
by

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An IAWA List of Microscopic Features for Hardwood Identification was recently published (IAWA Committee 1989). This list is a successor to the one published in 1981 (IAWA Committee 1981) with an explanation of the characters by R.B. Miller (Miller 1981). This paper compares the two lists, and notes similarities, differences, additions, deletions, and changes in interpretations and methodologies.

Features in the 1989 list that were not changed in interpretation, including the addition of categories for quantitative features, are:


Features in the 1989 list that were not included in the 1981 list are:


The following is a list of 1981 states (features) that have been deleted. Some states were deleted because they represented the common occurrence of a character (C). In the 1989 list these features (states) are described or implied by recording the absence of other features. Also, eliminated from the 1981 list were some transitional states that are now described by combining features in the 1989 list (T). Other 1981 features were deleted for various reasons, mostly for lack of information regarding diagnostic power (V).

C Pores in radial multiples (long/short).
T Perforation plates simple and scalariform.
T Perforation plates mostly simple, rarely scalariform.
V Spiral thickenings fine.
V Spiral thickenings coarse.
T Intervascular pitting transitional.
T Only some fibres septate.
V Apo- or paratracheal parenchyma banded; bands visible to the naked eye.

1) Feature not specifically listed in 1981 list (pp. 100-106), but described by recording a combination or absence of features.
2) Listed as a 'special feature' in 1981 list.
3) No change in interpretation or methodology; listed as a quantitative feature with undefined categories in the 1981 list; the 1989 list has defined categories and a quantitative feature with undefined categories.
V Apo- or paratracheal parenchyma banded; bands not visible to the naked eye.
V Sclerotic parenchyma cells present.
V Sclerotic ray cells present.
V Procumbent ray cell height in μm.
V Radial channels present.
V Cysts present.
V Oil or mucilage cells of the same size or slightly larger than adjacent cells.
V Oil or mucilage cells much larger than adjacent cells.
C One crystal per cell or chamber.
V Prismatic crystals not integumented.

V Crystals larger than 50 μm in the longest direction.
V Heartwood crystals present.
V Silica bodies spheroidal.
V Silica bodies irregular or aggregate.
V Size of silica bodies (μm).
V Silica and crystals in the same cell.
C Splinter burns to ash.
C Ash or charcoal grey or white.
V Basic specific gravity (quantitative feature).
V Tree or shrub, cultivated.
V Special features.

For those characters which, for various reasons, have been delimited differently a comparison of the 1989 IAWA list and the 1981 standard list is given below.

6. Vessels in tangential bands

Includes festoon arrangement of 1981 list. 'Ulmiform or wavy' pattern is now interpreted as a combination of tangential and diagonal patterns.

15. Scalariform perforation plates with with ≤ 10 bars
16. Scalariform perforation plates with 10–20 bars
17. Scalariform perforation plates with 20–40 bars
18. Scalariform perforation plates with ≥ 40 or more bars

The number of bars per perforation plate has been expanded from two states. (up to 20 and over 20) to 4 states (≤ 10, 10–20, 20–40, and ≥ 40).

19. Reticulate, foraminate, and/or other types of multiple perforation plates

The 1981 list had separate features for reticulate and foraminate.

Intervessel pit size (alternate and opposite)
24. Minute – ≤ 4 μm
25. Small – 4–7 μm
26. Medium – 7–10 μm
27. Large – ≥ 10 μm
28. Range of intervessel pit size (μm)

Essentially no change in interpretation or methodology except that size is now restricted to opposite and/or alternate pitting. Categories and/or quantitative values can now be used. Previously sizes for all pit types were included in a single quantitative feature.

31. Vessel-ray pits with much reduced borders to apparently simple: pits rounded or angular
32. Vessel-ray pits with much reduced borders to apparently simple: pits horizontal (scalariform, gash-like) to vertical (palisade)

Features 31 & 32 are subcategories of the 1981 feature 'vessel-ray pitting much larger than intervascular pitting'.
### 33. Vessel-ray pits of two distinct sizes or types and in the same ray cell

Feature 33 has a broader interpretation than the 1981 feature ‘vessel-ray pits definitely two-sized.’

### 34. Vessel-ray pits unilaterally compound and coarse (over 10 μm)

In the 1981 list ‘pits unilaterally compound’ included all unilaterally compound pits, irrespective of size.

