TORREYA

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THE DETERMINATION OF WOODS*

By Chester Arthur Darling

As an introduction to this key to the commercial timbers it seems desirable to give a few directions and to define a few terms. The wood of a tree, like the leaves, is often variable; this variation is seen in the width of the growth rings, in the texture, and in the color of the wood which may be due to its being either sap or heart wood or to the length of time that it has been exposed after being cut.

For determination of any wood, a sample at least an inch square in cross section and three inches in longitudinal section should be used; a larger piece often shows the characters better than a small one. In using the key a hand lens which magnifies at least four times and a sharp knife which will make a clean cut surface in cross section of the wood without tearing the tissue are necessary. Unless otherwise indicated the section cut crosswise of the grain is the one to be examined. When color is to be determined the longitudinal section which has been freshly cut and not the cross section should be used; it is always best to test for color by placing the wood against a white surface.

Growth rings are indicated by parallel markings more or less curved which are seen on the cross section of the wood, usually varying in width from $\frac{1}{32}$ in. to $\frac{1}{4}$ in.; in the cross section of the tree they appear as concentric rings. Where there are parallel markings of two distinct types alternating, one of harder or more compact wood than the other, the two taken together

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* Suggestions for improving the key as well as corrections and additions will be gladly accepted; specimens of wood may be obtained upon request; additional copies of the key may be secured for 10 cents by addressing the author at Columbia University, New York City.

indicate a single growth ring; the inner part of the segment of the ring which is either more porous or less compact indicates the spring wood, while the outer portion which is often less porous or more dense is the summer wood; each growth ring is made up of both spring and summer wood, the inner part always being the spring wood. In some of the pines the spring and the summer wood are distinguished from each other as two distinct bands; whereas in some woods there is a gradual transition from the spring to the summer, and in still other cases there is no apparent difference between the two.

The pith rays always appear as lines of compact wood in the cross section extending at right angles to the growth rings; in longitudinal radial section they appear as smooth patches at right angles to the parallel bands of the spring and summer wood. When the pith rays are very small, wetting the cross section will often cause them to be more easily seen.

The pores are small openings usually no larger than that caused by the prick of a pin; they are plainly visible with a magnifier on a cross section which is clean-cut, in some cases they may be seen without the aid of a magnifier. In the Black Locust and sometimes in the Thorny Locust these large pores are filled with cellulose material. The pores in the summer wood arranged *radially* will be at right angles to the growth rings, whereas those arranged *concentrically* will be parallel to the growth rings. To determine *a* or *b* of 19 it is always desirable to make as thin a cross section as possible with a sharp knife, hold the section up to the light, and by looking through it one can easily determine whether or not the cells are arranged in regular rows.

Resin ducts appear as very small dots in cross section; the surface of the wood must be clean-cut without any tearing of the tissue in order that one may be sure of the presence of the ducts; it is usually best to wet the wood *after* making the section, since wetting will cause the duct to be more easily seen. It is usually of a lighter color than the surrounding wet tissue.

The characteristics of odor and of taste can be used to advantage only after one has handled different kinds of wood; a *characteristic* odor or taste refers to one which is not commonly

found in many woods. As to the texture, whether hard or soft, experience again is the best guide; however if a wood can be easily indented with the finger nail it may be called a soft wood; weight as here used is comparative and can be determined only by using different kinds of wood. As in the use of any key the more one knows, the easier it is to use.

In using the key always begin with number 1, read both *a* and *b*; after determining in which group the particular specimen belongs turn to the number indicated and read both *a* and *b*, choosing the one which best describes the specimen; continue this process until the name is secured. Accuracy in observation and in following the key is of first importance.

1 *a*. In smooth cross section growth rings are conspicuously marked by a zone of large pores collected in the spring wood, alternating with a zone of denser summer wood with smaller pores; pores usually visible without magnifier.....2.

b. In smooth cross section the growth rings are not marked by a zone of large pores in the spring wood as in *a*.....15.

2 *a*. Pith rays comparatively broad, at least as broad as the large pores, conspicuous without magnifier; radiating and branching lines or patches in the summer wood.....3.

b. Woods not completely as in *a*.....4.

