals such as quartz and feldspar (Piperno 1988:12). In addition, pH, soil temperature, organic material, dissolved nitrogen and phosphorus, and the presence of iron and aluminum oxides are also thought by Piperno to regulate the levels of monosilicic acid in the soil (Piperno 1991:13). The plant vascular system allows for the groundwater to be shipped to every corner of the plant either through active or passive transport. As plants use or transpire the silicified groundwater, the remaining silica becomes attached to certain cellular structures and eventually takes the shape of the surrounding plant cells (Piperno 1991:15). Despite this simple process, there are a whole host of factors that are involved in the creation of phytoliths in plants.

A debate has emerged between scientists and archaeologists as to whether or not phytolith formation is primarily influenced by the genetic composition of a plant or the surrounding environment. The likely result is probably some combination of the two. In fact, recent studies are now pointing towards a heavy emphasis on genetic determination in conjunction with environmental factors. The growing general consensus in the academic community is that phytolith morphology is determined by genetics while phytolith production is influenced by the environment. Both of these factors can be
broken down into five subsequent parts. Environmental factors, such as the general climate, soil chemical composition, and the volume of available water, all influence phytolith production. The climate influences phytolith production by regulating the plants growing cycle. A short growing season may limit phytolith production by limiting a plants ability to expand and develop. As mentioned earlier, the soil composition is important because factors such as pH and silica concentration can enhance or restrict the available minerals required for production. In addition, the availability of water influences production by affecting transpiration rates and metabolic processes. The age of a plant can also play a role in phytolith production (Piperno and Pearsall1998:12).

Older plants typically contain a higher concentration of phytoliths due to the restraints of phytolith production in young cells. Opal phytoliths are not present in immature cells because the existence of a rigid mineral cast would limit the cells growth and expansion. Past studies have shown that the volume of immature cells may increase 60 to 150 times within a few days until maturation. Following this rapid increase in cell size, there is a great surge in water and mineral uptake in the cell thereby allowing the beginning formation of phytoliths (Sangster 1969:11). Consequently, the older the plant, the more phytoliths it will contain. Finally, genetic predisposition towards phytoliths is the largest factor in phytolith production and diversity.

Phytolith formation is influenced by genetics because many forms of phytoliths only appear in certain families and orders. Some families will show a tendency towards phytolith production while others will be completely absent of silicified structures. Piperno illustrated in a study that phytolith morphology is also almost exclusively influenced by a genetic relationship (1984:381). Genetics even determines the specificity
of silification within a species (Pearsall 2000:59; Piperno 1991:157). This specificity illustrates the relationship between phytolith morphology and cellular location within a plant species. The exact purpose of phytoliths within a plant must be quickly addressed before moving onto other phytolith topics.

Very little information is known about the nature or reason for phytolith production in plants. Some scientists have suggested that they serve as a sort of defense mechanism against hungry herbivores (Piperno 1991:49). However, there are not enough studies to ascertain the true botanical purpose of phytoliths. It can be said that they must serve some function due to the discrepancies in production among plant species. Within these producing species, phytoliths can be found in a wide array of locations.

Phytoliths are produced in all the regions of the plant including stem, root, bark, leaf, and inflorescence. However, the highest concentration of phytoliths frequently is found within leaf systems, specifically in the epidermis, mesophyll, sclerenchyma, and vascular tissues (Wilson 1982:4; Piperno 1985a:210). Within these plant regions, there are two general types of areas that produce phytoliths; idioblasts and cellular and intercellular spaces (Pearsall 2000:359). Idioblasts are plant cells that specialize in accumulating silica and in so doing eventually create phytoliths. Wilson, in 1982 suggests that there are about five types of silica deposition in the cellular and intercellular spaces of plant. One form of silica deposition involves the partial or complete filling in of cells. Sometimes, silica will adhere to thin cell linings or will form cell walls linking multiple phytolith assemblages. Phytoliths can also become mineralized appendages such as hooks, hairs, etc. Finally, some phytoliths do not conform to any cell structure thus becoming indistinguishable silica secretions (Wilson 1982:6). Paleoethnobotanists have
devised several different systems of classification that are used to categorize the wide variety of phytoliths.

When phytoliths are examined under a microscope, they are classified using any number of systems. One system called the botanical approach emphasizes the orientation, size, location, and shape of an articulated phytolith within a plant (Rapp and Mulholland 1992:7-9; Pearsall 2000:375). Therefore, phytolith context within a plant is crucial in its classification. This botanical system is frequently used by botanists. Another type of classification utilizes the Linnaean system of naming and is used mostly by micropaleontologists. Each type of phytolith, articulated or disarticulated, is assigned a Latin name and is treated like a single entity. This categorization system allows for the rules of taxonomic grouping to be followed. Finally, phytoliths can be classified based solely on morphology. Archaeologists use this system because it is the most useful tool in describing disarticulated phytoliths found in the soil. In one substyle of this classification, only morphological names and descriptions are used. Another method relates the phytolith morphological descriptions to known plant anatomy (Rapp and Mulholland 1992:7-9; Pearsall 2000:375). Both methods of morphological classification can be found in many different texts and reports. However, in order to classify phytoliths correctly using any of these approaches, a basic understanding of phytolith morphology is needed.

Phytoliths are grouped into two broad categories; incidental and nonsituational. Incidental phytoliths are those that partially or completely silicify a cell resulting in a morphological copy. Nonsituational phytoliths are created when other components of a cell are only partially silicified. Because these phytoliths are fragmented, they do not match the original shape of the cell. Yet both types of phytoliths permit the classification
of these silica bodies into one taxa or another (Piperno 1991:163). A brief introduction of the classification systems used for different plant families will now be discussed. I will begin with the most studied group of plants, the grasses.

Grasses, of the family Graminae, are monocotyledons that produce high volumes of distinctive phytoliths. These phytoliths are broken down into two morphological classes; long cell and short cell bodies (Pearsall et al. 1992:3,4). Long cell silica bodies vary in shape but are generally rectangular with winding and intertwining locking edges. The majorities of the phytoliths originate from the epidermal layers of leaf tissue and may include spines, hairs, or other epidermal projections that allow for better classification (Pearsall 2000:361). However, long cells alone are not distinctive enough to properly identify grass family and genus. On the other hand, short cell phytoliths have enough distinguishing characteristics to merit possible identification.

Short cell phytoliths are fairly distinctive silica bodies that lie across or in between leaf veins and other leaf tissues. Twiss and others originally divided short cells into four categories but later modification by Pearsall has given us a better three category system. These three categories include festucoid, chloridoid, and panicoid classes. Festucoid cells are identified by their circular, rectangular, elliptical, incline, and oblong shapes. The chloridoid class is typified by saddle-shaped bodies that form in short grasses in warm and dry environments. The panicoid class is characterized by cross, dumbbell and crenate-shaped phytoliths found in tall, tropical grasses (Pearsall and Trimble 1984: 120; Bozarth 1993:96; Pearsall and Piperno1993:9). In addition to short and long cell phytoliths, there are a variety of other morphologies associated with monocotyledons.
In non-grass species of monocotyledons, phytoliths are found prominently in the sub-epidermal tissues. Within these tissues, phytoliths take a variety of forms ranging from hat shaped to spherical to aspherical with troughs. Most of these forms are diagnostic in nature and can be associated with a plant family and genus (Pearsall 2000:361). The lesser studied dicotyledons also form a variety of diagnostic and useful phytoliths.

Phytoliths are produced in a number of regions within dicotyledonous plants but are most distinctive in the epidermal layer. Indeed studies have shown that silicified scleremchyma, vascular, and mesophyll tissues are redundant in shape and have very little taxonomic value (Piperno 1985a:219-223). Some phytoliths found in the epidermal layer are categorized as anticlinal or polyhedral. Anticlinal phytoliths are described as having sinuate shapes while polyhedral phytoliths may take a square to rectangular shape (Piperno 1985a:188-203). In addition, polyhedral phytoliths may have anywhere from four to eight sides (Bozarth 1993:3). Finally, the most abundant form of phytoliths in dicotyledons is derived from hair cells. Hair cells typically are the most distinctive phytoliths and are divided into segmented and nonsegmented categories (Piperno 1985a:187). Because so little previous research has been conducted with dicotyledons, these classification systems are subject to change. These changes are likely to occur due an increase in usage of phytoliths in archaeological reports.

Phytoliths are extremely useful archaeologically for a variety of reasons. First of all, phytoliths are relatively stable vertically and horizontally in the soil matrix after deposition (Piperno 1985b:247). Once a plant has died and decayed, its phytolith assemblage will not travel more than 20 meters horizontally from the original spot. This
ensures that phytoliths found within an archaeological layer are very likely to be associated with that time period (Pearsall 2000:392). The limited horizontal travel also allows for scientists to produce a fairly accurate record of local vegetation. Because phytoliths are composed of inorganic substances, they do not undergo organic decay and are fairly resistant to many forms of chemical and mechanical erosion. This built in resistance allows for phytoliths to remain intact in the soil for tremendously long periods of time (Wilson 1982:14). Finally, phytoliths are useful as archaeobotanical tools because, as previously discussed, their morphology permits proper family and genus identification of long dead plants.

Phytoliths are used by scientists to understand a variety of topics ranging from dietary habits of ancient humans to reconstructing past ecosystems. Rowlett and Pearsall showed that thermoluminescent techniques could be used on phytoliths for precise dating (Piperno 1991:178). Other scientists such as Fox and Perez have matched the markings on teeth enamel with specific phytoliths in order to determine diet (Fox, Perez, and Juan 1994:29). Phytoliths have even been discovered on the inside of old ceramics allowing some scientists to discern the original contents of the ceramic. However, phytoliths are most commonly used in paleoethnobotanical reconstructions of past landscapes and features.
Chapter III- Historical Architecture of the Tidewater

The study of phytoliths can be used to reconstruct and recreate past landscapes and cultural botanical relationships. The focus of this study is to establish a preliminary phytolith type collection of trees that were commonly used in the construction of seventeenth century homes at St. Mary’s City, Maryland. The type collection will provide the necessary comparative data for any future phytolith studies of the region. A brief description of Chesapeake Bay natural history follows.

The Chesapeake Bay can trace its roots back to the last ice age near the end of the Pleistocene Epoch. Some twenty thousand years ago, a one mile thick sheet of glacial ice covered everything roughly north of what is now known as Maryland. From the area near the modern mouth of the Susquehanna River, the ancient headwaters of the Susquehanna were formed from the runoff of the giant glaciers. This small river wound its way through the hills of Maryland, Virginia, and out across the continental shelf towards the shrunken Atlantic Ocean. Two thousand years later, an increase in global temperatures signaled the end of the ice age. With the rise in temperatures came the retreat of glaciers across North America. The glacier covering Pennsylvania began to melt shipping most of its water to the Atlantic Ocean via the now burgeoning Susquehanna River (White 1989:9).

