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DETERMINATION KEYS FOR IMPORTANT WEST-EUROPEAN WOODS AND TROPICAL COMMERCIAL TIMBERS

with the help of a hand-lens or a light microscope

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Abstract

This booklet contains three dichotomous keys for the identification of trunk wood. Included are 217 different West-European soft- and hardwood species, representing 123 genera arranged in 57 families and 95 tropical commercial timbers belonging to 83 genera in 36 families. For both groups a key is formed based on the use of a hand-lens magnifying 10 times, while for West-European woods also a key is present based on the use of a light microscope. For the hand-lens keys a clear-cut cross-surface of the sample is necessary; for the light microscope transverse, radial and tangential sections of the samples are required, with a thickness of about 15 μm. The use of a microscope will produce more reliable identifications. Descriptions and photographs of the treated species are not included.

An alphabetical arrangement is given of the West-European woods according to genus and species and according to family. For the tropical woods an arrangement is also made according to trade name.

Nomenclature for West-European woods is mainly verified with *Tutin* et al. (1964-1976) and *Dallimore & Jackson* (1966), for tropical woods is used in first instance *Hutchinson & Dalziel* (1954-1972) and *Lindeman & Mennega* (1963).

1. Introduction and acknowledgements

This booklet was primary made as an aid in wood identification, especially trunk wood of mainly large-sized woody plants. A consequent determination key is usually absent in literature dealing with timber or microscopic wood anatomy. Identification of wood samples is regularly required by law authorities, wood collectors, archaeologists, art historians, geologists etc. Furthermore, the use of the table is an instructive method for forestry students interested in wood anatomy, to become conversant with the subject. It shows how variable wood structure is and requires an intensive study of the material.

An introduction to wood anatomy, descriptions and photographs of the treated species are not included. For this purpose one has to consult other literature; for instance *Braun* (1970), *Greguss* (1955 and 1958), *Grosser* (1977) and *Schweingruber* (1978).

In the key for West-European species to be identified with a microscope, 167 species representing 108 genera in 54 families were included. In the key to be used when only a hand-lens is present, 119 species representing 80 genera in 38 families, are inserted. The two keys together cover 217 different species, belonging to 123 genera arranged in 57 families. In the hand-lens key for tropical commercial timbers 94 species are gathered belonging to 83 genera in 36 families.

An alphabetical arrangement is given of the West-European woods included

in the microscopical and hand-lens key, according to genus and species and according to family. For the tropical woods an arrangement is also made according to trade name. Nomenclature for West-European woods is verified with *Tutin* et al. (1964-1976), *Heukels* and *Van Ooststroom* (1977), *Heukels* and *Van der Meijden* (1983), *Boom* (1959), *Dallimore* and *Jackson* (1966) and *Jackson* (1895-1987); for commercial timbers *Voorhoeve* (1979), *Hutchinson* and *Dalziel* (1954-1972), *Lindeman* and *Mennega* (1963), *Exell* et al. (1960-1985), *Palmer* and *Pitman* (1972) and *Jackson* (1895-1987) were consulted.

Terms used are mainly based on the IAWA glossary (1964), while the definitions of fiber-tracheids and libriform wood fibres are from *Reinders* (1935).

The authors are grateful to the curators of institutional wood collections of Leiden, Utrecht and Wageningen for providing wood samples. Thanks are due to the numerous students for their critical remarks and rectifications of the keys during their use in wood anatomy courses. We are also grateful to Professor Dr. M.T.M. *Willemse* for his comments on the manuscript and to Mrs. J. *Cobben-Molenaar* and Mrs. G.G. *van de Hoef-van Espelo* for the typework.

2. Use of the key

Identification of gymnosperm woods (softwoods) with a hand-lens is difficult and in several cases hardly possible. To a lesser extent this also applies to angiosperm woods (hardwoods). In both cases a clear-cut cross surface of the sample is necessary. The key is based on the use of a hand-lens magnifying 10 times, not less and not more. A much more reliable method, however, is using a microscope. Therefore transverse, radial and tangential sections have to be made of the wood samples, varying in thickness from 10-20 μm. They can be made by hand, or with the help of a microtome. The last-mentioned method will produce better results, i.e. larger sections of equal thickness can be obtained, but this requires more time. Sections can be embedded in Kaiser's gelatin-glycerin, only glycerin or even water. In the last case the durability of the slide is very restricted. One has to bear in mind that there exists a large variability in wood structure of certain wood species, especially in twig material. So, if possible, trunk wood has to be used preferably collected from different places of the stem.

At several places in the dichotomous keys measurements of wood characters are asked. For this purpose a calibrated graduated scale is needed in the eye-piece when using a light-microscope, or a stage micrometer (a slide bearing an engraved scale in μm and an area divided into several square millimeters) when using the hand-lens key.

In order to obtain correct identifications the key must be used in combination with descriptions and/or illustrations given elsewhere (see references). Woods reference material in a comprehensive xylarium is desirable.

Users of the keys are kindly requested to communicate their commentary to the authors.

3. List of terms used

Bars – See Perforation plate, scalariform.
Cross-field – A term of convenience for the rectangle formed by the walls of a ray cell and an axial tracheid, as seen in radial section. Used mainly in conifers.
Cross section – A section perpendicular to the longitudinal axis of the trunk.
Crystalliferous cell – A cell containing one or more crystals.
Crystalliferous cell, chambered – A cell derived from a fusiform cambium initial that is divided into compartments by septa, and each compartment containing one (or more) crystals.
Fibre, Fiber (Am.) – A general term of convenience in wood anatomy for any long, narrow cell of wood or bast other than vessels and parenchyma.
Fibre, libriform wood – Much elongated fibre; mostly with relatively thick walls, without swollen appearance and rather often with mucilaginous layers; hardly ever annularly or spirally thickened; sometimes *septate* by very thin, commonly unpitted partition walls formed after secondary thickening of the fibre walls, the septate and non-septate types often occuring together; often containing starch (in sapwood) or crystals; having simple pits or pits with narrow borders and slit-like apertures (or rarely both kinds). In the tangential walls, pits are commonly much less numerous than in the radial walls and may be entirely lacking; in parts of the wall adjacent to vessels they are absent or few. The bordered pits leading to parenchyma cells are often more numerous and their borders somewhat larger than those to fibres of the same kind.
Fibre, septate wood – See Fibre, libriform wood.
Fibre-tracheid – Moderately elongated fibre-like tracheid; commonly with thick and apparently somewhat swollen walls, rarely with mucilaginous layers; hardly ever septate; never containing starch; rather often annularly or spirally thickened; having rather large bordered pits with lenticular to slit-like apertures. The pits are comparatively numerous in the tangential walls, in many instances outnumbering those in the radial. When such fibres constitute the ground tissue, the pits to the vessels ordinarily have borders of much the same size as those of pits in the walls of contact of two vessels.
Ground tissue – The longitudinally (vertical, axial) orientated system, vessels excluded, forming the main mass of the wood. Usually consisting either of fibre-tracheids, of fibre-tracheids and libriform wood fibres, of libriform wood fibres, or sometimes mainly axial parenchyma.
Growth layer – A layer of wood or bark produced apparently during one growing period; frequently, especially in woods of the temperate zones, divisible into *early wood* or bark (the less dense, larger-celled, first-formed part of a growth

ring; syn. *spring wood*) and *late wood* or bark (the denser, smaller-celled, later-formed part of a growth ring; syn. *summer wood*).

Heartwood – The inner layers of wood which, in the growing tree, have ceased to contain living cells and in which the reserve materials (e.g. starch) have been removed or converted into heartwood substances. It is generally darker in colour than sapwood, though not always clearly differentiated. See also *sapwood.*

Parenchyma, aliform – See Parenchyma paratracheal.

Parenchyma, apotracheal – Axial parenchyma typically independent of the pores or vessels. This includes: apotracheal parenchyma cells occurring either single or forming a more or less continuous layer of variable width at the close (*terminal parenchyma*) or at the beginning (*initial parenchyma*) of a season's growth; single apotracheal parenchyma strands or cells distributed irregularly among the fibres, as seen in cross section (*diffuse parenchyma*); axial parenchyma forming concentric lines or bands as seen in cross section (*metatracheal* – or *banded parenchyma*). Note: termed *apotracheal banded* if typically independent of the vessels and *paratracheal banded* if associated with the vessels.

Parenchyma, axial – Parenchyma cells derived from fusiform cambial initials.

Parenchyma, banded – See Parenchyma, apotracheal.

Parenchyma, confluent – See Parenchyma, paratracheal.

Parenchyma, diffuse – See Parenchyma, apotracheal.

Parenchyma, initial – See Parenchyma, apotracheal.

Parenchyma, metatracheal – See Parenchyma, apotracheal.

Parenchyma, paratracheal – Axial parenchyma associated with vessels or vascular tracheids. This includes: incomplete sheaths of occasional parenchyma cells around the vessels (*scanty paratracheal parenchyma*); paratracheal parenchyma forming a complete sheath around the vessels, of variable width and circular or slightly laterally oval in cross section (*vasicentric parenchyma*); paratracheal parenchyma with wing-like lateral extensions, as seen in cross section (*aliform parenchyma*); coalesced aliform parenchyma forming irregular tangential or diagonal bands as seen in cross section (*confluent parenchyma*).

Parenchyma, reticulate – A descriptive term for the net-like pattern formed on the cross section by rays and regularly spaced bands or lines of axial parenchyma when the bands or lines and the rays are of about the same width and distance apart. When the bands are distinctly narrower than the rays the term *scalariform parenchyma* is used.

Parenchyma, scalariform – See Parenchyma, reticulate.

Parenchyma, scanty paratracheal – See Parenchyma, paratracheal.

Parenchyma, terminal – See Parenchyma, apotracheal.

Parenchyma, vasicentric – See Parenchyma, paratracheal.

Parenchyma cell, fusiform – An axial parenchyma cell, derived from a fusiform initial without subdivision.

Parenchyma strand – An axial series of two or more parenchyma cells derived from a single fusiform initial.

Perforation, simple – A single and usually large and more or less rounded opening in the perforation plate.