3 *a*. Wood with reddish tinge.....**Red Oaks.** (*Quercus.*)

b. Wood dingy, not with reddish tinge.....**White Oaks.** (*Quercus.*)

4 *a*. Wood golden-colored or yellowish-brown; numerous smaller pores in summer wood appearing, without magnifier, as lighter colored specks or lines...5.

b. Wood not golden or yellowish.....6.

5 *a*. Pores in summer wood single or in small groups, not in conspicuously concentric lines; pith rays fine, conspicuous only with magnifier; large pores often filled.....**Black Locust.** (*Robinia pseudacacia.*)

b. Pores in summer wood usually in clusters appearing as irregular, concentric lines; pith rays conspicuous without magnifier.....**Mulberry.** (*Morus.*)

6 *a*. Wood reddish, pink, or salmon-colored; pores in summer wood conspicuous, often arranged in irregular concentric lines; pores in spring wood usually in two or more rows, the large pores sometimes filled.

Thorny Locust. (*Gleditsia triacanthos.*)

b. Wood not completely as in *a*.....7.

7 *a*. Pores in summer wood small, appearing as conspicuous concentric, wavy lines, sometimes continuous, often rail-fence like; wood comparatively light in weight.....8.

b. Pores in summer wood not completely as in *a*.....9.

8 *a*. Wood greenish-white; the large pith rays often as broad as the large pores.

Hackberry. (*Celtis.*)

b. Wood not greenish-white; pith rays not as broad as the large pores.

Elm. (*Ulmus.*)

9 *a.* Numerous fine straight, concentric lines nearly as distinct as the pith rays appear in the summer wood; pores often with a wall lighter colored than the surrounding tissue; wood heavy and hard.....**Hickory.** (*Hicoria.*)

b. Wood not completely as in *a* .....10.

10 *a.* Pores in summer wood very small, appearing as radial branching lines or spots, often indistinct; pith rays very fine, usually visible only with the magnifier.....**Chestnut.** (*Castanea dentata.*)

b. Pores in summer wood appearing as spots or as short broken lines, *not* radially arranged.....11.

11 *a.* Wood when wet has a characteristic odor and taste; wood light.

Slippery Elm. (*Ulmus fulva.*)

b. Wood not completely as in *a*.....12.

12 *a.* Wood red; pores in summer wood not arranged in lines, usually separate.

Coffee Tree. (*Gymnocladus dioica.*)

b. Wood not completely as in *a*.....13.

13 *a.* Wood comparatively light; pores in spring wood large and numerous, usually in three or more rows, sometimes filled; pores in summer wood often several together.....**Catalpa.** (*Catalpa Catalpa.*)

b. Wood not completely as in *a*.....14.

14 *a.* Wood whitish; large pores in spring wood comparatively few, usually occupying not more than one third of the ring.

White Ash. (*Fraxinus americana.*)

b. Wood brownish; large pores in spring wood comparatively numerous, often occupying one half of the ring.....**Black Ash.** (*Fraxinus nigra.*)

15 *a.* Pores usually visible without magnifier, generally scattered through the ring but more numerous and larger in the spring wood, gradually varying to smaller ones in the summer wood.....16.

b. All pores small or minute, rather evenly distributed, usually visible only with magnifier.....19.

16 *a.* Pith rays comparatively broad, the largest often twice as broad as the largest pores; pores often arranged in radial lines or patches.

Live Oak. (*Quercus virginiana.*)

b. Wood not completely as in *a*.....17.

17 *a.* Wood dark chocolate brown.....**Black Walnut.** (*Juglans nigra.*)

b. Wood not dark chocolate brown, usually light brown to whitish; fine straight concentric lines appear in the summer wood.....18.

18 *a.* Wood comparatively hard and heavy; large pores with a wall lighter colored than the surrounding tissue.....**Hickory.** (*Hicoria.*)

b. Wood comparatively light; large pores not as in *a.*

Butternut. (*Juglans cinerea.*)

19 *a.* Cells of different sizes, not arranged in regular compact radial rows as seen in thin cross section, sometimes visible without magnifier; pith rays often visible even without magnifier; growth rings sometimes indistinct. 20.

b. All cells of uniform size arranged in regular radial rows or tiers as seen in a thin cross section; pith rays very fine; growth rings always distinct, the summer wood often much harder than the spring wood.....34.