### Mean tangential diameter of vessel lumina

<table>
<thead>
<tr>
<th>Class</th>
<th>Mean (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40. ≤ 50 μm</td>
<td></td>
</tr>
<tr>
<td>41. 50–100 μm</td>
<td></td>
</tr>
<tr>
<td>42. 100–200 μm</td>
<td></td>
</tr>
<tr>
<td>43. ≥ 200 μm</td>
<td></td>
</tr>
</tbody>
</table>

### 44. Mean, +/- Standard Deviation, Range, n = x

Instead of measuring the larger vessels as recommended in 1981, vessels are now randomly selected with no bias toward the larger or smaller ones. Categories and/or quantitative values may be used.

### 46. ≤ 5 vessels per square millimetre

The methodology for determining vessels per square millimetre has been changed. In the 1981 list vessel multiples were counted as one no matter how many vessels were contained in the group. In the 1989 list each vessel is counted as one. The 1981 features ‘very few (up to 2)’ and ‘few (2–5)’ have been combined into feature 46; and ‘moderately few (5–10)’ and ‘moderately numerous (10–20)’ into feature 47. Feature 48 is the same as ‘numerous (20–40)’. ‘Very numerous (over 40)’ is now feature 49 (40–100). Feature 50 is new.

### 47. 5–20 vessels per square millimetre

### 48. 20–40 vessels per square millimetre

### 49. 40–100 vessels per square millimetre

### 50. ≥ 100 vessels per square millimetre

### 51. Mean, +/- Standard Deviation, Range, n = x

The 1981 list had two features focusing on the macroscopic aspect of whitish or yellowish deposits. Feature 58 is expanded to include both macro- and microscopic observations and the inclusion of all types of coloured deposits.

### 58. Gums and other deposits in heartwood vessels

The 1981 list followed Chattaway (1932), which contained 4 categories (very thin, thick, and very thick). The new list essentially combines the thin and thick categories, although the definitions are slightly different.

### 68. Fibres very thin-walled

### 69. Fibres thin to thick-walled

### 70. Fibres very thick-walled

The 1981 list followed Chattaway (1932), which contained 4 categories (very thin, thin, thick, and very thick). The new list essentially combines the thin and thick categories, although the definitions are slightly different.

### 75. Axial parenchyma absent or extremely rare

The 1981 list had separate features for absence or sparse apo- and paratracheal parenchyma.

### 77. Axial parenchyma diffuse-in-aggregates

No change, however, original list used the term reticulate (Record 1944) as synonymous with diffuse-in-aggregates. The 1989 list uses the term reticulate as a special type of banded parenchyma.
<table>
<thead>
<tr>
<th>Feature Number</th>
<th>Feature Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>78.</td>
<td>Axial parenchyma scanty paratracheal</td>
<td>In the 1981 list scanty and vasicentric were combined into one feature.</td>
</tr>
<tr>
<td>79.</td>
<td>Axial parenchyma vasicentric</td>
<td></td>
</tr>
<tr>
<td>80.</td>
<td>Axial parenchyma aliform</td>
<td>The new list contains two types of aliform parenchyma (lozenge and winged), whereas the 1981 list contained only aliform.</td>
</tr>
<tr>
<td>81.</td>
<td>Axial parenchyma lozenge-aliform</td>
<td></td>
</tr>
<tr>
<td>82.</td>
<td>Axial parenchyma winged-aliform</td>
<td></td>
</tr>
</tbody>
</table>
| 85.            | Axial parenchyma bands more than three cells wide                                   | Features describing banded parenchyma, either apo- or paratracheal, have changed. The 1981 list used ‘1 to 2’ and ‘mostl...
| 86.            | Axial parenchyma in narrow bands or lines up to three cells wide                    |                                                                            |
| 102.           | Ray height > 1 mm                                                                   | The 1981 list used a quantitative feature for maximum and minimum means of heights of multiseriate portion of largest rays. The 1989 list uses total ray height, but only two categories, i.e., over 1 mm (presence of feature 102) or under 1 mm (absence of feature 102). |
| 103.           | Rays of two distinct sizes                                                           | In the 1981 list, the width of the larger rays had to be at least 5 cells. In the 1989 list there is no limit for size classes and ray height may also play a part. |
| 105.           | All ray cells square and/or upright                                                  | Feature 105 is equal to the combination of ‘rays homocellular; cells typically square or upright’ and ‘rays heterocellular; body ray cells square’ in the 1981 list. |
| 107.           | Body ray cells procumbent with mostly 2–4 rows of upright and/or square marginal cells | The 1981 list had one feature ‘rays’ heterocellular; more than one row of upright cells’ which is now represented by two features (107 & 108). |
| 108.           | Body ray cells procumbent with over 4 rows of upright and/or square marginal cells  |                                                                            |
| 111.           | Tile cells                                                                           | This feature is the combination of the 1981 features ‘tile cells of the Durio type’ and ‘tile cells of the Pterospermum type’. |
| Rays per mm    |                                                                                      |                                                                            |
| 114.           | ≤ 4/mm                                                                               | No change in concept or methodology, but the individual categories have been reduced. The 1981 categories were 1–3, 4–7, 8–11, 12–17, and 18 or more rays/mm. |
| 115.           | 4–12/mm                                                                              |                                                                            |
| 116.           | ≥ 12/mm                                                                              |                                                                            |
| 119.           | Low rays storied, high rays non-storied                                              | The 1981 list had the feature ‘parenchyma, vessel elements and fibres storied; rays not storied’ and ‘parenchyma, vessel elements, fibres and/or low rays storied; high rays not storied’. |
| 120.           | Axial parenchyma and vessel elements storied                                         |                                                                            |
| 121.           | Fibres storied                                                                       |                                                                            |
123. Number of ray tiers per axial mm