Perforation, vessel – An opening from one vessel member to another.
Perforation plate – A term of convenience for the area of the wall (originally imperforate) involved in the coalescence of two members of a vessel.
Perforation plate, ephedroid – A plate having a small group of circular openings (as in *Ephedra*).
Perforation plate, scalariform – A plate with multiple perforations elongated and parallel. The remnants of the plate between the openings are called *bars*.
Phloem, included – Phloem strands or layers included in the secondary xylem of certain dicotyledonous woods. Two types are distinguished. Concentric: the cambium is short-lived and is replaced by new meristematic tissue, which develops in either the cortex, pericycle or secondary phloem and repeats the structure of the young stem. The stem thus consists of alternating zones of xylem and phloem. Foraminate: a single permanent cambium continues to function throughout the life of the stem and the xylem is normal except for the occurrence of strands of phloem embedded in it.
Pit – A recess in the secondary wall of a cell, together with its external closing membrane; open internally to the lumen.
Pit, bordered – A pit in which the membrane is overarched by the secondary wall
Pit, simple – A pit in which the cavity becomes wider, or remains of constant width, or only gradually narrows during the growth in thickness of the secondary cell wall, i.e. towards the lumen of the cell.
Pit aperture – The opening or mouth of a pit.
Pit border – The overarching part of the secondary cell wall of a pit.
Pit-pair, bordered – An intercellular paring of two bordered pits.
Pit-pair, half-bordered – An intercellular paring of a simple and a bordered pit.
Pit-pair, simple – An intercellular paring of two simple pits.
Pith fleck – An irregular strand of abnormal (often traumatic) parenchymatous tissue embedded in the wood and appearing on a longitudinal surface as a streak.
Pitting, alternate – Multiseriate pitting in which the pits are in diagonal rows. When the pits are crowded, the outlines of the borders tend to become hexagonal in surface view.
Pitting, opposite – Multiseriate pitting in which the pits are in horizontal pairs or in short horizontal rows. When the pits are crowded the outlines of the borders tend to become rectangular in surface view.
Pitting, scalariform – Pitting in which elongated or linear pits are arranged in a ladder-like series.
Pore – A term of convenience for the cross section of a vessel or of a vascular tracheid. The arrangement may be as follows: *solitary* (the number of solitary pores larger than 20 times the number of pore multiples); *solitary and in pore multiples* (the number of solitary pores 2-5 times the number of pore multiples); *for the greater part solitary* (the number of solitary pores 5-20 times the number of pore multiples); *for the greater part in multiples* (the number of pore multiples 5-20 times the number of solitary pores); *almost all in pore multiples* (the number of pore multiples larger than 20 times the number of solitary pores).

Pore, solitary – A pore completely surrounded by other elements.
Pore chain – A series or line of adjacent solitary pores.
Pore cluster – See Pore multiple.
Pore diameter – Tangential dimension of a vessel in cross section.
Pore multiple – A group of two or more pores crowded together and flattened along the lines of contact so as to appear as subdivisions of a single pore. The most common type is a *radial pore multiple*, in which the pores are in radial files with flattened tangential walls between them. Another type is a *pore cluster* in which the grouping is irregular.
Pore multiple, radial – See Pore multiple.
Pores, almost all in pore multiples – See Pore.
Pores, for the greater part in multiples – See Pore.
Pores, for the greater part solitary – See Pore.
Pores, solitary – See Pore.
Pores, solitary and in pore multiples – See Pore.
Radial section – A section parallel to the longitudinal axis of the trunk and rays; perpendicular to the cross- and tangential sections (rd).
Ray – A ribbon-like aggregate of cells extending radially in the xylem (*wood-, xylem ray*) and phloem (*phloem ray*). The rays may be: *homogeneous* (in conifers a ray composed of only ray parenchyma cells, ray tracheids absent: homocellular; in angiosperms a uniseriate ray, or a multi-seriate ray without a uni-seriate tail, or a multiseriate ray with a uni-seriate tail of only one cell high); *heterogeneous* (in conifers a ray composed of ray parenchyma cells and ray tracheids: heterocellular; in angiosperms a ray composed of several tiers, in addition to which multi-seriate tiers alternate with uni-seriate tiers which are more than one cell high).
Ray, aggregate – A group of small, narrow, xylem rays appearing to the unaided eye or at low magnification as a single large ray.
Ray, heterogeneous – See Ray.
Ray, homogeneous – See Ray.
Ray, multi-seriate – A ray two or more cells wide as seen in tangential section. Rays 1-4-seriate means, rays are 1-, 2- and/or 3-seriate.
Ray, phloem – The part of the ray external to the cambium.
Ray, uni-seriate – A ray one cell wide as seen in tangential section.
Ray, wood or xylem – The part of the ray internal to the cambium.
Ray cell, procumbent – A ray cell with its longest axis radial.
Ray cell, square – A ray cell approximately square as seen in radial section.
Ray cell, upright – A ray cell with its longest dimension axial.
Ray, silver (silvergrain) – A wood ray to be easily seen by the naked eye in the radial surface, strongly reflecting the light.
Ray tracheid – A tracheid forming part of the ray, usually margin cells (in some conifers).
Rd – See Radial section.
Ring, growth – In wood and bark a growth layer as seen in cross section.
Ring boundary, growth – The outer limit of a growth ring.

Ripple marks – See Storied.
Sapwood – The portion of the wood that in the living tree contains living cells and reserve materials (e.g. starch). See also *Heartwood.*
Spiral thickenings – Helical ridges on the inner face of, and part of, the secondary wall.
Storied (storeyed) – A term applied to the axial cells and rays in wood when these are arranged in horizontal series on tangential surfaces. The presence of storied structure is the cause of the *ripple marks* visible with the unaided eye.
Tangential section – A section parallel to the longitudinal axis and circumference of the trunk; perpendicular to the cross- and radial sections (tg).
Tg – See Tangential section.
Tracheid – An imperforate wood cell with bordered pits to congeneric elements. See *Fibre-tracheid.*
Tracheid, vascular – An imperforate wood cell with bordered pits to congeneric elements, resembling in form and position a small vessel number.
Tylosis, pl. tyloses- An outgrowth from an adjacent ray or axial parenchyma cell through a pit cavity in a vessel wall, partially or completely blocking the vessel lumen.
Vessel – An axial series of cells that have coalesced to form an articulated tube-like structure of indeterminate length; the pits to congeneric elements are bordered.
Vessel diameter – Tangential dimension of a vessel in cross section.
Vessel member or element – One of the cellular components of a vessel.
Wood, diffuse-porous – Wood in which the pores are of fairly uniform or only gradually changing size and distribution throughout a growth ring.
Wood, early – See Growth layer.
Wood, late – See Growth layer.
Wood, ring-porous – Wood in which the pores of the early wood are distinctly larger (4 or more times larger) than those of the late wood and form a well-defined zone or ring.
Wood, semi-ring-porous – Wood in which the early wood is marked by a zone of occasional large vessels, or numerous small vessels.
Wood, spring – See Growth layer
Wood, summer – See Growth layer

4. Determination key A for the most important West-European woods, with the help of a light-microscope

1.	Vessels present (Angiospermae; hardwood)	2	
	Vessels absent (Gymnospermae; softwood)	I	p. 11
2.	Growth-ring boundaries clearly visible	3	
	Growth-ring boundaries absent or hardly visible; wood with a homogeneous structure	II	p. 14
3.	Wide, aggregate wood rays absent	4	
	Wide, aggregate wood rays present	III	p. 17
4.	Wood ring-porous, or semi-ring-porous	5	
	Wood diffuse-porous	6	
5.	Wood ring-porous	IV	p. 18
	Wood semi-ring-porous	V	p. 23
6.	Pores solitary and in pore multiples, or almost all in pore multiples	7	
	Pores solitary, or for the greater part solitary	VI	p. 25
7.	Pore multiples composed of two or more pores arranged in radial files	VII	p. 29
	Pore multiples composed of two or more pores, not in typically radial files; equally distributed over the growth ring	VIII	p. 32

Group I – Wood without vessels.

1. Wood rays homogeneous 2
   Wood rays heterogeneous or locally heterogeneous 22

2. Growth-ring boundaries indistinct, not sharply confined 3
   Growth-ring boundaries distinct, sharply confined 5

3. Tracheids with an alternate pitting in the radial walls 4
   Tracheids with an opposite pitting in the radial walls . . . . . *Podocarpus blumei* Endl.

4. More than 20 wood rays per square mm in a tg section; wood rays usually 1-4 cells high; cross-field with 1-8, usually 2-5 half-bordered pit-pairs . . . . . *Araucaria angustifolia* (Bert.) O.K.
   Less than 20 wood rays per square mm in a tg section; wood rays usually more than 3 cells high; cross-field with 1-8, usually 5 or 6, scarcely 1-4 half-bordered pit-pairs . . . . . *Araucaria cunninghamii* D. Don

5. Spiral thickenings absent 6
   Spiral thickenings present 8

6. Wood rays 1-5-seriate; bordered pit-pairs in the rd walls of the tracheids arranged in 1-4 vertical rows 7
   Wood rays always 1-seriate; bordered pit-pairs in the rd walls of the tracheids arranged in 1-4 vertical rows . . . . . *Ginkgo biloba* L.
   Wood rays always 1-seriate; bordered pit-pairs in the rd walls of the tracheids arranged in 1 vertical row 15

7. Resin ducts absent; wood rays 1-60 cells high, 1-seriate but often 2-seriate in an area of 1-2 or 8-10 cells high; cross-field with 1-5 taxoid pits (the bordered part of the half-bordered pit-pair with a horizontal, wide, slit-like inner aperture and a round to oval outline of the border) 20
   Resin ducts sometimes present; wood rays 1-45 cells high, 1-seriate and only 2-5-seriate when a horizontal resin duct is present; cross-field with 1-6 pinoid pits (aperture of the bordered part of the half-bordered pit-pair almost as large as the border outline which almost covers the whole cross-field; in early wood), or cross-field with 1-4 piceoid pits (the bordered part of the half-bordered pit-pair with a longitudinal slit-like inner aperture sometimes extending the round outline of the border; in late wood) . . . . . *Abies alba* Mill.