The dramatic increase in volume of the Susquehanna River and the smaller Rappahannock, James, and Potomac Rivers, accelerated the rate of erosion allowing for the formation of a large river valley. This valley would later be filled with saltwater and become known as the Chesapeake Bay. The release of glacial water into the world’s oceans caused the Atlantic to expand across the continental shelf at a rate of fifty feet per year. Around ten thousand years ago, the Atlantic had expanded outward to the point
where its brackish waters were touching the Virginia Beach, Ocean City longitude. After this milestone, the glaciers continued to melt while the Atlantic began flooding the lower Susquehanna Valley. It was only until around 1000 B.C. that the Chesapeake Bay had finally reached its current shape and location (White 1989:9). This shape includes more than four thousand, six hundred miles of tidal shoreline with nineteen principal rivers and four hundred lesser creeks, streams, and tributaries. The three main rivers, the Susquehanna, Potomac, and James, have extensive watersheds that reach deep up into the Appalachian Mountains to the north and west and provide eighty percent of the freshwater to the bay. However, despite this volume of water, the average depth of the Chesapeake Bay is only twenty feet. The intricate and vast waterways formed by this flooded valley provided its human neighbors with a surplus of fishing and trading opportunities (Lippson and Lippson 1997:4). These humans also took advantage of the bountiful forests found throughout the peninsulas and plains near the Chesapeake Bay.

The land surrounding the Chesapeake Bay was initially covered with a surplus of woods and natural forests. The local Native Americans thinned the forest from time to time leaving the bulk of the trees intact. Large oaks dominated much of the forest vegetation especially in the upland regions of the bay (Kelso et al. 1995:48; Stone 1982:12). In addition, Chestnuts and pine trees grew in large quantities but were scattered throughout the region. Tulip poplars, sweetgum, and bald cypress species were found in the marshy areas along the riverside. Finally, a wide variety of other tree families such as cedars, elms, locusts, and walnuts, were discovered hidden in the forests of the Tidewater (Stone 1982:123; Kelso et al. 1995:47; Kelso 1984:19; Harris 1997:19; Evans 1957:16; 17). All of these trees were utilized, some more than others, by both the Native
Americans and later European colonists. Yet it was the combination of these waterways and vast natural resources on land that enticed many ambitious European colonists to form towns and cities.

The Chesapeake Bay had been inhabited by native populations long before the arrival of Europeans, even while it was still considered part of the Susquehanna River valley. Spanish and French explorers had entered the bay by 1560 yet it was the establishment of the English colony of Jamestown in 1607 that cemented the first real European presence in the bay. The colony of Jamestown was situated on an island in Virginia sixty miles from the mouth of the bay and was originally designed as an economic venture by the Virginia Company. However, by 1609, many unforeseen factors had combined to nearly destroy the colony. Yet it was the skillful leadership of Captain John Smith that kept the colony from ruin. Jamestown went through many hardships before it faded away from existence after it lost its status as Virginia’s capital in 1698.

Further North in the bay, a fur trader named William Claiborne had established at trading post on Kent Island. This post served as a station point for trade with nearby Native American tribes such as the Susquahannocks. The sovereignty of this small colony was later disputed when Cecilius Calvert, the Lord Baltimore, was granted the rights to an area of land between Pennsylvania and Virginia that he named Maryland (Williamson 1995:10-16).

St. Mary’s City was founded in 1634 as the capital of an area of the Chesapeake known as Maryland. This colony was established by Cecilius Calvert as a safe haven for English Catholics and as an experiment in religious toleration. St. Mary’s City did have its fare share of struggles and turmoil yet was spared much of the grief experienced by
their neighbor to the south, Jamestown. However the fate of St. Mary’s City was similar to that of Jamestown. Due to a variety of political and economic factors, Lord Calvert’s dream of religious freedom was dashed after the capital was moved to Annapolis in 1695 (Hurry 2001:9,58). Despite the political and religious differences between Kent Island, Jamestown, and St. Mary’s City; all three settlements shared similar styles of domestic architecture.

Three major factors shaped the style of colonial housing in the Tidewater region: the English background, the environment, and the inflated costs of frontier construction (Stone 1982:185). The immigrants and explorers who attempted a new life in the Chesapeake brought with them their experience and knowledge of English style housing and construction. However, there were many different forms of housing throughout England and a colonists building knowledge depended upon their own socioeconomic status and geographic origin. Throughout all the North American colonies, the country or place of origin in Europe played a significant role in housing style. Many of the immigrants to Maryland came from the highland and lowland zones of England and brought with them strikingly different notions of housing and living standards (Stone 1982:163). Middling New England farmhouses resembled those of East Anglia in England while houses in Delaware reflected North Country or Finnish styles. Some houses in Virginia reflected the housing traditions of southern England (Kulikoff 2000:121). However, seventeenth century houses were not exact replicas of their European counterparts. Modifications and concessions were made in part because of the available natural resources and the high cost of construction.
The most prevalent natural resource throughout the Tidewater region was wood. Tall pines, such as white and loblolly, hugged the coastline while great deciduous trees like oak and chestnut could be found slightly farther inland. Some of these trees such as sassafras, black locust, and red cedar, were well noted by colonists and Native Americans for their durability and strength. All of these trees were in great supply and were easily accessible (Carr et al 1988:133). Yet, it was the lack of other building material that heavily influenced Tidewater architecture. There was very little if any stone available for the construction of houses in Maryland and Virginia. Colonial structures were almost entirely made of wood and were relatively impermanent. Therefore, English house designs that normally required stone were modified accordingly. Incidentally, in the New England colonies, the availability of stone allowed for stronger and sturdier houses to be built. Sturdy buildings in seventeenth century Virginia and Maryland usually took the form of brick structures. But the absence of brick structures was tied more closely to economic constraints rather than a lack of natural resources (Carson et al 1988:113-124).

The abundance of certain natural resources for housing construction in the colonies was frequently offset by the cost of labor. For example, the cost of building a fifteen foot-long dwelling house in Virginia was around 300 pounds of tobacco (Forman 1967:12). This was a sizable amount for any average tobacco farmer to save. In 1682, a prominent citizen named William Fitzhugh lamented that due to the high cost of labor, a house built in Virginia would cost three times that of the same house in London (Kelso 1984:19). This was assuming that William Fitzhugh wished to construct a modest house by colonial standards. William M. Kelso suggests there were three phases of housing that a colonist may encounter during his or her lifetime in the New World.
When an immigrant first arrived in the colonial Tidewater, he or she started constructing a new life from scratch. Typically, the colonists’ first house was a simple structure designed purely for their survival (Kelso 1984:18). This house in fact bore very little resemblance to any contemporaneous houses in England (Kulikoff 2000:121). The houses built were similar in style to a medieval peasant accommodation and normally were a small one-story dwelling with one or two rooms and a loft. The walls were made of wattle and daub while the chimneys were made of timber instead of brick. It is important to note that the colonial one story house with a wooden chimney illustrated a shift in architectural design. Throughout England, most middling houses were moderately sized two story structures with a brick fireplace. The reduction in size and change in materials used in a seventeenth century house represents a cultural adaptation to a new environment (Stone 1982:185-186). If the colonist had survived the harshness of the first year, they would then construct a second, more permanent timber house (Kelso 1984:18).

The second stage of colonial housing proceeded immediately after the colonists had survived the first few years of hardship. Newer, stronger, and slightly less impermanent buildings were built to replace the small shacks and shanties from the previous seasons. While these larger houses followed English architectural specifications more closely, they were not exact replicas of their counterparts in England. For example, houses constructed in the Tidewater adhered to the English timber-frame tradition while certain houses in New England included a feature rarely found in England, a root cellar (Kelso 1984:19; Kulikoff 2000:121). Many colonists often underestimated the durability of these “impermanent” homes and never built a third, more “permanent” house (Carson et al. 1988:125).
Colonists in the seventeenth century Tidewater almost never reached what is regarded as the third stage of housing. This last stage of housing was a desire by colonists to build a permanent house that required minimal repair and provided an economic base for future generations. The few permanent houses that did exist incorporated brick, stone and stronger wood, into their designs. However, a variety of reasons prevented most homesteaders from creating large permanent houses. The first reason was that, as mentioned earlier, the labor friendly market caused the price of home construction to be exceedingly high.

Only the wealthiest landowners, such as Phillip Calvert and John Lewger of St. Mary’s City, could afford to build permanent structures. Secondly, some colonists, like those involved in the Virginia Company, headed back to England with their new wealth before they could build a third home. Finally, because of the high death rate among the early colonies, many did not live long enough to accrue the wealth necessary for construction. In fact, many of the so-called “impermanent” secondary structures proved to be quite long lasting and frequently outlived their owners (Kelso 1984:19). Yet in order to understand how tree species relate to colonial housing, one must examine the very basics of seventeenth century construction.

When building a timber colonial home, a settler used either one of two basic methods of construction; the frame first or mass structural approach. The mass structural method of building emphasized a style in which the wall played a vital part in the strength of the house. The wall was an “entity” and was important because it carried the majority of the weight of the roof (Bruskill 1997:170). This method of construction was slightly popular in England but was never a major style used in the colonies. In contrast,
the frame first method of construction was incredibly popular in both England and the colonies.

Throughout the Tidewater region, houses built in a frame first style could be seen in every major settlement. In frame construction, the weight of the roof and intermediate floors was placed upon a small number of vertical shafts that were securely attached to the ground or foundation (Brunskill 1997:170). This allowed for the wall to “serve as an enclosing element, keeping out rain and cold, keeping in heat, maintaining privacy” (Bruskill 1997:171). It was an advantageous style of construction because, in contrast to the mass structural approach, the walls could be created from local materials without the concern of structural integrity. In the case of the early Tidewater colonies, the most readily available material was wattle and daub (Bruskill 1997:171). Wattle and daub was a style of wall construction that utilized course wooden basketwork and clay, mud, or straw. Typically, thin and flexible wooden poles and branches called wattle were interwoven between the posts and framing studs of a house. The daub, usually a concoction of clay, plaster, and straw, then served as the infilling for the wattle (Lounsbury 1994:110,401). Instead of wattle and daub, some homeowners would create walls on the outside of their house by overlapping planks of a sturdy yet flexible wood. Some may have combined the two techniques by filling the wall units with wattle and daub while planking the outer layer of the house for extra protection (Carson et al 1988:131). There were a variety of impermanent house designs in the homesteaders’ repertoire that satisfied the needs of the early English colonist. Some of the earliest designs included the turf, earth, or log-walled house and the rafted house.
The rafted design was a very ancient style of building that eliminated the necessity of walls thereby creating an “A-framed” house. Because so much of the frame of the house was exposed to both the elements and soil, it suffered degradation fairly quickly. Consequently, this style of house served predominately as a tobacco shelter for farmers. Other colonists decided not to build a new house and stayed with the wigwam or dugout structure that they originally inherited from the Native Americans. These buildings were referred to as turf-, earth-, or log-walled houses because of the materials used in their construction (Carson et al. 1988:130, 131). One of the earliest English style houses constructed in the New World relied upon a structural component called a puncheon.

Puncheons were developed during the middle ages as a primitive structural component. These small and sturdy wooden posts were driven into the ground, a process called puncheoning, and were spaced equidistant from each other. Because the puncheons were relatively small, the distance between them was the same as the thickness of the puncheon. After a roof was attached, the spaces between the puncheons were filled with wattle and daub and possibly covered with boards (Forman 1967:6; Bruskill 1997:171; Carson et al. 1988:125). This type of quick and easy construction would appeal to someone with very little wealth and resources, such as poor peasant or an English colonist. Another medieval alternative would be the use crucks or cratchets to provide support for a house (Forman 1967:6).