20 *a.* Wood reddish-brown, streaked with irregular darker colored streaks or lines;

pores and pith rays very small often indistinct even with the magnifier; growth rings often inconspicuous.

Sweet Gum, Red Gum. (*Liquidambar Styraciflua.*)

b. Wood not completely as in *a*.....21.

21 *a.* Pith rays scarcely visible even with magnifier; wood soft and light, often whitish, usually with a silky luster in a freshly-cut cross section; pores numerous and scattered.....**Cottonwood. Willow.** (*Populus. Salix.*)

b. Wood not completely as in *a*.....2.

22 *a.* Pith rays conspicuously varying in width in cross section, some half as broad as others, the rays usually conspicuous without magnifier; wood usually hard and heavy.....23.

b. Pith rays not conspicuously varying in width as in *a*.....25.

23 *a.* Wood appears mottled on radial section; pores usually visible without magnifier; wood usually vinous red.....**Sycamore.** (*Platanus occidentalis.*)

b. Wood not completely as in *a*.....24.

24 *a.* Wood with a reddish tinge; broad pith rays numerous.

Beech. (*Fagus grandifolia.*)

b. Wood whitish; broad pith rays not numerous; growth rings usually wavy.

Blue Beech. (*Carpinus caroliniana.*)

25 *a.* Wood usually greenish-white, sometimes whitish when newly cut; pores small, numerous, crowded; wood light.

White Wood. Tulip Poplar. (*Liriodendron tulipifera.*)

b. Wood not completely as in *a*.....26.

26 *a.* Wood usually light brown, sometimes whitish when newly cut; pores small, not crowded; wood comparatively soft and light.

Basswood. (*Tilia americana.*)

b. Wood not completely as in *a*.....27.

27 *a.* Wood usually vinous red; pores numerous, scattered, conspicuous with magnifier, sometimes without; pith rays give a silvery grain on the radial section.....**Cherry.** (*Prunus serotina.*)

b. Wood whitish, yellowish, or reddish; pores few; pith rays often appear as reddish patches on the radial section.....28.

28 *a.* Pith rays about as broad as the largest visible pores, plainly visible in cross section without magnifier; on radial section the largest pith rays appear about $\frac{1}{16}$ in. high; pores numerous and distinct.....29.

b. The broadest pith rays about half as broad as the largest visible pores, often visible on cross section only with magnifier; on radial section the largest pith rays appear about $\frac{1}{32}$ in. high; pores often appear as whitish specks on cross section especially when wood is wet; wood usually of fine texture.

30.

29 *a.* The largest pith rays broader than the large pores; wood heavy and hard.

Hard Maples.

b. The large pith rays about the same width as the large pores; wood of medium weight and texture.....**Soft Maples.**

30 *a.* Wood with reddish tinge.....31.

b. Wood not with reddish tinge, either whitish, yellowish, or light brown....32.

31 *a.* Pores arranged in radial lines or patches; wood very hard and heavy.

Ironwood. (*Ostrya virginiana.*)

b. Pores scattered, not arranged as in *a*; wood of medium weight.
Red and **Cherry Birch.**

32 *a.* Growth rings very indistinct; pores minute and scattered.
Tulepo. Sour Gum. (*Nyssa sylvatica.*)

b. Growth rings clearly marked.....33.

33 *a.* Wood distinctly yellow; pores numerous occupying nearly all of the space; wood light.....**Buckeye. Horse Chestnut.** (*Æsculus.*)

b. Wood whitish; pores occupying not over half the space; wood of medium weight.....**Gray Birch. White Birch.**

34 *a.* In freshly cut longitudinal section wood is decidedly chocolate-colored, reddish, or reddish-brown, not merely tinged with red; resin ducts always wanting.....35.

b. Wood not completely as in *a*.....37.

35 *a.* Wood with lead-pencil-like odor; wood comparatively heavy, hard and compact, fine grained.....**Red Cedar.** (*Juniperus virginiana.*)

b. Wood comparatively light and soft.....36.