8. Axial parenchyma present 9
   Axial parenchyma absent 12

9. Axial parenchyma (for softwood) rather abundant (more than 3 cells to the square mm) 10
Axial parenchyma rare (less than 3 cells to the square mm) 11

10. Wood rays 1-3-seriate; 1-17 cells high; parenchyma cells with brown contents . . . . . *Cephalotaxus drupacea* S.et Z. . . . . (syn. of *C. harringtonia* (Forbes) R. Smith)
Wood rays 1-seriate, seldom 2-seriate; 1-6 (1-10) cells high; parenchyma cells without brown contents . . . . . *Cephalotaxus harringtonia* (Forbes) R. Smith

11. Wood rays 1-15 cells high, cells often with yellow-brown contents; largest rd dimensions of the early-wood tracheids about 45 µm . . . . . *Torreya nucifera* S.et Z.
Wood rays 1-12 cells high, cells without coloured contents; largest rd dimensions of the early-wood tracheids about 18 µm . . . . *Torreya grandis* Fort.

12. Wood rays often 2-seriate, sometimes 3-seriate; tracheids sometimes with resin-like contents . . . . . *Taxus wallichiana* Zucc.
Wood rays seldom 2-seriate; tracheids without contents 13

13. Cross-field with 1-5 half-bordered pit-pairs, often one 14
Cross-field with 1-7 half-bordered pit-pairs 11

14. Spiral thickenings with an angle of up to 30 degrees with the horizontal axis (use rd section); wood rays without brown contents . . . . . *Taxus baccata* L.
Spiral thickenings with an angle of up to 60 degrees with the horizontal axis (use rd section); wood rays with brown contents . . . . . *Taxus brevifolia* Nutt.

15. Tg walls of wood-ray parenchyma cells never intirely smooth, but wart-like, with many simple pit-pairs; axial parenchyma with resin-like contents . . . . . *Juniperus communis* L.
Tg walls of wood-ray parenchyma cells smooth, with a few simple pit-pairs 16

16. Cross-field with usually more than 1 half-bordered pit-pair 17
Cross-field with always 1 half-bordered pit-pair 20

17. Cross-field with 1-5, seldom 4, half-bordered pit-pairs, in early wood cupressoid (the bordered part of the half-bordered pit-pair with a usually rather wide diagonal aperture); on tg section more than 40 wood rays per square mm; axial parenchyma rare 18
Cross-field with 1-8, often 4, half-bordered pit-pairs, in early wood taxoid;

on tg section less than 40 wood rays per square mm; axial parenchyma with resin-like contents present 19

18. Wood rays often more than 5 cells high and sometimes 2-seriate in an area of several cells high; many wood-ray parenchyma cells with yellow-brown contents . . . . . *Chamaecyparis lawsoniana* (A. Murr.) Parl.
Wood rays seldom more than 5 cells high, usually 1-4 cells high, always 1-seriate; wood-ray parenchyma cells without yellow-brown contents . . . . . *Chamaecyparis nootkatensis* (D. Don) Spach

19. Wood rays 1-10 cells high . . . . . *Thuja orientalis* L.
Wood rays 1-12 cells high . . . . . *Thuja occidentalis* L.

20. Axial parenchyma absent . . . . . *Sciadopitys verticillata* (Thunb.) S.et Z.
Axial parenchyma present 21

21. Cross walls of axial parenchyma cells seldom smooth, but dentated or thickened like a rope with pearls . . . . . *Taxodium distichum* (L.) A. Rich.
Cross walls of axial parenchyma cells smooth, or hardly pearl-rope-like thickened . . . . . *Sequoia sempervirens* (D. Don) Endl.

22. Resin ducts (traumatic ones excluded) absent 23
Resin ducts (traumatic ones excluded) present 28

23. Wood rays exclusively 1-seriate or nearly so 24
Wood rays rather often locally 2-seriate 27

24. Cross-field with 0-6, seldom 5, half-bordered pit-pairs; axial (terminal) parenchyma present 25
Cross-field with 1-8 half-bordered pit-pairs; axial parenchyma absent or very sparce 26

25. Cross-field with 0-5, usually 2 or 3, half-bordered pit-pairs; wood rays 1-28 cells high . . . . . *Tsuga heterophylla* (Raf.) Sarg.
Cross-field with 0-6, usually 2 or 3, but also rather often with 4 half-bordered pit-pairs; wood rays 1-20 cells high . . . . . *Tsuga sieboldii* Carr.

26. Tracheids in cross section empty or seldom containing some cell substances . . . . . *Tsuga diversifolia* (Maxim.) Mast.
Tracheids in cross section rather often containing cell substances . . . . . *Tsuga canadensis* (L.) Carr.

27. Axial parenchyma rare (less than 3 cells to the square mm; use cross section), without red-brown contents; cross-field with 0-5, usually 1 or 2 half-bordered pit-pairs . . . . . *Cedrus libani* A. Rich.

Axial parenchyma (for softwood) rather abundant (more than 3 cells to the square mm; use cross section), with red-brown contents; cross-field with 1-9 half-bordered pit-pairs . . . . . *Sequoia sempervirens* (D. Don) Endl.

28. Axial parenchyma directly around the resin ducts (epithelial cells) thin-walled (1-2 μm) . . . . . *Pinus sylvestris* L.
Axial parenchyma directly around the resin ducts (epithelial cells) thick-walled (about 4 μm) 29

29. Early-wood tracheids with spiral thickenings against the inner wall . . . . . *Pseudotsuga menziesii* (Mirb.) Franco
Early-wood tracheids without spiral thickenings against the inner wall . . 30

30. Bordered pit-pairs in the rd walls of the early-wood tracheids arranged in 1 vertical row; spiral thickenings in the late-wood tracheids absent . . . 31
Bordered pit-pairs in the radial walls of the early-wood tracheids arranged in 1 or 2 vertical rows; spiral thickenings in the late-wood tracheids present 32

31. Wood rays with a resin duct, 1- or 2-seriate . . . . *Picea abies* (L.) Karst.
Wood rays with a resin duct, 1-5-seriate . . . *Picea sitchensis* (Bong.) Carr.

32. Cross-field with 1-6, usually 2 half-bordered pit-pairs . . . . . *Larix leptolepis* (S. et Z.) Endl. . . . . (syn.of *L. kaempferi* (Lamb.) Carr.)
Cross-field with 1-9 half-bordered pit-pairs . . . . . *Larix decidua* Mill.

Group II – Wood with vessels; growth-ring boundaries absent or hardly visible; wood structure homogeneous.

1. Wood rays 1-seriate, sometimes 2-seriate 2
Wood rays 1- and more-seriate 3

2. Ground tissue libriform wood fibres; crystals in wood-ray parenchyma cells . . . . . *Diospyros horsfieldii* Hiern
Ground tissue fibre-tracheids; crystals in axial parenchyma . . . . . *Eucalyptus globulus* Labill.

3. Wide wood rays often higher than 4 mm 4
Wide wood rays seldom higher than 4 mm 5

4. Greatest diameter of the large vessels 150-250 μm; hardly any ground tissue; vessels with horizontally streched bordered pit-pairs (outline border as well as aperture) . . . . . *Parthenocissus quinquefolia* (L.) Planch.

Greatest diameter of the large vessels smaller than 100 μm; ground tissue present in larger quantities; vessels with round to oval-shaped bordered pit-pairs (outline border as well as aperture) 27

5. Wood rays 1-6-seriate 6
   Wood rays 1-6-seriate and more-seriate 24

6. Wood rays 1-4-seriate, seldom also 4-seriate 7
   Wood rays 1-6-seriate 15

7. Division walls of vessels with simple perforations 8
   Division walls of vessels with scalariform perforations; spiral thickenings absent . . . . . *Buxus sempervirens* L.

8. Spiral thickenings present . . . . . *Myrtus communis* L.
   Spiral thickenings absent 9

9. Banded axial parenchyma clearly visible 10
   Banded axial parenchyma absent or hardly visible 11

10. Ground tissue fibre-tracheids . . . . . *Casuarina equisetifolia* L.
    Ground tissue libriform wood fibres 21

11. Ground tissue fibre-tracheids . . . . . *Myrtus communis* L.
    Ground tissue libriform wood fibres and sometimes also some fibre-tracheids 12

12. Libriform wood fibres all or nearly all septate 26
    Libriform wood fibres all or nearly all non-septate; chambered crystalliferous cells absent or scanty 13

13. Paratracheal axial parenchyma absent or hardly present 14
    Paratracheal axial parenchyma abundant . . . . . *Albizia stipulata* Boiv.

14. Pores arranged in pore multiples; wood rays 1-5-seriate . . . . . *Euphorbia dendroides* L.
    Pores solitary and in pore multiples; wood rays 1- and 2-seriate, seldom 3-seriate . . . . . *Nerium oleander* L.

15. Paratracheal axial parenchyma absent or hardly present 16
    Paratracheal axial parenchyma abundant 17

16. Greatest vessel diameter less than or equal to 50 μm; pores angular in cross section; slide of cross section brown . . . *Crataegus laevigata* (Poiret) DC.
    Greatest vessel diameter more than 50 μm; pores in cross section round

to hardly angular; slide of cross section almost white . . . . . *Crataegus monogyna* Jacq.

17. Wide, tg bands of axial parenchyma present in which many pores with a smaller diameter than those in the remaining wood . . *Ceratonia siliqua* L.
Such wide, tg bands of axial parenchyma absent 18

18. Paratracheal axial parenchyma not around all vessels. . *Citrus aurantium* L.
. . . . . *Citrus macroptera* Montrous.
Paratracheal axial parenchyma around all vessels, in tg direction wider than in rd direction 19

19. Many crystalliferous cells, but chambered crystalliferous cells absent . . .
. . . . . *Ficus elastica* Roxb.
Crystalliferous cells present only in chambered crystalliferous cells . . . 20

20. Larger pores sometimes with red-brown contents . *Albizia procera* Benth.
Larger pores never with red-brown contents . . *Albizia lebbeck* (L.) Benth.

21. Pores solitary or for the greater part solitary . . . . . *Diospyros kaki* L.
Pores solitary and in pore multiples; pores in pore multiples arranged in rd files of two or more pores 22

22. Vessels with tyloses; parenchyma cells often with crystals . . . . . .
. . . . . *Diospyros ebenum* Koenig
Vessels without tyloses; parenchyma cells sometimes with crystals . . . 23

23. Metatracheal parenchyma bands 1 cell wide, abundantly present; parenchyma cells without dark coloured contents . . . . . *Diospyros lotus* L.
Metatracheal parenchyma bands 1-3 cells wide; parenchyma cells with dark coloured contents . . . . . *Zizyphus jujuba* Lam.