Crucks, also called crachets, cratches, crotchets, or crutches, were forked posts tied together and spaced at intervals along the building. These posts supported the roof because they were connected to the upper story of the house through other timber
members such as ridge purlins, side purlins and wall-plates. Crucks were also much stronger than the puncheons because they were essentially pairs of bent or curved tree trunks. Consequently, these posts were spaced farther apart but were also filled with wattle and daub. This style of housing was even referenced in the first accounts of Captain John Smith during the early settlement days of Jamestown. Some houses cleverly used a combination of puncheons and crucks to provide better strength and security (Kelso 1984:18; Bruskill 1997:171; Forman 1967:4; Carson et al. 1988:130). This hole-in-the-ground style of construction lead to an alternative architectural design called hole-set framed buildings.

Contrary to puncheon and cruck houses, hole-set framed buildings required precise holes to be dug into the ground where posts, cut to exact measurements, would rest. These posts were attached to prefabricated frames that were raised quickly. Once raised, these frames were connected with little effort thereby allowing for fast house construction. The houses were stronger and lasted longer than many puncheon and cruck houses because of additional structures such as interrupted sills and additional mortise and tenon joints. Eventually the constant repair associated with rotting posts lead to the creation of framed buildings resting upon hole-set blocks (Carson et al. 1988:126).

Toward the second half of the seventeenth century, houses that rested upon replaceable hole-set blocks began to replace regular post-in-ground structures. These blocks extended the life of a house because they took all the environmental wear and abuse of a regular post without jeopardizing structural integrity. When a block began to rot away after a certain amount of time, it could be replaced without the need to create a whole new post. These blocks also allowed for much of the frame to rise above the
ground thereby preventing sill degradation. Yet much of the longevity of a house also depended on the species of tree used in its construction (Carson et al. 1988:129).

The English colonists took advantage of the apparent surplus of usable lumber right in their backyard. Once a tree was ringed, it was cut down and taken to a saw pit if one existed. In this pit, one man stood on the top of the log while the other stood in the pit. These two laborers used an up and down motion with the saw thereby cutting through the log. This was a very long, tedious, and dangerous process. However, depending upon the size of the tree, one square or two rectangular beams could be cut (Harris 1997:17). It was not until the beginning of the 18th century that saw mills began replacing saw pits as the primary means of creating usable lumber. This lumber was used for two vital purposes in the Tidewater, shipbuilding and home construction (Harris 1997:18).

In both shipbuilding and home construction, white oaks were the preferred species of tree. This species was so popular that one report from Virginia noted, “oakes there are as faire, straight, and tall and as good timber as any can be found, a great store, in some places very great” (Evans 1957:16). Tall pine trees were cited for their use as masts while cedar, sassafrass, and mulberry trees held potential use as materials for small boats (Evans 1957:16-17). A report from Maryland in 1635 best describes the abundance and usefulness of Tidewater timber

The timber of these parts is very good in abundance. It is useful for building of houses and ship. The white oak is good for pipe-staves, the red oak for wainscot. There is also walnut, cedar, pine and cyprus; chestnut, elm, ash and poplar, all of which are for building and husbandry (Stone 1982:13)

As the population of white oaks in local areas decreased, carpenters began using pine and chestnut to augment the oak used as construction material (Evans 1957:17). The extent of deforestation and timber usage in seventeenth century Tidewater is still very much unknown. Further paleoethnobotanical studies are required to gain a true picture of
the use of trees in the construction of colonial homes. One such study may be possible with the current excavations of a colonial house originally owned by Maryland aristocrat, John Lewger.

John Lewger was born in late 1601 or early 1602 of moderately wealthy parents in London. After growing up in East Anglia, in 1616 he was admitted to Trinity College, Oxford as a commoner where he eventually earned three different degrees. His formal education permitted him to be a judge, scribe, and an accountant while his informal education as an Anglican village rector gave him farming experience (Stone 1982:63). During his time at Oxford University, he developed a strong friendship with prominent Catholic aristocrat Cecil Calvert. Their friendship was so strong that by 1634, John Lewger gave up his job as a village rector and converted to Catholicism. Three years later in 1637, Lewger was titled as the secretary and surveyor for Lord Baltimore and was sent with a commission for a new provincial government for the newly founded colony of St. Mary’s City. Upon his arrival at St. Mary’s City with his wife and nine-year old son on November 28, 1637, he was given 100 acres of townland and two manors totaling slightly over three thousand acres (Stone 1982:2, 24; Manuscript on file: “St. John’s Freehold”). Shortly thereafter, Lewger began construction on his house called St. John’s Freehold.

John Lewger began the construction of the manorial home on a two hundred acre plantation in 1638. During its construction, Lewger employed many different laborers including three to four carpenters and eight or nine general workers. By 1639, the elaborate one and a half story manor and its outbuildings were complete (Stone 1982:89-91,188). This house was a well-built timbered farm house complete with a large kitchen and parlor on the ground floor. The sleeping chambers rested in the high attic while the
peak of the roof was reserved as the corn loft. The house was well furnished considering the limited availability of furnished goods on the frontier. The inside was well decorated with plastering between exposed posts, ground-laid plank floors, glazed windows, and a half brick chimney. By English standards, St. Johns was considered a modest home, equivalent to that frequently seen in the middle class. However, by Tidewater standards, St. Johns was a gentleman’s estate. Construction and expansion of the estate would continue on and off from 1640 onwards (Stone 1982:91,126). From its initial completion in 1639, St. Johns served as a central location for both public and private events.

One of the first notable events was from 1639 to 1641, when the parlor room of St. Johns served as the meeting place for the Maryland General assembly. When John Lewger served as Lord Calvert’s Secretary, court cases were heard in the parlor while his bedroom served as an office where taxes were collected and estates probated. In April of 1643, St. Johns became the state house of the province after Leonard Calvert left for England (Stone 1982:91; Manuscript on file: “The Role of St. John’s in Historical Archaeology”). Other notable events included “Mistress Margaret Brent’s unsuccessful appeal for two votes in the Maryland Assembly, Charles Calvert’s meeting with the Susquehannock war chiefs, (and) Josiah Fendall’s trial for treason” (Manuscript on file: “The Role of St. Johns in Historical Archaeology”). All of these events did not occur during John Lewger’s tenure as owner and proprietor.

John Lewger left for England around 1649 due to a variety of factors including disgust with the infighting between local Protestants and Catholics. His son, John Lewger Jr, held onto the property until it was sold to a merchant named Henry Fox. Shortly thereafter, Henry sold the land to a successful merchant named Simon Overzee. Simon
Overzee was a wealthy Virginian who had estates in both Maryland and Virginia. He expanded the plantation even further and added several new outbuildings to the property. However, his sudden death in 1662 left him with no heir. In exchange for several other Overzee properties, his second wife gave up her dower rights to St. John’s. In late 1662, Governor Charles Calvert became the proprietor of St. John’s. Lord Calvert continued to use the estate for public affairs yet as time passed; the house began to fall apart. Finally, in 1679, it was sold to Henry Exon where it served as an inn until sometime after 1687. The house was abandoned and fell into disrepair after the capital of Maryland was moved from St. Mary’s City to Annapolis in 1695 (Carson et al. 1981:185; Manuscript on file: “St. John’s Freehold”). It wasn’t until several hundred years later that St. Johns Freehold would once again play a prominent role in Maryland history.

The excavations of the St. Johns site have been continuing on and off for the past thirty years. The first major excavation work started in 1972 and ran until 1976. During this time period, many sections of the house were revealed providing tons of information relating to frame structuring and floor construction. The main parlor and kitchen were exposed along with a rare household addition, a stone lined cellar. Over three hundred thousand artifacts were found including many rare and unique ceramics and glassware. The St. Johns project was one of the first of its kind to not only focus on various material aspects, but also on landscape usage in the nearby yards. The ceramics found eventually led to the creation of a research tool called the Potomac Typological System (POTS) (Manuscript on file: “The Role of St. John’s in Historical Archaeology”). This system has been widely used to compare ceramic collections of colonial sites throughout North America. The work done at the St. Johns Site during the seventies helped to ignite an

An unknown circular feature, in area 52 E, was discovered during the excavations of the backyard approximately thirty five feet north of the main house. The eastern half of this feature was filled with backfill because it had previously been excavated in the 1970s. However, the western portion of the feature still remained intact upon discovery. This feature was located well below the plow zone and turned out to be a pit that measured approximately eight feet in diameter. The bottom of the pit was flat while the sides sloped only so slightly (Mitchell 2004:1-2). This feature holds great potential for paleoethnobotanical work, especially phytolith analysis, because of the lack of major artifact concentrations. The upper stratum of the feature contained some architectural artifacts such as brick, mortar, daub, etc. A terra cotta pipe and a small piece of Rhenish blue and gray stoneware are about the only examples of domestic artifacts recovered. However, the lower level, brown silty soil contained almost no artifacts whatsoever (Mitchell 2004:1,2). This major absence of artifacts, in conjunction with the general shape of the feature, has led some to speculate that it might in fact be an early example of a saw pit. If this true, then it is possible that the brown silty soil is the result of the decomposition of sawdust and bark. Yet the one biological indicator that does not
decompose easily is a phytolith. It may be possible, after creating a type collection of local and historically important trees, to either prove or disprove the saw pit theory by comparing phytoliths found in the soil with known phytolith samples. If the phytoliths prove the feature to be a sawpit, then it would be one of the earliest examples of this technology south of New England.
Chapter IV- Methods

**Introduction:** The methodology used to create this type collection can be broken down into three essential categories: collection, processing, and analysis.

**Collection:** The specimens collected for this project were gathered from local trees around the St. Mary’s College campus and from the grounds at Historic St. Mary’s City with two exceptions, the Juniper and Ash specimens. The Juniper and Ash specimens were collected from known trees in Mt. Holly Springs, and Mechanicsburg Pennsylvania. These trees were identified using local field identification guides and local botanical enthusiasts familiar with the area. Small leaf and stem specimens were collected over a wide range of dates including 10/15/03, 11/21/03, 1/10/04, and 1/14/04. These samples were placed into separate labeled bags for storage in the Kent Hall sociology and anthropology laboratory where they would eventually be processed separately. The samples collected for examination included *Pinus strobus*, *Juglans nigra*, *Robinias pseudoacacia*, *Juniperus spp.*, *Fraxinus spp.*, *Juniperus virginiana*, *Quercus alba*, *Ulmus americana*, and *Taxodium distichum*. Due to seasonal constraints and unforeseen problems in the project, inflorescence samples of each tree species could not be collected.