36 *a.* Wood reddish-brown, not with characteristic resinous odor.
Redwood. (*Sequoia.*)

b. Wood light chocolate brown with a characteristic, resinous, shingle-like odor.
Canoe Cedar. Incense Cedar. (*Thuja. Libocedrus.*)

37 *a.* Wood decidedly white in freshly-cut longitudinal section, comparatively soft and light.....38.

b. Wood usually straw-colored or tinged with red, not noticeably white.....39.

38 *a.* A few small resin ducts present appearing as specks in smooth cross section when wood is wet.....**White** or **Black Spruce.** (*Picea.*)

b. Resin ducts wanting.....**Balsam Fir.** (*Abies balsamea.*)

39 *a.* Transition from spring to summer wood (not summer to spring) more or less abrupt; bands of summer wood marked from bands of spring wood by fairly well defined lines.....40.

b. Transition from spring to summer wood gradual.....49.

40 *a.* Resin ducts wanting.....41.

b. Resin ducts present, seen as specks especially in the bands of summer wood when wood is wet.....43.

41 *a.* Wood light brown, with characteristic, resinous, shingle-like odor when wet.
White Cedars. (*Thuja. Chamaecyparis.*)

b. Wood not with characteristic odor as in *a*.....42.

42 *a.* Growth rings usually variable in width; wood when fresh with a soapy or greasy character; summer wood straw color.
Cypress. (*Taxodium distichum.*)

b. Growth rings more or less regular in width; summer wood brownish.
Western White Firs. (*Abies.*)

43 *a.* On freshly-cut section wood has a characteristic, resinous, turpentine-like odor when wet; wood heavy, hard, and resinous, rather fine grained.
Longleaf Pine. (*Pinus palustris.*)

b. Woods not completely as in *a*.....44.

44 *a.* Summer wood somewhat orange-yellow as seen in tangential section; growth rings regular in width often wavy in appearance; resin ducts usually oblong

in cross section, usually in groups, often not very distinct; wood with a rather characteristic odor when wet; western species.

Douglas Spruce. (*Pseudotsuga Douglasii.*)

b. Woods not completely as in *a*.....45.

45 *a.* Average growth rings usually less than $\frac{1}{8}$ in. broad, more or less regular in width.....46.

b. Some growth rings more than $\frac{1}{8}$ in. broad, often irregular in width....48.

46 *a.* Western wood; average growth rings about in. $\frac{1}{16}$ or less broad.

Bull Pine. (*Pinus ponderosa.*)

b. Eastern and southern woods; average growth rings more than $\frac{1}{16}$ in. broad. 47.

47 *a.* Wood noticeably reddish; transition from spring to summer wood often gradual in at least some of the rings.....**Red Pine.** (*Pinus resinosa.*)

b. Wood not noticeably reddish; transition from spring to summer wood abrupt.

Short-leaved Pine. (*Pinus echinata.*)

48 *a.* Bands of summer wood distinctly marked from bands of spring wood on *each* side; adjacent rings often variable in width; some resin ducts often oblong in cross section.....**Loblolly Pine.** (*Pinus Taeda.*)

b. Some bands of summer wood distinctly marked from bands of spring wood only on *one* side of ring; resin ducts appear as circular dots in cross section; wood comparatively hard and heavy....**Tamarack.** (*Larix laricina.*)

49 *a.* Wood light brown, soft, light, with a distinctly resinous, shingle-like odor when wet; resin ducts wanting; summer wood darker than the spring wood.

White Cedars. (*Thuja. Chamaecyparis.*)

b. Wood not completely as in *a*.....50.

50 *a.* Resin ducts present appearing as specks especially when wood is wet....51.

b. Resin ducts wanting, or not distinguishable.....57.

51 *a.* Growth rings usually variable in width; wood when fresh with a soapy or greasy character; summer wood straw colored.

Cypress. (*Taxodium distichum.*)

b. Woods not completely as in *a*.....52.

52 *a.* Wood comparatively hard and heavy; some growth rings usually $\frac{1}{8}$ in. or more broad.....**Tamarack.** (*Larix laricina.*)

b. Wood comparatively soft and light.....53.