24. Wood rays 1-8-seriate . . . . . *Wisteria sinensis* (Sims) Sw.
Wood rays 1-8-seriate and more-seriate 25

25. Ground tissue fibre-tracheids; wood rays 1-4-seriate and 15-20-seriate . . .
. . . . . *Casuarina equisetifolia* L.
Ground tissue libriform wood fibres and axial parenchyma . . . . . .
. . . . . *Ficus elastica* Roxb.

26. Chambered crystalliferous cells absent . . . . . *Punica granatum* L.
Chambered crystalliferous cells present (abundant) . . *Ceratonia siliqua* L.

27. Spiral thickenings present . . . . . *Mahonia aquifolium* (Pursh) Nutt.
Spiral thickenings absent . . . . . *Vitex agnus-castus* L.

Group III – Wood with vessels; growth-ring boundaries clearly visible; wide, aggregate wood rays present.

1. Division walls of vessels with simple perforations 2
   Division walls of vessels with scalariform perforations 4

2. Wood rays usually 1-seriate; sometimes 2-seriate in an area of at the most 3 cells high 8
   Wood rays also multi-seriate 3

3. Wood rays 1-5-seriate . . . . . *Carpinus betulus* L.
   Wood rays 1-5-seriate and more-seriate 10

4. Pores solitary . . . . . *Cornus sanguinea* L.
   Pores in pore multiples, usually arranged in rd files of 2 or more pores . 5

5. Scalariform perforation plates with more than 10 bars; greatest vessel diameter larger than 50 µm; wood rays all or nearly all 1-seriate 6
   Scalariform perforation plates with less than 10 bars; greatest vessel diameter smaller than 50 µm; wood rays 1-5-seriate 7

6. Late wood with more than 80 vessels per square mm (use cross section) . . . . . *Alnus glutinosa* (L.) Gaertn.
   Late wood with less than 80 vessels per square mm (use cross section) . . . . . *Alnus incana* (L.) Moench

7. Wood rays often 2-seriate, seldom 3-seriate . . . . . *Corylus avellana* L.
   Wood rays often 3-seriate, sometimes 4-seriate . . *Alnus virides* (Chaix) DC.

8. Wood ring-porous 9
   Wood not ring-porous . . . . . *Quercus ilex* L.

9. Large vessels in early wood usually arranged in 3 tg layers (about 700 µm wide); transition rather gradually from large early-wood vessels to small late-wood vessels 11
   Large vessels in early wood arranged in at the utmost 2 tg layers (about 500 µm wide); transition rather abrupt from large early-wood vessels to small late-wood vessels . . . . . *Quercus robur* L.

10. Ground tissue libriform wood fibres . . . . . *Hibiscus syriacus* L.
    Ground tissue fibre-tracheids . . . . . *Rosa canina* L.

11. Large crystals present in wood-ray parenchyma cells; wood-ray parenchyma cells often with brown contents; greatest vessel diameter less than 250 µm . . . . . *Quercus rubra* L.

Large crystals absent in wood-ray parenchyma cells; wood-ray parenchyma cells usually without brown contents; greatest vessel diameter more than 250 µm . . . . . *Quercus petraea* (Matt.) Liebl.

Group IV – Wood ring-porous; growth-ring boundaries clearly visible; wide, aggregate wood rays absent.

1. In late wood conspicuous pore multiples absent, pores usually solitary or arranged in rd pore multiples of 2 or more vessels 2
   In late wood conspicuous, large, usually tg pore multiples present . . . 21

2. Wood rays usually 1-seriate, sometimes 2-seriate in an area of at the utmost 3 cells high 3
   Wood rays 1- and multi-seriate or only multi-seriate 5

3. Axial parenchyma diffuse in a ground tissue of libriform wood fibres (use cross section); gelatinous layer often present in libriform wood fibres . . . . . *Castanea sativa* Mill.
   Axial parenchyma metatracheal in a ground tissue of libriform wood fibres (use cross section); gelatinous layer sometimes present in libriform wood fibres 4

4. Large vessels in early wood usually arranged in 3 tg layers (about 700 µm wide); transition rather gradually from large early-wood vessels to small late-wood vessels 57
   Large vessels in early wood arranged in at the utmost 2 tg layers (about 500 µm wide); transition rather abrupt from large early-wood vessels to small late-wood vessels . . . . . *Quercus robur* L.

5. Division walls of vessels with ephedroid perforations . . . . *Ephedra spec.*
   Division walls of vessels with simple or scalariform perforations 6

6. Wood rays less than 5-seriate 7
   Wood rays 1-5-seriate and more-seriate 10

7. Wood rays 1- and 2-seriate, sometimes 3-seriate 8
   Wood rays often 3-seriate or also more than 3-seriate 13

8. Spiral thickenings present 9
   Spiral thickenings absent 47

9. Crystals present; paratracheal axial parenchyma abundant; parenchyma cells with red-brown contents . . . . . *Koelreuteria paniculata* Laxm.
   Crystals absent; paratracheal parenchyma scarce; parenchyma cells without

red-brown contents . . . . . .*Frangula alnus* Mill.

10. Wood rays not predominantly 5- and more-seriate 11
Wood rays predominantly 5- or more-seriate 17

11. Wide wood rays more than 10-seriate 12
Wide wood rays less than 10-seriate 15

12. Large vessels in early wood usually arranged in 3 tg layers (about 700 µm wide); transition rather gradually from large early-wood vessels to small late-wood vessels 57
Large vessels in early wood arranged in at the utmost 2 tg layers (about 500 µm wide); transition rather abrupt from large early-wood vessels to small late-wood vessels . . . . . *Quercus robur* L.

13. Spiral thickenings absent; ground tissue libriform wood fibres 14
Spiral thickenings present; ground tissue fibre-tracheids 50

14. Axial parenchyma with crystals present . . . . *Albizia julibrissin* Durazz.
Axial parenchyma without crystals 51

15. Spiral thickenings present 16
Spiral thickenings absent 53

16. Wood rays of more than 2 mm heigh present; ground tissue fibre-tracheids . . . . . .*Rosa canina* L.
Wood rays of more than 2 mm heigh absent; ground tissue libriform wood fibres . . . . . .*Hibiscus syriacus* L.

17. Wood rays predominantly 4-6-seriate . . . . . *Elaeagnus angustifolia* L.
Wood rays predominantly 6-11-seriate or wider 18

18. Wood rays heterogeneous . . . . . *Ailanthus altissima* (Mill.) Sw.
Wood rays homogeneous 19

19. Spiral thickenings absent; fusiform parenchyma cells present . . . . . *Tamarix gallica* L.
Spiral thickenings present; fusiform parenchyma cells absent 20

20. Vessels without yellow-brown tyloses . . . . . *Gleditsia triacanthos* L.
Vessels often with yellow-brown tyloses . *Prunus dulcis* (Mill.) D.A. Webb

21. Wood rays 1-13-seriate 22
Wood rays 1-15-seriate and several mm heigh . . . . . *Vitis vinifera* L.

22. Wood rays less than 90 µm wide 23
Wood rays more than 90 µm wide 44

23. Wood rays 1-4-seriate 24
Wood rays 1-4-seriate and more-seriate 26

24. Wood rays predominantly homogeneous . . . *Catalpa bignonioides* Walt.
Wood rays heterogeneous 25

25. Greatest vessel diameter in early wood less than 90 µm . . . . . .
. . . . . *Frangula alnus* Mill.
Greatest vessel diameter in early wood more than 150 µm . . . . . .
. . . . . *Rhus typhina* L.

26. Wood rays 1-7-seriate 27
Wood rays 1-7-seriate and more-seriate 29

27. Early-wood vessels without tyloses 28
Early-wood vessels with tyloses 54

28. Crystals present in wood-ray parenchyma cells 48
Crystals absent in wood-ray parenchyma cells 49

29. Wood rays 1-8-seriate 30
Wood rays 1-8-seriate and more-seriate 31

30. Tg pore multiples in late wood seldom connecting more than 2 wood rays with each other 33
Tg pore multiples in late wood often connecting more than 2 wood rays with each other 36

31. Uni-seriate wood rays absent or very sparcely present . . . . *Morus alba* L.
Uni-seriate wood rays regularly present 32

32. Wood rays also regularly 2- and 3-seriate; crystals abundant . . . . . .
. . . . . *Zelkova carpinifolia* (Pall.) K.Koch
Wood rays seldom 2-, never 3-seriate; crystals not abundant . . . . . .
. . . . . *Celtis sinensis* Pers. var. *japonica* Nak.

33. Early-wood vessel diameter about 100 µm; chambered crystalliferous cells present . . . . . *Cercis siliquastrum* L.
Early-wood vessel diameter about 200 µm; chambered crystalliferous cells absent 34

34. Early-wood zone with large vessels, about 1000 µm wide . . . . . .

. . . . . *Gymnocladus dioicus* (L.) K. Koch
Early-wood zone with large vessels, about 600 µm wide 35

35. Early-wood zone with large vessels with a diameter of about 300 µm, consisting of one tg vessel layer against the growth-ring boundary . . . . . .
. . . . . *Zelkova serrata* (Thunb.) Mak.
Early-wood zone with large vessels with a diameter of about 500 µm, consisting of more than one tg vessel layer . . . . . *Sophora japonica* L.

36. Greatest early-wood vessel diameter more than or equal to 250 µm; late-wood vessel surface area in cross section smaller or equal to the surface area of the libriform wood fibres 37
Greatest early-wood vessel diameter less than 250 µm; late-wood vessel surface area in cross section larger or equal to the surface area of the libriform wood fibres 40

37. Wood rays not or hardly wider at the growth-ring boundary 38
Wood rays wider at the growth-ring boundary 39

38. Chambered crystalliferous cells present; axial parenchyma and vessels with orange-brown contents . . . . . *Melia azedarach* L.
Chambered crystalliferous cells absent; axial parenchyma and vessels without orange-brown contents . . . . . *Morus alba* L.

39. Crystals often present in margin cells of wood rays; vessels and wood-ray parenchyma cells often with brown contents . . . . . *Celtis australis* L.
Crystals absent or scarcely present in margin cells of wood rays; vessels and wood-ray parenchyma cells without brown contents . . . . . .
. . . . . *Celtis occidentalis* L.