**Processing:** The methodology used in this project was based on the techniques successfully employed by biology student Catrina Trainor in her Honors thesis of 2001 (Trainor 2001:31-33). Before the plant tissues could be processed for examination, they underwent a cleaning procedure to remove excess detritus and dirt. This step was deemed necessary by archaeologists because it limits possible contamination of the plants by
outside pollen, phytoliths, etc. Dr. Pearsall of the University of Missouri developed a very successful method of cleaning plant tissue. She describes this process in detail in her book *Paleoethnobotany: A Handbook of Procedures* (2000:436)

1. Weigh out samples and place them in labeled centrifuge tubes. Leave tissues whole for this stage. For each sample, fill the tube with distilled water and decant it into a clean Buschner funnel. Rinse the tube once, and then rinse the samples with generous amounts of distilled water. Using clean forceps, return the sample to the tube.
2. Fill the tubes with 2% Liquinox solution… cover, and let sit overnight.
3. Place test tubes in an ultrasonic bath (sonicator) for 15 minutes.
4. Remove test tubes from the bath and rinse each sample using a clean Buchner funnel, as described in step 1. As samples are returned to the tubes after rinsing, break up tissues into small pieces.
5. Allow samples to dry before proceeding with processing (a low-temperature oven is useful for this purpose)

For this project there was one modification to Pearsall’s procedures due to laboratory limitations. In the first step, the samples were placed into available test tubes and not into centrifuge tubes. The rest of the procedures were followed without modification. In step five, the samples were placed into glass vials where they were then dried at 75 degrees centigrade in a low-temperature oven for three days.

The dry samples were placed into aluminum foil envelopes and ashed at 450 degrees centigrade for twelve hours in a programmable muffle furnace. This procedure was experimentally determined to combine optimum temperature and time for proper phytolith ashing (Trainor 2001:32). The temperature of 450 degrees centigrade is high enough to incinerate the carbon in the plant tissue but not cause the release of water in phytoliths. If the temperature in the oven is too high, water will escape from phytoliths thereby causing a change in shape. A high oven temperature can also cause phytoliths to fuse together (Pearsall 2000:436). An ashing time shorter than twelve hours would not completely remove all the carbon while an ashing time of over twelve hours ran the risk of damaging the phytoliths.
Analysis:

**Observation and slide preparation:** Phytoliths were mounted for microscopic observation by measuring a small quantity of ash and suspending it in Permount on the slide. Permount is a strong slide medium designed for the creation of relatively permanent slides. Because the ultimate goal of this project was to create a type collection to be used by future researchers, permanent slides must be made. However, one negative aspect of the Permount was that because of the high viscosity, phytoliths were not easily rotated for better viewing. The scanning procedure I used was a technique originally designed by Dr. Pearsall called “diagnostic scanning” (448-454).

“Diagnostic scanning” involves the systematic scanning of rows in a microscope in order to count 500 phytoliths. The slide is scanned thoroughly from top to bottom or from side to side with each phytoliths and phytolith type being counted. Once 500 phytoliths have been found, or the end of the slide has been reached, the scanner tallies up the number of times each type of phytolith is found (Pearsall 2000:453, 545). The first slide was diagnostically scanned at 200X while the second and third slides were quickly scanned at 100X to check for new phytolith types. Once the scanning was completed, the total phytolith counts were entered into a database for statistical analysis (Trainor 2001:33). Digital photographs of the observed phytoliths were taken by a Cooke SensiCam high performance camera at 300X magnification.

**Classification:** The classification scheme utilized in this project was similar to that used by Trainor in her Honors research paper. This classification system, originally devised by Piperno, emphasized morphological features that related a phytolith to its cellular origin. This system was used for three reasons. The first reason was that it was a
conservative system that allowed for easy classification without the need of complicated terminology. Secondly, this type of classification was simple enough to negate experience as a large factor in phytolith identification and analysis (Trainor 2001:33-34). Finally, this system was used in order to establish continuity between phytolith descriptions of Trainor’s Honors thesis and this St. Mary’s Project.
Chapter V- Results and Discussion

Results

The results of this study show that every tree species investigated produced phytoliths to some level and extent. Before a discussion of results can continue, it is important to address the question of what it means to be diagnostic and how is it defined. The diagnostic value of a phytolith is based on two factors; the morphological uniqueness of a silica body and how many of those types are produced. If a phytolith has a distinct size and shape and is produced in a fairly large volume, it is said have high diagnostic value. However, if this unique shape is produced in a low quantity, it then has a low diagnostic value. A phytolith with low diagnostic value may also be a silica body with a very generic shape with no discrete features. The volume of generic phytoliths produced does not matter because the shape and size cannot be specifically correlated to a species or family during a paleoethnobotanical investigation. Some species in this study produced unique phytoliths while others created very generic and taxonomically useless versions. Of these generic silica bodies, some showed similarities at the family all the way up to the class level. The dicotyledon phytolith totals can be seen in figures 5.1 through 5.10 and in table 5.1.

Discussion

The plants studied in this project were a mix of gymnosperms and dicotyleaneous angiosperms. In gymnosperm plant tissues, silica forms a variety of shapes and figures and accumulates in many different locations. However, because very little research has been conducted on gymnosperms, there is no set classification scheme for this group of plants. What little research there is indicates that phytoliths form in epidermal or
hypodermal cells, stomata, tracheids, parenchyma cell walls, and mesophyll cells (Hodson et al 1996:126-128). On the other hand, phytoliths produced by dicotyledons have been studied a bit more extensively. The range of silica bodies created by dicotyledons includes hair cell phytoliths, both segmented and nonsegmented, hair base phytoliths, cystoliths, polyhedral and anticlinal phytoliths, elongate and other sclerenchyma phytoliths, tracheids, and spherical phytoliths (Piperno 1988:97-104). As in the case of both dicotyledons and gymnosperms, unknown or unidentified phytoliths were documented and photographed. The discussion below describes the phytoliths found in both the leaf and stem regions and discuss their potential diagnostic abilities.

**Fagaceae- Quercus alba**

During the diagnostic count of the white oak species, the leaf specimens typically produced three different types of slightly useful phytoliths. These leaves contained spherical hair bases, regular cystoliths, and polyhedral epidermal cells. As can be seen in figure 5.2, spherical hair bases and polyhedral epidermal cells constituted the least number of phytoliths. These clear phytoliths ranged anywhere from ten to thirty micrometers in length and ten micrometers in height. The cells were seen singularly and in fragments but were also frequently found connected together. In fact, lightly silicified polyhedral epidermal cells often surrounded hair base cells (plate 1b and 1c). The largest volume of known phytoliths found was that of the lightly tinted cystoliths as can be seen in plate 1a and figure 5.2. These phytoliths measured approximately ten micrometers in diameter and were found individually instead of in clumps or groups. The highest number of phytoliths found in the diagnostic count fell into the category of unknown (figure 5.1).
Most of these phytoliths were either clear or tinted and usually appeared in fragment form (plate 1d and 1e). The phytoliths identified in the stem sections of the white oak were only slightly different in structure from their leaf counterparts.

In the stem specimens examined, there were three types of phytoliths that were identified; regular cystoliths, polyhedral epidermal cells, and elongate sclerenchyma cells (figure 5.2). The regular cystoliths, with their circular and slightly tinted bodies, were similar to those found in the leaf samples (plate 1f). However, the number of cystoliths found in the stem samples was much higher than those found in the leaf samples (figure 5.2). In fact, the stem cystoliths numbered the highest out of any of the known phytoliths for *Quercus alba*. The next highest phytolith count, following the cystoliths, belonged to the polyhedral epidermal cells (figure 5.2). These stem epidermal cells are different from those found in leaf tissue because they bear a stronger resemblance to tissue fragments. The phytoliths are tinted a light tan color and appear to have inclusions within the cells (plate 1g). Finally, one or two silicified sclerenchyma cells, also called sclereids, were seen during the scanning process. These sclereids were long and clear cellular structures that averaged between ten to fifteen micrometers in diameter (plate 1i). The bulk of the phytoliths found in from the stem samples were categorized as unknown structures (figure 5.1). Examples of these unknown structures can be seen in plates 1j and 1k. The only other type of phytolith identified was a possible hair cell phytolith found while conducting a quick scan of the remaining stem slides (plate 1h).

Most of the phytoliths found within the leaf and stem tissues of the *Quercus alba* tree have some diagnostic ability. The polyhedral epidermal cells and hair base cells are only slightly useful diagnostically because this type of cell is widely distributed in the
plant kingdom. The presence of sclereids is useful because this type of phytolith is restricted to mostly woody dicots. Finally, the large quantity of regular cystoliths adds to the diagnostic ability of white oak phytoliths.
This is where Table 5.1 will go
Figure 5.1: Quercus alba Total Phytolith Distribution
Figure 5.2: *Quercus alba* Known Phytolith Distribution

Phytolith Types

- Segmented Hair Cells
- Nonsegmented Hair Cells
- Spherical Hair Bases
- Regular Cystoliths
- Polyhedral Epidermal Cells
- Anticlinal Epidermal Cells
- Elongate Sclerenchyma
- Other Sclerenchyma
- Regular Tracheids
- Spherical Smooth
- Spherical to Aspherical Regulose

Phytolith Cell Count

Leaf

Stem
**Ulmaceae-Ulmus americana**

A diagnostic scan of the leaf samples taken from the *Ulmus americana* tree revealed three types of phytoliths. The most common type of known phytolith found was the polyhedral epidermal cell (figure 5.4). This clear phytolith varied in size from ten to twenty micrometers in diameter and was typically found in clumps of three or more (plate 2a). The second most common phytolith was a cell that was found frequently surrounded by seven epidermal cells, the hair base phytolith (figure 5.4). The hair base phytoliths were clear, circular bodies at least ten micrometers in diameter. These phytoliths also had a dimpled surface thereby making them more unique (plates 2a, 2b, 2c). The last type of phytolith found in any sizable quantity was the nonsegmented hair cell (figure 5.4). Nonsegmented hair cells were tan in coloration and varied in size and shape. One example of a hair cell can be seen in plates 2e. As in the *Quercus alba* species, the majority of phytoliths were classified as unknown types (figure 5.3). Within this classification, the phytoliths were broken down into unknowns and stomata’s. Unknown phytoliths were typified by indistinguishable plant and cell fragments (plate 2h). On the other hand, stomata phytoliths were very distinct and were easily identified by their clear coloration and inner and outer circles (plate 2g). A later quick scan of *Ulmus americana* slides also revealed the presence of two sclereid types (plates 2d and 2f). The variety of phytoliths found in the stem portion of the *Ulmus americana* were significantly less than that of the leaf.

None of the known phytoliths found during the diagnostic scan of the *Ulmus americana* stem samples were produced in high volumes. Akin to the leaf samples, the polyhedral epidermal phytoliths were produced in higher quantities than other phytoliths.
Aside from their darker coloration, the epidermal cells found were similar in size and shape to those found in the leaf slides (plate 2j). The other known phytolith found during the scanning process was an elongated sclereid cell. This phytolith measured about twenty-five to thirty micrometers across and was clear with a slight textured surface (plate 2k). However, the majority of phytoliths found in the stem sample fell into the category of unknowns. Three prime examples of unknown phytoliths were seen in plates 2i, 2L, and 2m. These phytoliths ranged in shape from rectangular to polyhedral to amorphous and from clear to light tan in coloration.