The 1981 list used 'number of tiers per cm'; now units are millimetres.

132. Laticifers or tanniniferous tubes

This feature is the combination of the 1981 features 'latex tubes present' and 'tanniniferous tubes present'.

140. Prismatic crystals in chambered upright and/or square ray cells

Feature 140 is the combination of '2', '4', and '8' chambered crystals and feature 142 is the combination of 'long' and 'short' crystalliferous chains.

142. Prismatic crystals in chambered axial parenchyma

This feature is the combination of the 1981 features 'druse crystals in upright ray cells' and 'druse crystals in procumbent ray cells'.

145. Druses in ray parenchyma cells

In the 1981 list 'acicular or navicular crystals' were listed together, in the 1989 list acicular crystals is feature 150, and navicular crystals is in feature 152.

150. Acicular crystals

This feature is the combination of the 1981 features 'cubic and rectangular crystals', 'navicular crystals', and several other types.

152. Crystals of other shapes (mostly small)

This feature is the combination of the 1981 features 'silica bodies in upright ray cells' and 'silica bodies in procumbent ray cells'.

160. Silica bodies in ray cells

Features in the 1989 list describing geographical distribution have been greatly expanded using subcategories of Brazier & Franklin's broad regions which are equivalent to the 1981 list except for feature 183. This feature is a broad region that is the combination of the 1981 features 'Mexico, Central America, West Indies' and 'tropical South America'. The 1981 feature 'Mexico, Central America, West Indies' is the combination of features 184 and 185. The 1981 feature 'tropical South America' is divided into feature 186 (tropical South America) and feature 187 (southern Brazil).

183. Neotropics and temperate Brazil (Brazier & Franklin region 81)
184. Mexico and Central America
185. Caribbean
186. Tropical South America
187. Southern Brazil
188. Temperate South America incl. Argentina, Chile, Uruguay, and S. Paraguay (Brazier & Franklin region 82)

Separate features for colourless and brown water and ethanol extract have been combined into features 206 and 211, respectively.

206. Water extract basically colourless to brown or shades of brown
211. Ethanol extract basically colourless to brown or shades of brown
217. Splinter burns to charcoal
218. Splinter burns to a full ash: Colour of ash bright white
219. Splinter burns to a full ash: Colour of ash yellow-brown
220. Splinter burns to a full ash: Colour of ash other than above
221. Splinter burns to a partial ash

Features for the splinter test have been modified to conform to the techniques used at CSIRO, Australia. No change has been made to 'splinter burns to charcoal', but the ash characteristics have changed. Features 218, 219, and 221 are new.

References