40. Pore multiples in late wood arranged in tg layers 41
Pore multiples in late wood not typically arranged in tg layers 43

41. Late-wood vessel surface area in cross section much larger than the surface area of the libriform wood fibres . . . . . *Ulmus laevis* Pall.
Late-wood vessel surface area in cross section somewhat larger or equal to the surface area of the libriform wood fibres 42

42. Early-wood zone with large vessels, consisting of more than one tg vessel layer . . . . . *Ulmus carpinifolia* G. Suckow
. . . . . (syn. of *U.minor* Mill.)
Early-wood zone with large vessels, consisting of one tg vessel layer . . . .
. . . . . *Ulmus americana* L.

43. Crystals present in axial parenchyma . . *Broussonetia papyrifera* . (L.) Vent.

Crystals absent in axial parenchyma . . . . . *Sophora japonica* L.

44. Wood rays 1-7-seriate . . . . . *Morus nigra* L.
Wood rays 1-7-seriate and more-seriate 45

45. Crystalliferous cells and fusiform parenchyma cells present . . . . . *Zelkova carpinifolia* (Pall.) K.Koch
Crystalliferous cells and fusiform parenchyma cells absent 46

46. Early-wood vessel diameter less than 250 µm . . . *Gleditsia triacanthos* L.
Early-wood vessel diameter more than 250 µm . . . . . *Ailanthus altissima* (Mill.) Sw.

47. Solitary vessels in late wood thick-walled (about 8 µm); narrow sheath of paratracheal parenchyma around the vessels (use cross section) 52
Solitary vessels in late wood thin-walled (about 2 µm); very wide sheath of paratracheal parenchyma around the vessels (use cross section) . . . . . *Paulownia tomentosa* (Thunb.) Steud.

48. Crystals abundant, spiral thickenings absent; wood rays homogeneous . . . . . *Broussonetia papyrifera* (L.) Vent.
Crystals sparce, spiral thickenings present; wood rays heterogeneous . . . . . *Rhus typhina* L.

49. Tg pore multiples in late wood seldom connecting more than 2 wood rays . . . . . *Sophora japonica* L.
Tg pore multiples in late wood often connecting more than 2 wood rays 55

50. Vessels with red-brown contents present . . . . . *Hippophae rhamnoides* L.
Vessels with red-brown contents absent . . . . . *Syringa vulgaris* L.

51. Greatest early-wood vessel diameter about 175 µm; wood rays seldom 4-seriate . . . . . *Amorpha fruticosa* L.
Greatest early-wood vessel diameter about 300 µm; wood rays often 4-seriate . . . . . *Fraxinus excelsior* L.

52. Greatest early-wood vessel diameter about 175 µm; wood rays often heterogeneous . . . . . *Amorpha fruticosa* L.
Greatest early-wood vessel diameter about 300 µm; wood rays sometimes heterogeneous . . . . . *Fraxinus americana* L.

53. Chambered crystalliferous cells present; wall-thickness of small vessels in late wood about 4 µm . . . . . *Albizia julibrissin* Durazz.
Chambered crystalliferous cells absent; wall-thickness of small vessels in

late wood about 7 µm . . . . . *Fraxinus excelsior* L.

54. Wood rays less than 30 cells high; crystals in axial parenchyma absent . . . . . *Catalpa bignonioides* Walt.
Wood rays also more than 40 cells high; crystals in axial parenchyma present . . . . . *Robinia pseudo-acacia* L.

55. Greatest vessel diameter of large vessels, less than 200 µm . . . . . *Caragana arborescens* Lam.
Greatest vessel diameter of large vessels, more than 200 µm 56

56. Wood rays 1-5-seriate, heterogeneous; wood-ray parenchyma cells not always procumbent; fibre- tracheids present . . *Campsis radicans* (L.) Seem.
Wood rays 1-5-seriate and more-seriate, homogeneous; wood-ray parenchyma cells procumbent; fibre-tracheids absent . . . . *Ulmus americana* L.

57. Large crystals in wood-ray parenchyma cells present; wood-ray parenchyma cells often with brown contents; greatest vessel diameter of large vessels less than 250 µm . . . . . *Quercus rubra* L.
Large crystals in wood-ray parenchyma cells absent; wood-ray parenchyma cells usually without brown contents; greatest vessel diameter of large vessels more than 250 µm . . . . . *Quercus petraea* (Matt.) Liebl.

Group V – Wood semi-ring-porous; growth-ring boundaries clearly visible; wide aggregate wood rays absent.

1. Wood rays 1-seriate, sometimes 2-seriate 2
Wood rays multi-seriate 4

2. Division walls of vessels with simple perforations 3
Division walls of vessels with scalariform perforations . . . *Myrica gale* L.

3. Spiral thickenings present . . . . . *Euonymus europaeus* L.
Spiral thickenings absent or hardly visible ones sparcely present . . . . . *Vaccinium vitis-idaea* L.

4. Wood rays 1-6-seriate 5
Wood rays 1-6-seriate and more-seriate 18

5. Division walls of vessels all with simple perforations or with simple and scalariform perforations 6
Division walls of vessels all with scalariform perforations 7
Division walls of vessels all with ephedroid perforations . . *Ephedra spec.*

6. Division walls of vessels all with simple perforations 8
Division walls of vessels with simple and scalariform perforations . . . 9

7. Spiral thickenings absent 17
Spiral thickenings present . . . . . *Viburnum lantana* L.

8. Spiral thickenings absent 10
Spiral thickenings present 13

9. Spiral thickenings present . . . . . *Lonicera caprifolium* L.
Spiral thickenings absent or hardly visible ones spracely present . . . . . *Vaccinium myrtillus* L.

10. Wood rays 1-5-seriate 11
Wood rays 1-5-seriate and more-seriate 12

11. Wood rays often 3-seriate, seldom 4-seriate . . . . . *Juglans cineria* L.
Wood rays often 4-seriate . . . . . *Juglans nigra* L.

12. Ground tissue fibre-tracheids and libriform wood fibres; diameter of vessels more than 100 µm . . . . . *Juglans regia* L.
Ground tissue fibre-tracheids; diameter of vessels less than 100 µm . . . . . *Erica arborea* L.

13. Spiral thickenings perpendicular to the longitudinal axis of the wood or almost so; vessels and wood-ray parenchyma cells with brown contents . . . . . *Hippophae rhamnoides* L.
Spiral thickenings not perpendicular to the longitudinal axis of the wood; vessels and wood-ray parenchyma cells without brown contents 14

14. Wood rays 1-4-seriate, usually 2-seriate; early-wood vessel diameter about 60 µm 15
Wood rays 1-5-seriate, early-wood vessel diameter more than 60 µm . . 24

15. Ground tissue fibre-tracheids . . . . . *Sorbus aucuparia* L.
Ground tissue libriform wood fibres with or without fibre-tracheids . . 16

16. Ground tissue libriform wood fibres . . . . . *Frangula alnus* Mill.
Ground tissue libriform wood fibres and fibre-tracheids . . . . . *Ligustrum vulgare* L.

17. Wood rays predominantly 1-seriate . . . . . *Myrica gale* L.
Wood rays predominantly 2-seriate . . . *Cercidiphyllum japonicum* S.et Z.

18. Division walls of vessels all with simple perforations 19

Division walls of vessels with simple and scalariform perforations; spiral thickenings absent; wood rays 1-4-seriate and 10-30-seriate 26

19. Spiral thickenings absent 20
Spiral thickenings present 21

20. Pores for the greater part arranged in pore multiples; wood rays also more than 10-seriate . . . . . *Hedera helix* L.
Pores for the greater part or exclusively solitary; wood rays less than 10-seriate . . . . . *Erica arborea* L.

21. Wood rays less than 2 mm high 22
Wood rays up to 2 mm high or higher 25

22. Orange-red contents in vessels present 23
Orange-red contents in vessels absent . . . . . *Prunus spinosa* L.

23. Greatest vessel diameter less than 200 µm . . . . . *Prunus dulcis* (Mill.) D.A. Webb.
Greatest vessel diameter more than 200 µm . . . . . *Melia azedarach* L.

24. Ground tissue fibre-tracheids and libriform wood fibres; greatest vessel diameter of large vessels about 200 µm . . . . . *Juglans nigra* L.
Ground tissue libriform wood fibres; greatest vessel diameter of large vessels about 90 µm . . . . . *Caragana arborescens* Lam.

25. Greatest vessel diameter about 45 µm; ground tissue libriform wood fibres and fibre-tracheids . . . . . *Mahonia aquifolium* (Pursh) Nutt.
Greatest vessel diameter about 135 µm; ground tissue fibre-tracheids . . . . . *Rosa canina* L.

26. Wood rays 1-20-seriate . . . . . *Fagus sylvatica* L.
Wood rays 1-20-seriate and more-seriate . . . . . *Fagus orientalis* Lipsky

Group VI – Wood diffuse-porous; pores solitary, or for the greater part solitary; growth-ring boundaries clearly visible; wide, aggregate wood rays absent.

1. Wood rays 1-seriate, sometimes 2-seriate 2
Wood rays multi-seriate 5

2. Division walls of vessels with simple perforations 3
Division walls of vessels all or nearly all with scalariform perforations; spiral thickenings absent . . . . . *Hamamelis virginiana* L.

3. Spiral thickenings present 4
Spiral thickenings absent . . . . . *Quercus ilex* L.

4. Wood rays with procumbent margin cells . . . . . *Euonymus europaeus* L.
Wood rays with upright or square margin cells . . . . . *Cotoneaster melanocarpa*. Lodd. ex C.K. Schneider . . . . . (syn. of *C. niger* (Thunb.) Fries)

5. Wood rays 1-4-seriate 6
Wood rays 1-4-seriate and more-seriate 17

6. Division walls of vessels all or nearly all with simple perforations 7
Division walls of vessels all or nearly all with scalariform perforations . 12

7. Spiral thickenings present 8
Spiral thickenings absent 29

8. Wood rays usually homogeneous but also heterogeneous with a short tail; 2-seriate wood rays in longitudinal series seldom fusing together 9
Wood rays heterogeneous; 2-seriate wood rays in longitudinal series often fusing together with their 1-seriate tails, forming wood rays with at least 5 tiers 10

9. Fibre-tracheids with many bordered pit-pairs in the tg walls 11
Fibre-tracheids with only a few bordered pit-pairs in the tg walls . . . . . *Sorbus aucuparia* L.