The phytoliths found in leaf and stem samples of *Ulmus americana* may prove to be useful as diagnostic tools. The hair base phytoliths, when compared to other plant hair bases, may prove to be unique and highly diagnostic. Since silicified epidermal cells are rather common across a wide variety of plants, their usefulness in identifying a tree family or genus is somewhat limited. The nonsegmented hair cells and stomata also have limited diagnostic use because they are redundant forms that occur in a number of unrelated species and families. However, the presence of sclerenchyma cells adds to the diagnostic value of the species due to limited frequency among woody and herbaceous plants.
Figure 5.3: Ulmus americana Total Phytolith Distribution

Phytolith Types

- Unknowns
- Spherical to Aspherical Rugose
- Spherical Smooth
- Regular Tracheids
- Other Sclerenchyma
- Elongate Sclerenchyma
- Regular Cystoliths
- Polyhedral Epidermal Cells
- Spherical Hair Bases
- Segmental Hair Cells
- Regular Hair Cells
- Other Cells
- Unknowns

Phytolith Cell Count

Leaf

Stem

Total Phytolith Distribution
Figure 5.4: *Ulmus americana* Known Phytolith Distribution
The overall phytolith count reached during the diagnostic scan of the *Juglans nigra* species was much lower than any other species of tree examined. The total number of phytoliths documented while examining the leaf sample was one hundred and ninety five while the stem sample was even less at one hundred and seventy one phytoliths. The most prevalent phytoliths in the leaf sample were the polyhedral epidermal cells (figure 5.6). This type of phytolith was fairly large, over thirty micrometers in width, and was a lightly tinted green or tan coloration. These cells appeared as if they were a combination of silicified material and partially unashed plant fragments (plates 3a and 3b). The second most common known phytoliths were the hair base cells and nonsegmented hair cells (table 3b). The hair base phytoliths were dark in coloration, circular in shape, and from thirty to fifty micrometers in diameter (plates 3a and 3b). The nonsegmented hair cells varied in size and shape and can be seen in plates 3c and 3d. The final phytolith type that was observed during the diagnostic scan was the elongate sclerenchyma cell. The sclereids documented were long, clear cells that, when examined carefully, appeared to contain some inner lining or layer (plates 3e and 3f). Contrary to other species, the number of phytoliths classified as unknowns was lower than that of one of the known types (figure 5.5). A whole range of possible phytoliths and plant fragments can be seen in slides 3g through 3j. The types of phytoliths found in the stem sample varied very little from those found in the leaf slides.

Contrary to the *Juglans nigra* leaf sample, the largest numbers of phytoliths created by the stem tissue were classified as unknowns. All of these phytoliths were different in size and shape with very little consistency in morphology. None of the
examples given in appendix A were repeated other times during examination. However, plates 3p through 3u do allude to the wide range of possibilities associated with phytolith production. The darkly colored hair cells found were almost exactly the same as their counterparts in the leaf tissues (plate 3m). The epidermal cells in the stem section took the form of fragments and were scattered throughout much of the slide (plate 3L). Both the segmented and nonsegmented hair cells were clear, long, and smooth while the cystolith phytolith was short and bumpy (plates 3k, 3n, 3o).

The diagnostic ability of the *Juglans nigra* is limited to the availability of specific phytoliths that are useful for identification purposes. The epidermal and hair base phytoliths not particularly useful because they are not completely silicified cell bodies. The segmented and nonsegmented hair phytoliths are slightly more helpful because their production is limited to dicotyledonous plant species. Finally, the most valuable phytolith for diagnostic purposes, but also the rarest, is the clear cystolith
Figure 5.5: Juglans nigra Total Phytolith Distribution
Figure 5.6: *Juglans nigra* Known Phytolith Distribution

- Segmented Hair Cells
- Nonsegmented Hair Cells
- Spherical Hair Bases
- Regular Cystoliths
- Polyhedral Epidermal Cells
- Anticlinal Epidermal Cells
- Elongate Sclerenchyma
- Other Sclerenchyma
- Regular Tracheids
- Spherical Smooth
- Spherical to Aspherical Regulose
The majority of phytoliths that were found for the *Robinia pseudoacacia* plant either fell into the unknown category for leaf samples or into the tracheid category for stems. In the leaf samples, over four hundred phytoliths, of the five hundred necessary for a diagnostic count, were classified as unknown phytoliths (figure 5.7). These phytoliths were quite varied and examples were seen in plates 4c, 4d, and 4e. The number of known phytoliths was so small that it was not always possible to find and photograph examples of these cells (figure 5.8). One example that was found was the polyhedral epidermal cell and hair base on plate 4c. It is interesting to note that on this plate, the dark coloration of the phytolith may indicate that not all of the plant material was properly ashed. These cells may be a combination of plant fragments and phytoliths. The other phytolith found was the ever elusive cystolith. The cystolith shown in plate 4a is a clear silicated body that measures about fifteen micrometers in diameter. In contrast to the leaf samples, most of the silica bodies found in the stem tissue were classified under a known type of phytolith.

As stated previously, most of the phytoliths found in the stem specimens were categorized as tracheids. Most of these tracheids were rectangular to square in shape, had a light green coloration, and measured at least ten micrometers in length (plate 4h). The other type of phytolith that was found during the diagnostic search was the elongate sclerenchyma cell. This phytolith was very similar to other sclereids in that it was long with a clear body and some internal structure (plate 4g). Phytoliths classified as unknowns had a wide range of shapes and colors (plates 4i through 4L). Finally, during a
quick scan of the remaining *Robinia pseudoacacia* slides, heavily silicified epidermal cells and charred plant epidermal cells were seen side by side (plate 4m).

Phytoliths found while examining the stem and leaf samples of the *Robinia pseudoacacia* tree do not appear to hold diagnostic potential. At first glance, the vast quantity of tracheids produced by the stem would seem to be useful for identification purposes. However, tracheids are commonly produced throughout much of the plant kingdom and have very little taxonomic value. The only phytolith of any value would be the possible sclerenchyma phytoliths. Other phytoliths are produced in such low quantities as to not be helpful diagnostically.
Figure 5.7: *Robinia pseudoacacia* Total Phytolith Distribution
Figure 5.8: *Robinia pseudoacacia* Known Phytolith Distribution

Phytolith Types

- Segmented Hair Cells
- Nonsegmented Hair Cells
- Spherical Hair Bases
- Regular Cystoliths
- Polyhedral Epidermal Cells
- Anticlinal Epidermal Cells
- Elongate Sclerenchyma
- Other Sclerenchyma
- Regular Tracheids
- Spherical to Aspherical Regulose
- Stereotal to Aspermatic Regulose

Leaf

Phytolith Cell Count

0

50

100

150

200

250

300

350

400

Segmented Hair Cells

Nonsegmented Hair Cells

Leaf

Stem
Oleaceae-Fraxinus spp.

The results of examining both the leaf and stem tissues of the *Fraxinus spp.* has shown there to be very little in the way of known phytoliths. An overwhelming majority of phytoliths turned out to be unknown phytoliths or plant fragments (figure 5.9). In the leaf samples, these unknowns were a myriad of shapes and sizes and represented the compilation of undefined, partially, and completely silicified phytoliths as well as plant fragments (plates 5e through 5i). Only three types of known phytoliths were found during the diagnostic scan of the leaf sample; these were nonsegmented hair cells, polyhedral epidermal cells, and anticlinal epidermal cells (figure 5.10 and plates 5a and 5b). However, during the following quick scan, both hair base cells and elongated sclerenchyma cells were found (plates 5a, 5c, and 5d).

The stem tissue of *Fraxinus spp.* yielded even less of the known phytoliths than the leaf sample. Polyhedral epidermal cells and nonsegmented hair cells were the two kinds of known phytoliths discovered during the diagnostic scan (plates 5k and 5o). The only other classifiable phytolith found during the subsequent quick scan was a light green elongated sclerenchyma cell (plate 5L). Finally, examples of the unknown phytoliths are presented in plates 5j, 5m, and 5n.

There is almost no diagnostic ability associated with the *Fraxinus spp.* tree. The known phytoliths are so small in number as to make them almost useless as indicators of plant species. Since there was no consistent type of unknown phytolith present in the tissues, the likelihood of using an unknown silica body for identification purposes is almost nothing.
Figure 5.9: Fraxinus spp. Total Phytolith Distribution
Figure 5.10: *Fraxinus* spp Known Phytolith Distribution

<table>
<thead>
<tr>
<th>Phytolith Types</th>
<th>Leaf</th>
<th>Stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segmented Hair Cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonsegmented Hair Cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spherical Hair Bases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Cystoliths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyhedral Epidermal Cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticlinal Epidermal Cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elongate Sclerenchyma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Sclerenchyma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Tracheids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spherical Smooth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spherical to Aspherical Regulose</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Cupressaceae- Juniperus virginiana**

Because there is no set classification system established for gymnosperms, the process of properly identifying phytoliths became much harder. Therefore, it is hard to truly compare phytolith differentiation between species of gymnosperms and nongymnosperms. However, phytolith processing pressed onward. In the leaf tissues of this tree, a large portion of phytoliths were classified as unknowns (figure 5.11). These unknowns were either plant fragments or indistinguishable clear phytoliths (plate 6b). The second highest type of phytolith found was categorized as “clear vascular”. These phytoliths were mostly clear and contained many substructures associated with vascular tissue (plate 6b). The next highest produced phytolith was the “clear fragment” phytolith. This phytolith was completely clear with no inclusions and was very irregular in shape (plate 6a). The rest of the phytoliths that were found varied in shape and size but were produced in very small quantities (plates 6c through 6h and figure 5.11).

The majority of objects found in the stem tissue fell into the category of “epidermal cellular tissue” and were nothing more than unashed cellular remnants (figure 5.12). However, the second highest amount phytoliths found was categorized as “clear irregular” types. These clear phytoliths lacked a distinct and constant shape but obviously were formed in various parts of the tissue (plate 6i). The last type of phytolith discovered during the diagnostic scan was a clear “dumbbell” shape (plate 6j). Several interesting varieties of phytoliths were found during the quick scan of the stem specimen. Transparent epidermal and hair cell phytoliths counted among the new types discovered
(plates 6k and 6L). The most interesting cell found during the quick scan was a clear phytolith with serrated edges (plate 6m).

The diagnostic ability of the phytoliths in the species *Juniperus virginiana* is somewhat limited. The phytoliths that are produced, such as the “dumbbell”, “clear irregulars”, hair cells, epidermal cells, and “serrated edge”, are very diagnostic when put together in context. However, because they are produced in such small quantities, they have limited archaeological value.
Figure 5.11: *Juniperus Virginiana* Leaf Sample Phytolith Distribution

Phytolith Types

- Unknowns
- Sclereid
- Polyhedra
- Greenish polyhedra
- Clear vascular
- Clear fragment
- Brown fragment
- Clear with inclusions
- Clear, unknown
- Hair cell
- Clear fragment

Phytolith Count
Figure 5.12: *Juniperus virginiana* Stem Sample Phytolith Distribution

- Clear irregular
- Epidermal cellular tissue
- Dumbbell

Phytolith Types

Phytolith Count

0 50 100 150 200 250 300 350
The diagnostic scan of the stem and leaf tissues revealed that this species of tree does not produce a wide variety of phytoliths. In the leaf tissues, the majority of the objects viewed were “tan tissue remains” (figure 5.13). These “tan tissues” are a combination of lightly silicified cells and leftover plant remains (plates 7a and 7c). The other type of phytolith that was counted during the diagnostic scan was classified as “clear fragments” (figure 5.13). This type of phytolith was completely transparent and had an irregular shape (plate 7b). A possible sclerenchyma cell was found during the routine quick scan process (plate 7d).