53 *a.* Wood with a decidedly reddish tinge on longitudinal section when dry, not merely red in summer wood.....54.

b. Wood not noticeably red on longitudinal section.....55.

54 *a.* Eastern wood; transition from spring to summer wood often abrupt in some growth rings; sap wood often with bluish streaks.

Red Pine. (*Pinus resinosa.*)

b. Western wood; transition from spring to summer wood gradual in all of the growth rings.....**Western White Pine.** (*Pinus monticola.*)

55 *a.* Resin ducts comparatively large often darker than the wood; wood often stained around the resin ducts; summer wood noticeably harder and darker than the spring wood; western wood..**Sugar Pine.** (*Pinus Lambertiana.*)

b. Woods not completely as in *a*.....56.

56 *a.* Growth rings about $\frac{1}{16}$ in. or more broad; resin ducts conspicuous when wood is wet; wood with pine odor when wet; eastern wood.

White Pine. (*Pinus Strobus.*)

b. Growth rings about $\frac{1}{32}$ in. broad; resin ducts very small, few; western wood. **Engelman's Spruce.** (*Picea Engelmanni.*)

57 *a.* Average growth rings less than $\frac{1}{16}$ in. broad; cells often just visible with the magnifier in cross section; western woods.....58.

b. Average growth rings more than $\frac{1}{16}$ in. broad.....59.

58 *a.* Very small resin ducts appearing as tiny specks in cross section when wood is wet.....**Engelman's Spruce.** (*Picea Engelmanni.*)

b. No resin ducts present.....**Red Firs.** (*Abies.*)

59 *a.* Wood whitish, comparatively soft and light; eastern wood. **Balsam Fir.** (*Picea balsamea.*)

b. Wood dingy colored or with reddish tinge.....60.

60 *a.* Growth rings regular in width, about $\frac{1}{8}$ in. broad; wood of fine texture; western species.....**Western White Firs.** (*Abies.*)

b. Growth rings usually variable in width; wood of rather coarse texture, often silvery on longitudinal section.....61.

61 *a.* Eastern wood; spring wood light-flesh-color when wet; wood splintery. **Eastern Hemlock.** (*Tsuga canadensis.*)

b. Western wood; spring wood dark-flesh-color when wet; summer wood buff-colored on radial section.....**Western Hemlock.** (*Tsuga Mertensiana.*)

COLUMBIA UNIVERSITY.

THE FLORA OF NORTHAMPTON COUNTY, PENNSYLVANIA

BY WILBUR L. KING

(*Continued from August* TORREYA)

SCROPHULARIACEAE

VERBASCUM THAPSUS L. In fields and waste places, Bethlehem. July 15. 1899.

VERBASCUM LYCHNITIS L. In fields and waste places. (Porter.) Fairly abundant along the Canal at Raubsville (J. A. Ruth)

VERBASCUM BLATTARIA L. Common in fields and waste places, Bethlehem.

LINARIA LINARIA (L.) Karst. Common in fields and waste places, Bethlehem.

ANTIRRHINUM ORONTIUM L. On ore dumps in Bethlehem Steel Co.'s yards. Reported in Bull Torrey Club, **19**: 10. 1892.

SCROPHULARIA MARYLANDICA L. In thickets along Lehigh River at Bethlehem. Aug. 5, 1899.

SCROPHULARIA LEPORELLA Bicknell. In woods and along roadsides. (Porter.)

CHELONE GLABRA L. In wet soil along Monocacy creek 2½ miles north of Bethlehem. Sept. 3, 1899.

PENTSTEMON HIRSUTUS (L.) Willd. In dry soil ½ mile west of Freemansburg. May 29, 1897.

PAULOWNIA TOMENTOSA (Thunb.) Baill. Escaped from cultivation along towpath ½ mile east of Bethlehem.

MIMULUS RIGENS L. In moist soil along Lehigh river near Bethehem July 15, 1899.

MIMULUS ALATUS Soland. In swamps. (Porter.)

GRATIOLA AUREA Muhl. In sandy wet places along Delaware river and at Bethlehem. (Porter.)