10. Axial parenchyma abundant; ground tissue fibre-tracheids; about 16 wood rays per tg mm (use cross section) . . . . . *Pyrus communis* L.
Axial parenchyma scarce; ground tissue fibre-tracheids and libriform wood fibres; about 40 wood rays per tg mm (use cross section) . . . . . *Prunus padus* L.

11. Axial parenchyma without brown contents . . . . . *Malus sylvestris* Mill.
Axial parenchyma often with brown contents . . . *Sorbus aria* (L.) Crantz

12. Greatest cell lumen diameter of early-wood fibre-tracheids less than 10 µm 13
Greatest cell lumen diameter of early-wood fibre-tracheids more than 10 µm 14

13. Number of bars of the scalariform perforation plates less than 20; ground tissue fibre-tracheids . . . . . *Buxus sempervirens* L.
Number of bars of the scalariform perforation plates also more than 20; ground tissue fibre-tracheids and libriform wood fibres . . . *Cornus mas* L.

14. Number of bars of the scalariform perforation plates less than 23 . . . . . *Liquidambar styraciflua* L.
Number of bars of the scalariform perforation plates also more than 23 15

15. Early-wood vessel diameter less than or equal to 60 µm; 3-seriate wood rays absent or scarcely present 16
Early-wood vessel diameter also more than 60 µm; 3-seriate wood rays rather abundant . . . . . *Cercidiphyllum japonicum* S.et Z.

16. Scalariform perforation plates with less than 35 bars . . . . . *Viburnum lantana* L.
Scalariform perforation plates also with more than 35 bars 30

17. Division walls of vessels only with simple perforations 18
Division walls of vessels with simple and scalariform perforations or only with scalariform perforations 25

18. Spiral thickenings absent 19
Spiral thickenings present (also use tg section) 20

19. Early-wood vessel diameter about 50 µm . . . . . *Erica arborea* L.
Early-wood vessel diameter about 200 µm 24

20. Vessel diameter up to 230 µm or more; ground tissue libriform wood fibres . . . . . *Wisteria sinensis* (Sims) Sw.
Vessel diameter less than 230 µm; ground tissue fibre-tracheids or fibre-tracheids and libriform wood fibres 21

21. Chambered crystalliferous cells present . . . . . *Mespilus germanica* L.
Chambered crystalliferous cells absent 22

22. Wood rays predominantly 2-seriate; wood slightly ring-porous; ground tissue fibre-tracheids and libriform wood fibres . . . . . *Prunus padus* L.
Wood rays predominantly 3- and 4-seriate; wood not at all ring-porous; ground tissue fibre-tracheids 23

23. Greatest vessel diameter less than or equal to 60 µm; slide of cross section brown; pores angular in cross section . . . *Crataegus laevigata* (Poir) DC.
Greatest vessel diameter more than 60 µm; slide of cross section almost white; pores round to hardly angular in cross section . . . . . *Crataegus monogyna* Jacq.

24. Wood rays often 3-seriate, seldom 4-seriate . . . . . *Juglans cineria* L.
Wood rays often 4-seriate . . . . . *Juglans nigra* L.

25. Division walls of vessels all or nearly all with scalariform perforations . 26
Division walls of vessels seldom with scalariform perforations 31

26. Spiral thickenings scarce, hardly visible 27
Spiral thickenings abundant, clearly visible 32

27. Wood rays less than 6-seriate; diameter of early-wood vessels near the growth-ring boundary, wider than those of the other vessels . . . . . *Vaccinium myrtillus* L.
Wood rays 1-6-seriate and more-seriate (aggregate rays); diameter early-wood vessels near the growth-ring boundary, not wider than those of the other vessels 28

28. Number of bars of the scalariform perforation plates less than 12 . . . . . *Rhododendron ferrugineum* L.
Number of bars of the scalariform perforation plates more than 15 . . . . . *Cornus sanguinea* L.

29. Greatest vessel diameter about 260 μm; metatracheal axial parenchyma present; ground tissue libriform wood fibres; wood rays often 3-seriate . . . . *Juglans cineria* L.
Greatest vessel diameter about 90 μm; metatracheal axial parenchyma absent; ground tissue fibre-tracheids; wood rays sometimes 3-seriate . . . . . *Malus sylvestris* Mill.

30. Axial parenchyma without brown contents . . . . . *Weigela florida* (Bunge) A.DC.
Axial parenchyma with brown contents . . . . . *Viburnum opulus* L.

31. Wood rays 1-20-seriate . . . . . *Fagus sylvatica* L.
Wood rays 1-20-seriate and more-seriate . . . . . *Fagus orientalis* Lipsky

32. Number of bars of scalariform perforation plates more than 30; greatest vessel diameter more than 30 μm; wood rays often 5-seriate . . . . . *Staphylea colchica* Stev.
Number of bars of scalariform perforation plates less than 30; division walls of vessels also with simple perforations; greatest vessel diameter less than 30 μm; wood rays seldom 5-seriate . . . . . *Vaccinium corymbosum* L.

Group VII – Wood diffuse-porous; pores solitary and in pore multiples or almost all in pore multiples; pore multiples composed of two or more pores arranged in radial files; growth-ring boundaries clearly visible; wide, aggregate wood rays absent.

1. Paratracheal parenchyma with wide (more than 3 cell layers) sheaths around the vessels, often with wing-like lateral (tg) extensions (aliform) (use cross section); metatracheal axial parenchyma absent 2
   Paratracheal parenchyma with narrow (less than 3 cell layers) sheaths around the vessels, not aliform 4

2. Wood rays 1-4-seriate; chambered crystalliferous cells absent . . . . . *Albizia stipulata* Boiv.
   Wood rays 1-4-seriate and more-seriate; chambered crystalliferous cells present 3

3. Wide vessels sometimes with brown contents, wood rays without contents; libriform wood fibres all or nearly all non-septate . *Albizia procera* Benth.
   Wide vessels without brown contents, wood rays with brown contents; libriform wood fibres all or nearly all septate . . . . *Albizia lebbeck* (L.) Benth.

4. Wood rays usually 1-seriate 5
   Wood rays usually multi-seriate 13

5. Spiral thickenings absent 6
   Spiral thickenings present . . . . . *Aesculus hippocastanum* L.

6. Division walls of vessels with scalariform perforations 7
   Division walls of vessels without scalariform perforations 9

7. Wood rays seldom 2-seriate 8
   Wood rays often 2-seriate . . . . . *Corylus avellana* L.

8. Late-wood vessels less than 80 to the square mm (use cross section) . . . . *Alnus incana* (L.) Moench
   Late-wood vessels more than 80 to the square mm (use cross section) . . . . *Alnus glutinosa* (L.) Gaertn.

9. Wood rays with procumbent margin cells 10
   Wood rays with upright margin cells 11

10. Less than 60 pore multiples and solitary pores visible to the square mm (using a magnification of about 100 times) . . . . . *Populus nigra* L.
    More than 60 pore multiples and solitary pores visible to the square mm (using a magnification of about 100 times) . . . . . *Populus tremula* L.

11. Libriform wood fibres septate . . . . . *Punica granatum* L.
Libriform wood fibres non-septate 12

12. Paratracheal parenchyma present; parenchyma cells without brown contents . . . . . *Salix alba* L.
Paratracheal parenchyma absent; parenchyma cells with brown contents. . . . . *Salix caprea* L.

13. Wood rays 1-5-seriate 14
Wood rays 1-5-seriate and more-seriate 27

14. Spiral thickenings absent or hardly visible 15
Spiral thickenings present and clearly visible 20

15. Scalariform pitting in vessel walls present 16
Scalariform pitting in vessel walls absent 17

16. Wood rays 1-3-seriate, seldom 3-seriate; libriform wood fibres septate . . . . . *Magnolia acuminata* (L.) L.
Wood rays 1-5-seriate, often 3-seriate; libriform wood fibres non-septate. . . . . *Magnolia x soulangeana* Soul.

17. Division walls of vessels with scalariform perforations; storied structure absent (tg) 18
Division walls of vessels without scalariform perforations; storied structure present (tg) . . . . . *Diosypros lotus* L.

18. Number of bars of the scalariform perforation plates less than 10 . . . . . *Alnus viridis* (Chaix) DC.
Number of bars of the scalariform perforation plates more than 10 . . . 19

19. Average number of bars of scalariform perforation plates more than 17.6 . . . . . *Betula pubescens* Ehrh.
Average number of bars of scalariform perforation plates less than 17.6 . . . . . *Betula pendula* Roth

20. Apotracheal parenchyma bands clearly visible, cells often with resin-like contents 21
Apotracheal parenchyma bands absent or hardly visible and irregular . 23

21. Spiral thickenings arranged irregularly; rd pore chains of more than 3 pores scarcely present . . . . . *Juglans nigra* L.
Spiral thickenings arranged regularly; rd pore chains of more than 3 pores regularly present 22

22. Parenchyma strand consisting of 3-10 cells . . . . *Ostrya carpinifolia* Scop.
Parenchyma strand consisting of 6-13 cells . . . . . *Ostrya virginiana* (Mill.) K.Koch

23. Late-wood vessel diameters much smaller than those in the early wood 24
Late-wood vessel diameters not or only slightly smaller than those in the early wood 25

24. Ground tissue fibre-tracheids and libriform wood fibres . *Prunus padus* L.
Ground tissue libriform wood fibres . . . . . .*Frangula alnus* Mill.

25. Axial parenchyma absent or scarcely present; wood rays often 3-seriate, homogeneous, spindle-shaped (use tg section) 26
Axial parenchyma abundant; wood rays seldom 3-seriate, several tiers, elongated (use tg section) 33

26. Ground tissue libriform wood fibres . . . . . *Acer saccharinum* L.
Ground tissue libriform wood fibres and fibre-tracheids 27

27. Ground tissue mainly fibre-tracheids 28
Ground tissue mainly libriform wood fibres 29

28. Average early-wood vessel diameter less than 60 µm . . *Ilex aquifolium* L.
Average early-wood vessel diameter more than 60 µm . . . *Prunus padus* L.