In stem tissues, the vast majority of structures observed were phytoliths categorized as “granular fragments” (figure 5.14). These “granular fragments” were small, clear phytoliths that were frequently found in clusters (plate 7f). The other two forms of phytoliths, “clear unknown” and “clear cube”, were found only in small quantities. The “clear unknown” phytoliths were relatively amorphous and never had a set shape or design (plate 7e). The “clear cube” was just that, a small clear cube. During the quick scan of the stem slides, a single, clear sclerenchyma phytolith was discovered (plate 7g).

The phytoliths produced by the species *Taxodium distichum* are not unique enough to be considered diagnostically useful.
Figure 5.13: $\textit{Taxodium distichum}$ Leaf Sample Phytolith Distribution

Phytolith Types

- Tan tissue remains
- Clear fragment

Phytolith Count

0

50

100

150

200

250

300

350

400

450

500

Figure 5.13: $\textit{Taxodium distichum}$ Leaf Sample Phytolith Distribution
Figure 5.14: *Taxodium distichum* Stem Sample Phytolith Distribution
**Cupressaceae-Juniperus spp.**

The majority of phytoliths found while examining the leaf sample of the *Juniperus spp* tree were classified as either as “tan epidermal fragments”, “clear polyhedral” or “unknown” (figure 5.15). The “tan epidermal fragments” were usually collections of unashed plant material with some slight silicification. These fragments frequently took the shape of epidermal cells or vascular tissues and contained many different cellular components (plate 8a). “Clear polyhedral” phytoliths were clear and irregular fragments that were once part of a larger phytoliths structure (plate 8b). The cellular bodies that were classified as “unknown” took a range of shapes from amorphous, tan blobs to irregular shaped clear silica masses (plates 8f and 8g). There were two other types of phytoliths found during the diagnostic scanning processes, the “sclereid” and the “clear fragment”. The sclereid, also known as an elongated sclerenchyma cell, had a transparent coloration and a series of holes along its one side (plate 8d). “Clear fragments were different from “clear polyhedral” phytoliths because they did not appear to have been connected to any large structure. The “square” and “hair cell” bodies were two other types of phytoliths found during the quick scan portion of the leaf slides (slides 8c and 8e).

Most of the cell bodies seen while examining the stem tissues were categorized as “cell fragments” (figure 5.16). These fragments were little more than unashed plant material that may or may not have contained phytoliths (plate 8h). The next most prominent phytoliths seen was the “epidermal with inclusions” variety. This epidermal phytolith ranged from clear to very light yellow in coloration and most often had brown, circular inclusions within the cell (plate 8n). The other phytoliths found while scanning
included the “clear epidermal”, “light green cube”, “sclereid”, “transparent glob”, and “unknowns” (plates 8i, 8k, 8L, and 8o). There were two very interesting phytoliths discovered while conducting the quick scan. The first one found was a very long and clear silicified elongated hair cell that measured at least forty micrometers across (plate 8j). The second type of phytoliths found was a clear body approximately ten to fifteen micrometers in width with slightly serrated edges (plate 8m).

As with the *Juniperus virginiana*, the diagnostic ability of the phytoliths found in the *Juniperus spp* plant is rather limited. There does not appear to be enough distinct phytoliths from this plant that would allow for use in identification. The sclereid and serrated edge phytoliths might be useful at a very general taxonomic level but the rest of the phytoliths hold no diagnostic value.
Figure 5.15: *Juniperus* spp. Leaf Sample Phytolith Distribution
Figure 5.16: *Juniperus spp.* Stem Sample Phytolith Distribution
The result of the diagnostic scan of the leaf tissue was interesting because of the unique phytoliths found. One of the most unique phytoliths observed was termed “clear cubes” and was also the most produced (figure 5.17). These cubes had a light green to clear coloration and ranged in size from five micrometers to fifteen micrometers in length (plate 9a). It was interesting to note that these cubes also had some striations across their bodies. The two next prominent phytoliths observed were the “unknowns” and the “tan epidermals” types. The “unknown” category was primarily comprised of plant fragments and unrecognizable phytoliths (plate 9f and 9g). The “tan epidermal” phytoliths were actually just tan plant fragments of epidermal cells. The three other types of phytoliths that were discovered during the diagnostic process were labeled “strange lightly silicified”, “straight lightly silicified”, and “clear fragment”. The “strange lightly silicified” phytolith appeared to be an intertwined group of long and clear phytoliths (plate 9c). This phytolith may be a tangled mess of elongate sclerenchyma cells. The phytolith termed “straight lightly silicified” was a very unique object in which different surface textures were visible (plate 9e). The last phytolith found, the “clear fragment” was essentially just a clear phytolith (plate 9d). Finally, the only other phytolith found in the leaf sample was a possible hair cell or sclereid discovered during the quick scan procedure (plate 9b).

The diagnostic scan of the stem sample resulted in the discovery of phytoliths similar to those produced in the leaf sample (Figure 5.18). The overwhelming majority of phytoliths found were categorized as “clear cubes”. These cubes were the same phytoliths that were described previously in leaf samples (plate 9j). The other phytoliths found
during the diagnostic scan were called “clear fragments”. These phytoliths were transparent and irregularly shaped silica bodies that appeared as if they were fragments broken off a main body (plate 9i). During the quick scan of the remaining stem slides, hair cell, hair base, sclerenchyma, epidermal, and unknown phytoliths were observed (plates 9h, 9k, 9L, 9m, and 9n).

The phytoliths unearthed while examining the slides of the *Pinus strobus* species may prove to be diagnostic. The “clear cubes”, when compared to other types phytoliths, may prove unique enough to be able to associate them with the *Pinus strobus* species, or at the very least, the *Pinaceae* family. Indeed, there appears to be enough moderately unique phytoliths, such as the sclereids for some level of diagnostic ability to be present.
Figure 5.17: *Pinus strobus* Leaf Sample Phytolith Distribution
Figure 5.18: Pinus strobus Stem Sample Phytolith Distribution
Chapter VI: Conclusions

The two primary goals of this project were to: 1. Discover if certain historically important tree species produced phytoliths, and 2: If these trees do produce phytoliths, what are they and are they diagnostically useful in paleoethnobotanical reconstructions? The results of the study indicate that all of the species included in the project do produce phytoliths.

Some of these species examined produced a wide range of phytolith types while others produce only one or two varieties. The quantity of phytoliths produced also changed from species to species. For example, the species *Fraxinus spp.* (ash) and *Juglans nigra* (black walnut) produced the least number of phytoliths in the study. *Fraxinus spp.* generated only a handful of discernable phytoliths and hundreds of plant fragments intermixed with partially silicified materials. The phytoliths created by the *Juglans nigra* tree were few and far in between as well. This species of tree had a nice mix of plant fragments and phytoliths but only several hundred were visible. In truth, there was not enough material to even reach the five hundred count necessary for diagnostic scanning. On the other hand, species such as *Ulmus Americana* (American elm) and *Pinus strobes* (White pine), created large quantities of phytoliths in their tissues. They, along with the majority of the species involved in the study, each produced the necessary five hundred silica bodies required for conducting a diagnostic scan. Therefore, it can be said that all of these historically important trees imported silica into their systems to produce phytoliths in their leaves and stem tissues. Yet not all of the phytoliths that were created looked exactly the same.
The types of phytoliths produced, and their diagnostic value, varied from species to species. Some trees produced phytoliths that could be categorized as very diagnostic and useful in paleoethnobotanical reconstructions. Others proved to be very generic and of very little use to archaeologists. Each of the species examined fell into one of three diagnostic categories; most diagnostic, moderately diagnostic, and least diagnostic. These species are organized into the following chart:

Table 6.1: Diagnostic Rating of Historic Tree Species

<table>
<thead>
<tr>
<th>Most diagnostic</th>
<th>Moderately diagnostic</th>
<th>Least Diagnostic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulmus americana</td>
<td>Quercus alba</td>
<td>Robinia pseudoacacia</td>
</tr>
<tr>
<td>Pinus strobus</td>
<td>Juniperus virginiana</td>
<td>Fraxinus spp.</td>
</tr>
<tr>
<td></td>
<td>Juniperus spp.</td>
<td>Taxodium distichum</td>
</tr>
<tr>
<td></td>
<td>Juglans nigra</td>
<td></td>
</tr>
</tbody>
</table>

Tree species that were designated as the “most diagnostic” had a fairly high level of phytolith production coupled with a wide array of unique silica bodies. In this study, both *Ulmus Americana* and *Pinus strobus* created a diverse arrangement of phytoliths in rather large numbers. This level of diagnostic ability indicates that the unique phytoliths in these two species would be useful in paleoethnobotanical projects such as reconstructing past landscapes. Species that gained a rating of “moderately diagnostic” produced many different types of phytoliths in small numbers. For example, the *Juniperus virginiana* (eastern red cedar) tree produced a very unique “dumbbell” shape that is rare in tree species, especially gymnosperms. However, because only one “dumbbell” was
found, it has very limited use as a diagnostic tool. Thus, the plants in the “moderately diagnostic” level might be useful as backup references but would not be incorporated into the main body of useful phytolith keys. Finally, species that fell into the category of “least diagnostic” produced only generic types of phytoliths or extremely small quantities of slightly diagnostic phytoliths. The quantity of these generic phytoliths does not matter because they are produced by many different taxa across many different families. The extremely low number of slightly useful phytoliths is not diagnostic either because of the lack of consistency within a plant. If a plant species only creates one or two phytoliths within a certain region, it is possible that these phytoliths might be a fluke. The phytoliths are therefore not representative of the plant. They are also fairly useless because if the plant does not create enough phytoliths, it would not be accurately represented in the soil context. Helping to interpret the phytoliths gleaned from archaeological soil contexts was the primary motivation behind this study.

The creation of a small type collection of phytoliths from historically important trees was an important first step towards establishing a valuable archaeobotanical database in the Chesapeake region. This project sought to add to the slowly growing body of knowledge of phytoliths in the Bay. By creating a type collection of local tree species, archaeologists can now begin to compare phytoliths found in the soil with known plant specimens. One example would be to compare the phytoliths found in the soil of the potential saw pit, 18ST1-23 feature 52B, at the St. John’s site, at Historic St. Mary’s City, with those discussed in this project. This project can also serve, much like Catrina Trainors project did for this one, as a reference for future phytolith projects and
investigations. However, the research possibilities concerning this topic and specific subject matter are endless. Much more can be done even with this project.

Numerous avenues of interest can be pursued in relation to this phytolith project. One of the first things that can be done is to conduct a more in-depth investigation of the selected tree species. The use of better scientific scrutiny, such as morphometric and statistical analysis would dramatically improve the information attained from these little phytoliths. In addition, in order to truly gain a full picture of all the phytolithic possibilities, the researcher must not only examine the stem and leaves, but also the wood, bark, fruit, and roots of the selected species. Other project spin-offs might entail expanding the collection of trees to include other historically important specimens such as chestnut, maple, and white pine. A comparison of species within a family, such as white oak compared to shingle oak, might also yield valuable information pertaining to the specificity of phytoliths in the plant kingdom. Whichever road is taken, the study of these phytoliths will only serve to enrich the body of knowledge used in the subfield of archaeology known as paleoethnobotany.
Chapter VII: References

Anderson, Michelle D.

Bailey, Liberty Hyde and Ethel Zoe Bailey

Bey, Calvin F.

Bozarth, Steven

Bruskill, R. W.

Carr, Lois Greem, Philip D. Morgan, and Jean Burrell Russo

Carson, Cary, and Norman F. Barka, William Kelso, Garry Wheeler Stone, and Dell Upton

Cheifetz, Anna, Clare Double, Loretta Barnard and Denise Imwold eds.

Carey, Jennifer H.

Coladonato, Milo.


Cummings, Abbott Lowell


Evans, Cerinda W.

1957. *Some Notes on Shipbuilding and Shipping in Colonial Virginia*. Williamsburg, VA: Virginia 350th Anniversary Celebration Corporation

Forman, H. Chandlee.


Fox, C. Laluela, A. Pérez-Pérez and J. Juan


Harris, Richard


Hodson, M. J., S. E. Williams and A. G. Sangster


Harms, W.R.


Huntley, J. C.


Hurry, Silus D.


Manuscript on File “St. John’s Freehold”. Historic St. Mary’s City Commission, St. Mary’s City, MD “The Role of St. John’s in Historical Archaeology”. Historic St. Mary’s City Commission, St. Mary’s City, MD


Pearsall, Deborah M., Dolores R. Piperno, Elizabeth H. Dinan, Marcelle Umlauf, Zhijun Zhao, Robert A. Benfer Jr.

Piperno, Dolores R.

Piperno, Dolores R.

Piperno, Dolores R. and Deborah M. Pearsall

Rogers, Robert

Rovner, Irwin,

Sangster, A.G.

Schlesinger, Richard C.

Seiler, John R., Edward C. Jensen, and John A. Peterson


Stone, Gary Wheeler

Sullivan, Janet.


Trainor, Catrina A.
Tirmenstein, D.  
1999a. “Botanical and Ecological Characteristics of *Taxodium communis*”. 
Electronic document.  

USDA, NRCS.  
http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=frpe , accessed March 30, 2004  

Wendel, G. W. and H. Clay Smith  

White, Christopher P.  


Williams, Robert D.  

Williamson, Gene  

Wilson, Samuel M.  
Wright, Jonathan and H. Michael Rauscher  
Chapter VIII: Acknowledgements

The very nature of this project required that I attained help from many people from different segments of St. Mary’s College of Maryland, Historic St. Mary’s City, and beyond. Without their help, this project would not have been a success. I would like to start off by thanking Ruth Mitchell, Silas Hurry, and Dr. Henry Miller of Historic St. Mary’s City for all of their help related to researching the St. Johns Site and seventeenth century home construction. Their knowledge and expertise in this field was invaluable. A special thanks goes to Dr. Heather Trigg of the University of Massachusetts at Boston for providing many literary resources concerning phytoliths. This project can be described as interdisciplinary with much of the help I received coming from the biology department. Thank you Elaine Szymkowiak and Tom Brewer of the Biology department for allowing me work in their labs and borrow vital pieces of equipment. In addition, thank you Dr. Bill Williams for the use of the St. Mary’s College herbarium. Another person who played a key role in my project was Dan Brannigan. Dan Brannigan’s intimate knowledge of local flora was useful in the collection and identification of tree samples. I’d like to take this opportunity to thank my friends and housemates at St. Mary’s College of Maryland. Their friendships, especially my housemates Dan, Graham, Corky, and Noah, helped me to enjoy a life outside of my St. Mary’s Project. I would also like to thank my family for their unending love and support during this project. Finally, I extend my most heartfelt thanks towards my two wonderful anthropology advisors; Drs Dan Ingersoll and Kate Meatyard. This project would not have been possible without their incredible support. These two professors not only provided excellent guidance and wisdom for the project, but also helped me to become a better anthropologist.
Historically Important Tree Species

Appendix A:
Guide to Plants in Appendix A

Appendix A serves as a reference for the types of phytoliths found in the nine specimens examined through the use of digital photographs. In addition, the appendix contains both scientific and common names, and brief biological and historical backgrounds of the species in the study.

Sample 1 - *Quercus alba*

Common names: white oak, stave oak, ridge white oak, forked-leaf white oak, fork-leaf oak

*Quercus alba* (white oak) is one of the most well known species of oak and is a member of the beech family (*Fagaceae*) and the subgenus *Lepidobalanus*. White oaks are deciduous trees whose range extends from the swamps and Appalachian Mountains of the east coast to the farmlands of the Midwest. These monoecious dicots are a slow growing species that average from sixty to eighty feet in height. However, specimens over one hundred feet are not unheard of. White oaks generally live a long time with some individuals lasting for six hundred years. *Quercus alba* is best recognized by its leathery leaf with five to nine obtuse lobes, whitish to ashy gray bark, and acorns with a cap that covers one quarter of the body. In addition, white oaks produce a wood that is very durable and strong (Seiler et al. 2003: *Quercus alba* Illustration 1a: *Quercus alba* tree (Seiler et al. 2003: *Quercus alba* fact sheet)
fact sheet). It was this hardiness that caught the attention of carpenters in seventeenth century North America.

Oaks, especially white oak, were one of the most commonly used woods throughout the English colonies in America. They were utilized in almost every aspect of colonial life. William Wood of New England recognized the multitude of purposes that oak served when he wrote

Of Oakes, there be three kindes, the red Oake, white, and blacke; as these are different in kinde, so are they chosen for such uses as they are most fit for, one kind being more fit for clapboard, other for sawneboard, some fitter for shipping, others for houses (Cummings 1979:47)

In 1635, a similar account was described in the journal “A Relation of Maryland”, where “The timber of these parts is very good in abundance. It is useful for building of houses and ships. The white oak is good for pipe-staves, the red oak for wainscot” (Stone 1982:13). In ships and houses, oak provided the strength necessary for the construction of key aspects of the frames. Because this species was so common and so strong, it became the preferred building material for many colonists (Harris 1997:19; Cummings 1979:49; Evans 1957:16.)
Illustration 1b: Native range of *Quercus alba* (Rogers 2004: *Quercus alba L*).

Illustration 1c: Examples of stem, leaf, acorn, and bark (Seiler et al. 2003: *Quercus alba* fact sheet).
Sample 2-Ulmus americana

Common names: American elm, white elm, water elm, soft elm, Florida elm

*Ulmus americana* is a deciduous species of tree that belongs to the Elm family (*Ulmaceae*). This family contains fifteen genera and one hundred and fifty species of trees and shrubs (Bailey and Bailey 1976:1137). American elms thrive almost anywhere in the eastern half and central regions of the United States ranging from slightly north of Maine down to the edge of the Florida everglades and out west towards the Dakotas and Nebraska. This species of elm grows and matures quickly and lives to be about one hundred and seventy five to two hundred years old. Some of the oldest known elms have been dated to three hundred years old. The average height of this dicot ranges from one hundred to two hundred feet. One unique feature of the tree is that it begins to fork into separate branches somewhere between ten and twenty off the ground. *Ulmus americana* can be easily identified because of its deeply notched leaves complete with smooth upper slides and slightly downy undersides. American elms also have a deeply furrowed gray-brown bark and uniquely winged seeds. The bark protects wood that is heavy, hard, strong, and deeply grained. Despite its’ inherit strength, the wood of an American elm is also very flexible.
Aside from oak and pine, elm was one of the most common types of trees used in the construction of timbers for colonial houses. These timbers usually provided main structural support in the form of posts, sills, beams, etc. (Harris 1997:19). Elms were also used in the construction of furniture and other domestic objects such as tables and barrels (Coladonato 1992: Management considerations of Ulmus americana). One of the earliest mentions of elm in Maryland was recorded in “A Relation of Maryland” published in 1635. These early colonists saw that “There is also…elm…; all of which are for building and husbandry.” (Stone 1982:13).
Ulmus americana

Illustration 2b: Native range of *Ulmus americana* (Bey 2004: Ulmus americana L.)

Illustration 2c: Examples of stem, leaf, flower, seed, and bark (Seiler et al. 2003: *Ulmus americana* fact sheet)
Sample 3-Juglans nigra

Common names: black walnut, walnut, eastern black walnut, American walnut

*Juglans nigra* (black walnut) is a deciduous dicot species that is a member of the family *Juglandaceae*. This family contains six genera and about sixty species of plants that are spread throughout North and South America, Asia, and Europe (Bailey and Bailey 1976:613; USDA, NRC 2004: Plant profile for Juglans Nigra) The black walnut has a range that extends from southern New York State down south to Georgia and west to Texas and Iowa. However, black walnuts do not grow in the southern portions of the Mississippi River Valley and Delta (Williams 2004: Juglans nigra L.). The average height of a black walnut tree is around eighty feet with some reaching a maximum height of one hundred and twenty five feet (Coladonato 1991: Botanical and Ecological characteristics of Juglans nigra). This monecious species is easily distinguished by its alternate, pinnately compound leaflets, round and thick walnut seeds, and light brown and deeply furrowed diamond shaped bark (Seiler et al. 2003: Juglans nigra fact sheet) *Juglans nigra* is also one of the heaviest and strongest of hardwoods available in North America (Coladonato 1991: Management Considerations of Juglans nigra)
Despite its’ strength and durability, the use of walnut trees by carpenters in colonial America is mentioned only briefly in passing. There is reference to its use as construction material for buildings and carpentry work in the 1635 article “A Relation of Maryland” (Stone 1982:13). Black walnut wood was also used in some ship construction when one report details that “Walnut trees very many, excellent faire timber above four-score foot, straight without a bough” (Evans 1957:16). Walnut is used in more modern times for the construction of doors, tables, desks, bookcases, etc. (Coladonato 1991: Management Considerations of Juglans nigra). Perhaps the early colonists did the same.


**Juglans nigra**

Illustration 3b: Native range of *Juglans nigra* (Williams 2004: *Juglans nigra* L.)

Illustration 3c: Examples of fruit, stem, bark (two types), and leaf (Seiler et al. 2003: *Juglans nigra* fact sheet)
Sample 4- *Robinia pseudoacacia*

Common names: black locust, false acacia, yellow locust, white locust, green locust, post locust, shipmast locust, locust

The *Robinia pseudoacacia* (black locust) species is one of twenty or so varieties of trees and shrubs of the locust family *Leguminosae* (subfamily *Faboideae*) that can be found throughout most of North America (Sullivan 1993: Introductory of Robinia pseudoacacia). The original natural range of the black locust follows the Appalachian Mountains from central Pennsylvania southwest finally ending in northern Alabama. The original range also included isolated patches around the country in states such as Missouri, Arkansas, and Oklahoma (Huntley 2004: Robinia pseudoacacia L). Black locusts are deciduous dicots that typically mature at a height ranging from forty to sixty feet. A few individuals growing in prime soil conditions have reached a physiological limit of around one hundred feet. This species develops rapidly reaching maturity between the ages of twenty and forty. However, black locusts start to decay after forty years and never live longer than 100 years (Sullivan 1993: Botanical and ecological characteristics of Robinia pseudoacacia).