29. Wood rays 1-6-seriate 36
Wood rays 1-6-seriate and more-seriate 30

30. Greatest vessel diameter less than 150 µm 31
Greatest vessel diameter more than 150 µm . . . . . *Broussonetia papyrifera* (L.) Vent.

31. Axial parenchyma in late wood abundant, with dark-coloured contents; often a terminal parenchyma cell layer present of 2 to 3 cells wide . . . . . *Acer saccharum* Marsh. . . . . (syn. of *A. saccharophorum* C. Koch)
Axial parenchyma in late wood absent or scarcely present; if present then without dark-coloured contents 32

32. Wood rays lower than 500 µm . . . . . *Acer platanoides* L.
Wood rays also much higher than 500 µm . . . . . *Acer pseudoplatanus* L.

33. Wood-ray parenchyma cells with much brown contents . . . . . *Ostrya carpinifolia* Scop.
Wood-ray parenchyma cells without or sometimes with some brown con-

tents 34

34. Vessels thin-walled, about 2 µm thick (use cross section); chambered crystalliferous cells absent 35
Vessels thick-walled, about 5 µm (use cross section); chambered crystalliferous cells present . . . . . *Poncirus trifoliata* (L.) Raf.

35. Division walls of vessels with round perforations . . . *Carpinus betulus* L.
Division walls of vessels with scalariform perforations *Corylus avellana* L.

36. Greatest vessel diameter about 270 µm . . . . . *Juglans regia* L.
Greatest vessel diameter about 80 µm . . . . . *Acer campestre* L.

Group VIII – Wood diffuse-porous; pores solitary and in pore multiples or almost all in pore multiples; pore multiples composed of two or more pores, not arranged in typically radial files; growth-ring boundaries clearly visible; wide, aggregate wood rays absent.

1. Wood rays 1-4-seriate 2
Wood rays 1-4-seriate and more-seriate 6

2. Wood rays for the greater part not 1-seriate 3
Wood rays for the greater part 1-seriate 5

3. Pores regularly arranged over the growth ring . *Lonicera periclymenum* L.
Pores, especially in the late wood, usually arranged in radial pore multiples 4

4. In early wood, near the growth-ring boundary, a continuous vessel layer present which is about 4 pores wide . . . . . *Rhamnus utilis Decne* . . . . . (syn. of *R. dahurica* Pall.)
In early wood, near the growth-ring boundary, a discontinuous vessel layer present which is about one pore wide . . . . . *Rhamnus catharticus* L.

5. Wood rays with procumbent margin cells . . . . . *Populus tremula* L.
Wood rays with upright margin cells . . . . . *Salix alba* L.

6. Wood rays less than 4 mm high 7
Wood rays up to 5 mm high or higher . . . . . *Hedera helix* L.

7. Division walls of vessels all with simple perforations or with simple and scalariform perforations 8
Division walls all with scalariform perforations 13

8. Division walls of vessels all with simple perforations 9
Division walls of vessels with simple and scalariform perforations . . . 14

9. Spiral thickenings absent . . . . . *Hedera helix* L.
Spiral thickenings present 10

10. Ground tissue libriform wood fibres with or without fibre-tracheids . . 11
Ground tissue fibre-tracheids; wood rays heterogeneous; wood-ray parenchyma cells short in radial direction, tile cells present; apotracheal parenchyma absent . . . . . *Prunus cerasus* L.
. . . . . *Prunus spinosa* L.

11. Spiral thickenings wide (about 2 μm); ground tissue libriform wood fibres and fibre-tracheids 12
Spiral thickenings narrow (less than 2 μm); ground tissue libriform wood fibres . . . . . *Cercis siliquastrum* L.

12. 4-Seriate wood rays often present . . . . . *Tilia platyphyllos* Scop.
4-Seriate wood rays seldom present . . . . . *Tilia cordata* Mill.

13. Spiral thickenings absent; ground tissue libriform wood fibres . . . . . .
. . . . . *Liriodendron tulipifera* L.
Spiral thickenings present; ground tissue fibre-tracheids . . . . . .
. . . . . *Ilex aquifolium* L.

14. Spiral thickenings absent 15
Spiral thickenings present . . . . . *Lonicera periclymenum* L.

15. Greatest vessel diameter about 40 μm . . . . . *Ilex aquifolium* L.
Greatest vessel diameter about 100 μm 16

16. Wood rays up to 15-seriate; 1-seriate wood rays present . . . . . .
. . . . . *Platanus occidentalis* L.
Wood rays also wider than 15-seriate; 1-seriate wood rays absent or very scarce . . . . . *Platanus orientalis* L.

17. Wood rays less than 90 μm wide (use tg section); pores regularly arranged within the growth ring (use cross section) 18
Wood rays also wider than 90 μm (use tg section); fibre-tracheids areas with pores alternate with libriform wood fibre areas without pores . . . . .
. . . . . *Ulex europaeus* L.

18. Axial parenchyma abundant; maximum wood-ray height more than 1500 μm . . . . . *Tilia platyphyllos* Scop.
Axial parenchyma absent or sparcely present; maximum wood-ray height less than 1500 μm . . . . . *Prunus avium* L.

4.1. Alphabetical arrangement of the treated West-European woods according to genus and species

Between brackets behind scientific name: family; group number of light-microscope key; serial number in hand-lens key. Last column: h = included in hand-lens key, m = included in light-microscope key.

Abies alba Mill. (Pinaceae; group I; 21)	m, h
Abies grandis (Dougl. ex D.Don) Lindl. (Pinaceae; 21)	h
Abies x insignes Carr. ex Bailly (Pinaceae; 21)	h
Acer campestre L. (Aceraceae; gr. VII)	m
Acer negundo L. (Aceraceae; 69,102)	h
Acer palmatum Thunb. (Aceraceae; 69,102,108)	h
Acer platanoides L. (Aceraceae; gr. VII; 69,102)	m, h
Acer pseudoplatanus L. (Aceraceae; gr. VII; 102)	m, h
Acer saccharinum L. (Aceraceae; gr. VII)	m
Acer saccharum Marsh. (syn. of A. saccharophorum C. Koch) (Aceraceae; gr. VII)	m
Aesculus hippocastanum L. (Hippocastanaceae; gr. VII; 107)	m, h
Ailanthus altissima (Mill.) Swingle (syn. A. glandulosa Desf.) (Simaroubaceae; gr. IV; 32)	m, h
Albizia julibrissin Durazz. (Leguminosae-Mim.; gr. IV)	m
Albizia lebbeck (L.) Benth. (Leguminosae-Mim.; gr. II, VII)	m
Albizia procera Benth. (Leguminosae-Mim.; gr. II, VII)	m
Albizia stipulata Boiv. (Leguminosae-Mim.; gr. II, VII)	m
Alnus glutinosa (L.) Gaertn. (Corylaceae; gr. III, VII; 62,110)	m, h
Alnus incana (L.) Moench (Corylaceae; gr. III, VII)	m
Alnus virides (Chaix) DC. (Corylaceae; gr. III, VII)	m
Amelanchier lamarckii F.G. Schroed. (Rosaceae; 89)	h
Amorpha fruticosa L. (Leguminosae-Pap.; gr. IV)	m
Aralia elata (Miq.) Seemann (Araliaceae; 52)	h
Araucaria angustifolia (Bertolini) O.K. (Araucariaceae; gr. I)	m
Araucaria cunninghamii D.Don (Araucariaceae; gr. I)	m
Berberis vulgaris L. (Berberidaceae; 34,54)	h
Betula pendula Roth (syn. B. alba sensu Coste, syn. B. verrucosa Ehrh.) (Corylaceae; gr. VII; 111)	m, h
Betula pubescens Ehrh. (Corylaceae; gr. VII)	m
Bilderdykia aubertii (L.Henry)Moldenke (syn. Polygonum aubertii L.Henry) (Polygonaceae; 33,49)	h
Broussonetia papyrifera (L.) Vent. (Moraceae; gr. IV, VII)	m
Buxus sempervirens L. (Buxaceae; gr. II, VI; 83)	m, h
Calocedrus decurrens (Torr.)Florin (syn. Libocedrus decurrens Torr.) (Cupressaceae; 15)	h
Campsis radicans L.Seem. (Bignoniaceae; gr. IV)	m

Caragana arborescens Lam. (Leguminosae-Pap.; gr. IV, V)	m
Carpinus betulus L. (Corylaceae; gr. III, VII; 60, 96)	m, h
Castanea sativa Mill. (Fagaceae; gr. IV; 42)	m, h
Casuarina equisetifolia L. (Casuarinaceae; gr. II)	m
Catalpa bignonioides Walt. (Bignoniaceae; gr. IV; 40, 43)	m, h
Cedrus atlantica (Endl.) Manetti ex Carr. (Pinaceae; 22)	h
Cedrus deodara (D. Don) G. Don fil. (Pinaceae; 22)	h
Cedrus libani A.Rich. (Pinaceae; gr. I)	m
Celtis australis L. (Ulmaceae; gr. IV; 57)	m, h
Celtis occidentalis L. (Ulmaceae; gr. IV)	m
Celtis sinensis Pers. var.japonica Nak. (Ulmaceae; gr. IV)	m
Cephalotaxus drupacea S. et Z. (syn. of C. harringtonia (Forbes) R. Smith (Cephalotaxaceae; gr. I; 18)	m, h
Cephalotaxus harringtonia (Forbes) R. Smith (Cephalotaxaceae; gr. I; 18)	m, h
Ceratonia siliqua L. (Leguminosae-Caes.; gr. II)	m
Cercidiphyllum japonicum S. et Z. (Cercidiphyllaceae; gr. V, VI; 76, 80)	m, h
Cercis siliquastrum L. (Leguminosae-Caes.; gr. IV, VIII)	m
Chamaecyparis lawsoniana (A. Murr.) Parl. (Cupressaceae; gr. I; 17, 21)	m, h
Chamaecyparis nootkatensis (D.Don) Spach (Cupressaceae; gr. I)	m
Chamaecyparis pisifera (Sieb. et Zucc.) Endl. (Cupressaceae; 13)	h
Citrus aurantium L. (Rutaceae; gr. II)	m
Citrus macroptera Montrous. (Rutaceae; gr. II)	m
Clematis vitalba L. (Ranunculaceae; 30)	h
Cornus mas L. (Cornaceae; gr. VI)	m
Cornus sanguinea L. (Cornaceae; gr. VI)	m
Corylus avellana L. (Corylaceae; gr. III, VII; 61, 106)	m, h
Cotoneaster melanocarpa Lodd. ex C.K. Schneider (syn. of C. niger (Thunb.) Fries) (Rosaceae; gr. VI)	m
Cotoneaster spec. (Rosaceae; 88)	h
Crataegus laevigata (Poir.) DC. (syn. C. oxyacantha L.) (Rosaceae; gr. II, VI; 85)	m, h
Crataegus x lavallei Herincq ex Lavallee (Rosaceae; 85)	h
Crataegus monogyna Jacq. (Rosaceae; gr. II, VI; 85)	m, h
Cryptomeria japonica (L.f.) D.Don (Taxodiaceae; 15)	h
Diospyros ebenum Koenig (Ebenaceae; gr. II)	m
Diospyros horsfieldii Hiern (Ebenaceae; gr. II)	m
Diospyros kaki L. (Ebenaceae; gr. II)	m
Diospyros lotus L. (Ebenaceae; gr. II, VII; 69, 100)	m, h
Dipterohia sinensis Oliv. (Aceraceae; 112)	h
Elaeagnus angustifolia L. (Elaeagnaceae; gr. IV)	m
Ephedra spec. (Ephedraceae; gr. IV, V)	m
Erica arborea L. (Ericaceae; gr. V, VI; 84)	m, h
Eucalyptus globulus Labill. (Myrtaceae; gr. II)	m