*Robinia pseudoacacia* is most readily identified by its alternate, compounded leaves, two

![Illustration 4a: Robinia pseudoacacia tree](Seiler et al. 2003: Robinia pseudoacacia fact sheet)
to four inch spines on the stems, gray to dark brown furrowed bark, and pea pod shaped fruit.

Black locust was not a wood that was commonly used for construction in the British colonies. When it was available, its durability made it ideal for structural supports such as posts and beams (Kelso 1984:19; Carson et al 1988:133). Black locust wood may also have been incorporated into boxes, crates, and even ship frames (Huntley 2004: Robinia pseudoacacia L). However, black locust was not utilized as extensively as other tree species such as oak and pine.
Robinia pseudoacacia

Illustration 4b: Native range of Robinia pseudoacacia (Huntley 2004: Robinia pseudoacacia L)

Illustration 4c: Samples of bark, flower, fruit, leaf, and spines (Seiler et al. 2003: Robinia pseudoacacia fact sheet)
Sample 5- *Fraxinus spp.*

Common names: There are many common names associated with different species within this family. The most common general name used is **ash**.

Ash trees belong to the olive family (*Oleaceae*) and are deciduous dicots that can be found throughout most of North America. Of the sixty-five species of ash, some have ranges that overlap areas of 17th century British colonization. These species include *Fraxinus americana* (white ash), *Fraxinus caroliniana* (Carolina ash), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), *Fraxinus profunda* (pumpkin ash), and *Fraxinus quadrangulata* (blue ash). Most ashes are typically fast growing trees and can be recognized by their small, pinnate leaves, small flowers, and winged fruit called samaras (Cheifetz et al 1999:392; Bailey and Bailey 1976:485; USDA, NRCS 2004:Plant Profile for *Fraxinus*).

Ash was not one of the main trees used for timber in the colonies but instead served more of an auxiliary purpose. The species was one of several mentioned in the 1635 article “A Relation of Maryland”. The article stated “There is also…elm, ash, and poplar; all which are for building and husbandry” (Stone 1982:13). Richard Harris had discovered in other documents several examples of ash being incorporated into housing
construction or general carpentry (1997:19). Finally, ash was not only used in the Tidewater colonies, but was also utilized throughout New England (Cummings 1979:49)
**Fraxinus spp.**

Illustration 5b: Ranges of selected ash species

Illustration 5c: Examples of bark, seed, leaf, tree, and stem from *Fraxinus americana* (Seiler et al. 2003: *Fraxinus americana* fact sheet)
Sample 6- *Juniperus virginiana*

Common names: eastern red cedar, red cedar, aromatic cedar

*Juniperus virginiana* (red cedar) is coniferous species that is a member of the family *Cupressaceae.* In this family there are seven genera and about seventy different species of shrubs and trees that belong to the genus *Juniperus* (USDA NRCS 2004: Plant Profile for *Juniperus virginiana*; Bailey and Bailey 1976:615). The native range of the red cedar covers most of the eastern United States extending from Maine down to Florida and westward until approximately the 100th longitude (Lawson 2004: *Juniperus virginiana* L). This slow growing gymnosperm can reach a height of anywhere between forty and seventy feet and can survive for over four hundred and fifty years. Identification of a red cedar depends upon its current growth form. At an early age, red cedars have a form that is “narrowly conical with its branches growing up and out at a sharp angle to form a compact tree” (Anderson 2003: Botanical and Ecological Characteristics of *Juniperus virginiana*). Later in life, these trees develop into a broadly conical shape. Red cedars can be identified by their short scale or long awl leaves, yellow-brown or light blue-green
flowers, berry-like cones, scaled twigs, and red-brown bark that peals in strips (Seiler et al. 2003:Juniperus virginiana fact sheet).

Cedar, especially red cedar, served a variety of functions in the British colonies of seventeenth century North America. Early in colonial history, it was mentioned in “A Relation of Maryland” as one of the trees that was useful for “building and husbandry” (Stone 1982:13). The durability of cedar made it particularly appealing to carpenters who were searching for a reliable and sturdy wood source (Carson et al 1988:133). Some builders used cedar as the main timber supports in houses (Kelso 1984:19). Other carpenters, especially those in New England, found that cedar could be made into long lasting clapboards. In fact, in 1663, John Josselyn expressed his pleasure with cedar by saying

this Tree the English [at Massachusetts Bay] saw into boards to floor their Room, for which purpose it is excellent, long lasting, and wears very smooth and white; likewise they make shingles to cover their houses with instead of tyle, it will never warp. (Cummings 6:48)

Some of these same carpenters also used cedar to construct more domestic and commercial objects such as chests, boxes, and staves. (Cummings 1979:48). And by 1676, it was reported by Edward Randolph that even the timber framed buildings of Harvard University were covered with shingles of cedar (Cummings 1979:49). Cedar was even noted as a fine wood for making the small boats necessary to traverse the creeks and rivers of the New World (Evans 1957:16,17).
Juniperus virginiana

Illustration 6b: Native range of *Juniperus virginiana* (Lawson 2004: Juniperus virginiana L)

Illustration 6c: Examples of bark, two types of leaves, and fruit (Seiler et al. 2003: Juniperus virginiana fact sheet)
Sample 7- *Taxodium distichum*

Common names: bald cypress, pond cypress, cypress, white cypress, gulf cypress, southern cypress, red cypress, swamp cypress, yellow cypress

*Taxodium distichum* (bald cypress) is a member of the family *Taxodiaceae* (Redwood family) that contains five genera and twelve species of trees. Three of these species, *Taxodium ascendens*, *Taxodium distichum*, and *Taxodium mucronatum*, are some form of cypress tree (USDA, NRCS 2004:Plant Profile for Taxodium distichum; Coladonato 1992:Introductory of Taxodium distichum; Whilhite and Toliver 2004:Taxodium distichum L). The bald cypress has a natural range that follows the Atlantic coastal plain from southern Maryland and Delaware south to Florida and westward around the Gulf of Mexico continuing through Texas (Whilhite and Toliver 2004:Taxodium distichum L). This coniferous gymnosperm is a slow growing; long lasting species that can survive for up to one thousand two hundred years and reach a height of around one hundred and twenty feet (Coladonato 1992:Botanical and ecological characteristics of Taxodium distichum). A bald cypress tree can easily be recognized by its feathery, pinnately compound leaf, peltate scaled cones, fibrous red-brown bark, and aerating projections or
“knees” sticking up from the soil (Bailey and Bailey 1976:1098; Seiler et al. 2003:Taxodium distichum fact sheet).

Of all the species examined in this study, the bald cypress was mentioned the least in many historical documents. It was used, or had the potential to be used as building material because of the reference to it in “A Relation of Maryland” in 1635 (Stone 1982:13). Bald cypress wood provides strong, durable timber for construction purposes (Bailey and Bailey 1976:1098). Because this wood is highly resistant to decay, it would have been an excellent choice for use as planking, posts, shingles, etc. (Coladonato 1992:Management Considerations of Taxodium distichum). However, the extent of bald cypress use throughout the colonies is not truly known.
*Taxodium distichum*

Illustration 7b: Natural range of *Taxodium distichum* (Whilhite and Toliver 2004: Taxodium distichum (L) Rich.)

Illustration 7c: Examples of bark, two phases of fruit, and leaf (Seiler et al. 2003: Taxodium distichum fact sheet)
**Sample 8- Juniperus spp.**

Common names: There are many common names associated with different species within this family. The most common general name used is **Juniper**

*Juniper* trees are members of the family *Cupressaceae* and are related to about seventy other different species of trees and shrubs, including red cedar. Hence, many different species are referred to as junipers and therefore it is sometimes hard to make a clear distinction as to the exact species mentioned in older texts. When junipers are mentioned in colonial texts, they may be discussing the species *Juniperus communis* (common juniper). Common junipers are deciduous gymnosperms that grow in almost corner of the globe. However, because they require cooler climates, the native range of the species stretches from northern Canada southward until the southern edge of Virginia. The average juniper will reach a height of around thirty feet and will approximately one hundred and fifty years (Timmerstein 1999:Botanical and Ecological Characteristics of Juniperus communis). The common juniper is best identified by “sword-like” leaves that come in bunches of three, small yellow cones, and a thin, red to brown bark (Seiler et al. 2003:Juniperus communis fact sheet).

The use of the juniper tree in colonial construction was probably very similar to that of the red cedar because they are from the same genus. Junipers provide a strong, finely grained wood suitable for carpentry work (Timmerstein 1999:Management...
Considerations of Juniperus communis). However, because of the similarities between red cedars and junipers, some there is bound to have been confusion in the historical record regarding the use of each species.
Juniperus spp.

Illustration 8b: Native range of Juniperus spp. (Seiler et al. 2003: Juniperus communis fact sheet)

Illustration 8c: Examples of bark, fruit, and two types of leaves (Seiler et al. 2003: Juniperus communis fact sheet)
Sample 9- *Pinus strobus*


*Pinus strobus* (white pine) is a coniferous gymnosperm tree species that is a member of the family *pinaceae*. In this family, there are seven genera and one hundred and twenty one species of plants. The white pine is only one of fifty species in the genus *Pinus*. The native range of the white pine spans predominately the northeastern United States and Canada. This area covers the Appalachian Mountains from Tennessee to Maine and the great lakes region of the U.S. and Canada (Wendel and Smith 2004: *Pinus strobus* L).

Within this region, white pines grow quickly to an average height of around sixty feet. However, some individuals in virgin forests can reach a height of one hundred and fifty feet. These taller trees can endure in excess of four hundred and fifty years while the average white pine survives at least two hundred years (Carey 1993: Botanical and ecological characteristics of *Pinus strobus*). White pines are easily recognizable by their three to five inch, blue-green needles and reddish-brown to grey-brown, deeply furrowed bark. Other physical features
include four to seven inch long cones, cylindrical and yellow male fruit, and light green female fruit (Seiler et al. 2003:Pinus strobus fact sheet).

Members of the pine family, such as white pine, were very sought after by colonists in the seventeenth and eighteenth centuries. Colonists in both the New England and Tidewater regions wrote of its abundance and many uses. William Wood of the New England colonies noted that “The Firre and Pine be trees that grow in many places...shooting up exceeding high, especially the Pine. They doe afford good masts, good board, Rozin, and Turpentine.” (Cummings 1979:49). A Tidewater colonist wrote a similar letter in “A Relation of Maryland” in which he said “The timber of these parts is very good in abundance. It is useful for building of houses and ships...There is also...cedar, pine, and cyprus...all which are for building and husbandry.” (Stone 1981:13). Aside from its uses in shipbuilding, pine was also incorporated into various aspects of the house including the trims, doors, window sashes, boarded partitions, and floors. As the surplus of oak slowly dwindled with time, pine quickly became a suitable alternative as framing material eventually replacing oak all together (Cummings 1970:49).
**Pinus strobus**


Illustration 9c: Examples of needles, cones, fruit, and bark (Seiler et al. 2003: Pinus strobus fact sheet).