Euonymus europaeus L. (Celastraceae, gr. V, VI; 85)	m, h
Euphorbia dendroides L. (Euphorbiaceae; gr. II)	m
Fagus orientalis Lipsky (Fagaceae; gr. V, VI)	m
Fagus sylvatica L. (Fagaceae; gr. V, VI; 64)	m, h
Ficus elastica Roxb. (Moraceae; gr. II)	m
Frangula alnus Mill. (syn. Rhamnus frangula L.)(Rhamnaceae; gr.IV, V, VII; 39)	m, h
Fraxinus americana L. (Oleaceae; gr. IV)	m
Fraxinus excelsior L. (Oleaceae, gr. IV; 41)	m, h
Fraxinus ornus L. (Oleaceae; 41)	h
Ginkgo biloba L. (Ginkgoaceae, gr. I; 19)	m, h
Gleditsia triancanthos L. (Leguminosae-Caes.; gr. IV; 33)	m, h
Gymnocladus dioicus (L.)K.Koch (Leguminosae-Caes.; gr. IV)	m
Hamamelis virginiana L. (Hamamelidaceae; gr. VI)	m
Hedera helix L. (Araliaceae; gr. V, VIII; 64)	m, h
Hibiscus syriacus L. (Malvaceae; gr. III, IV)	m
Hippophae rhamnoides L. (Elaeagnaceae; gr. IV, V)	m
Hydrangea petiolaris Sieb. et Zucc. (Saxifragaceae; 30, 62)	h
Ilex aquifolium L. (Aquifoliaceae; gr. VII, VIII; 104)	m, h
Juglans cineria L. (Juglandaceae; gr. V, VI)	m
Juglans nigra L. (Juglandaceae; gr. V, VI, VII; 67)	m, h
Juglans regia L. (Juglandaceae; gr. V, VII; 97)	m, h
Juniperus communis L. (Cupressaceae; gr. I; 12)	m, h
Juniperus virginiana L. (Cupressaceae; 14)	h
Koelreuteria paniculata Laxm. (Sapindaceae; gr. IV; 48)	m, h
Laburnum anagyroides Med. (Leguminosae-Pap.; 55)	h
Larix decidua Mill. (Pinaceae; gr. I; 4)	m, h
Larix kaempferi (Lamb.) Carr. (Pinaceae; 4)	h
Larix leptolepis (Sieb. et Zucc.) Endl. (syn. of L. kaempferi (Lamb.) Carr.) (Pinaceae; gr. I)	m
Larix spec. (Pinaceae; 4)	h
Ligustrum vulgare L. (Oleaceae; gr. V)	m
Liquidambar styraciflua L. (Hamamelidaceae; gr. VI; 108)	m, h
Liriodendron tulipifera L. (Magnoliaceae; gr. VIII; 77, 103)	m, h
Lonicera caprifolium L. (Caprifoliaceae; gr. V)	m
Lonicera periclymenum L. (Caprifoliaceae; gr. VIII)	m
Magnolia acuminata (L.) L. (Magnoliaceae; gr. VII)	m
Magnolia x soulangeana Soul. (Magnoliaceae; gr. VII; 104)	m, h
Mahonia aquifolium (Pursh) Nutt. (Berberidaceae; gr. II, V)	m
Malus spec. (Rosaceae; 81)	h
Malus sylvestris Mill. (Rosaceae; gr. VI; 75)	m, h
Melia azedarach L. (Meliaceae; gr. IV, V)	m
Mespilus germanica L. (Rosaceae; gr. VI)	m
Morus alba L. (Moraceae; gr. IV)	m
Morus nigra L. (Moraceae; gr. IV)	m

Morus spec. (Moraceae; 51)	h
Myrica gale L. (Myricaceae; gr. V)	m
Myrtus communis L. (Myrtaceae; gr. II)	m
Nerium oleander L. (Apocynaceae; gr. II)	m
Ostrya carpinifolia Scop. (Corylaceae; gr. VII; 110)	m, h
Ostrya virginiana (Mill.) K.Koch (Corylaceae; gr. VII)	m
Parthenocissus quinquefolia (L.) Planch. (Vitaceae; gr. II)	m
Paulownia tomentosa (Thunb.) Steud. (Scrophulariaceae; gr. IV)	m
Phellodendron amurense Rupr. (Rutaceae; 47)	h
Picea abies (L.) Karst. (Pinaceae; gr. I; 5)	m, h
Picea sitchensis (Bong.) Carr. (Pinaceae; gr. I)	m
Pinus nigra Arnold ssp. laricio (Poir.) Maire (Corsican pine) (Pinaceae; 5)	h
Pinus nigra Arnold ssp. nigra (Austrian pine) (Pinaceae; 5)	h
Pinus strobus L. (Pinaceae; 5)	h
Pinus sylvestris L. (Pinaceae; gr. I; 5)	m, h
Platanus occidentalis L. (Platanaceae; gr. VIII)	m
Platanus orientalis L. (Platanaceae; gr. VIII)	m
Platanus spec. (Platanaceae; 63,94)	h
Podocarpus blumei Endl. (Podocarpaceae; gr. I)	m
Poncirus trifoliata (L.) Raf. (Rutaceae; gr. VII)	m
Populus x canadensis Moench (Salicaceae; 113)	h
Populus nigra L. (Salicaceae; gr. VII; 113)	m, h
Populus spec. (Salicaceae; 113)	h
Populus tremula L. (Salicaceae; gr. VII, VIII; 113)	m, h
Prunus avium L. (Rosaceae; gr. VIII; 72, 101)	m, h
Prunus cerasus L. (Rosaceae; gr. VIII)	m
Prunus dulcis (Mill.) D.A.Webb (syn. P. amygdalus Batsch) (Rosaceae; gr. IV, V)	m
Prunus padus L. (Rosaceae; gr. VI, VII; 72, 78, 95, 101)	m, h
Prunus persica (L.) Batsch (Rosaceae; 51, 71)	h
Prunus serotina Ehrh. (Rosaceae; 72, 95, 101)	h
Prunus spinosa L. (Rosaceae; gr. V, VIII; 51)	m, h
Pseudotsuga menziesii (Mirb.) Franco (syn. P. taxifolia Britt.) (Pinaceae; gr. I; 4)	m, h
Punica granatum L. (Punicaceae; gr. II, VII)	m
Pyracantha coccinea M.J.Roem. (Rosaceae; 73, 88)	h
Pyrus amygdaliformis Vill. (Rosaceae; 86)	h
Pyrus communis L. (Rosaceae; gr. VI; 86)	m, h
Pyrus spec. (Rosaceae; 86)	h
Quercus ilex L. (Fagaceae; gr. III, VI)	m
Quercus petraea (Mattuschka) Liebl. (Fagaceae; gr. III, IV; 28)	m, h
Quercus robur L. (Fagaceae; gr. III, IV; 28)	m, h
Quercus rubra L. (syn. Q. borealis Michx)(Fagaceae; gr. III, IV; 28)	m, h
Rhamnus catharticus L. (Rhamnaceae; gr. VIII)	m

Rhamnus frangula L. (syn. of Frangula alnus Mill.) (Rhamnaceae; gr. IV, V, VII; 39)	m, h
Rhamnus utilis Decne (syn. of R. dahurica Pall.) (Rhamnaceae; gr. VIII; 92)	m, h
Rhododendron ferrugineum L. (Ericaceae; gr. VI)	m
Rhododendron spec. (Ericaceae; 73)	h
Rhus typhina L. (Anacardiaceae; gr. IV)	m
Robinia pseudo-acacia L. (Leguminosae-Pap.; gr. IV; 43, 45)	m, h
Rosa canina L. (Rosaceae; gr. III, IV, V)	m
Salix alba L. (Salicaceae; gr. VII, VIII; 113)	m, h
Salix caprea L. (Salicaceae; gr. VII)	m
Salix spec. (Salicaceae; 77, 113)	h
Sambucus nigra L. (Caprifoliaceae; 101)	h
Sambucus racemosa L. (Caprifoliaceae; 101)	h
Sarothamnus scoparius (L.)Wimm. ex Koch (syn. of Cytisus scoparius (L.) Link) (Leguminosae-Pap.; 35, 56, 93)	h
Sciadopitys verticillata (Thunb.) S. et Z. (Taxodiaceae; gr. I; 12)	m, h
Sequoia sempervirens (D.Don) Endl. (Taxodiaceae; gr. I; 7)	m, h
Sequoiadendron giganteum (Lindl.) Buchholz (Taxodiaceae; 7)	h
Sophora japonica L. (Leguminosae-Pap.; gr. IV; 49)	m, h
Sorbus aria (L.) Crantz (Rosaceae; gr. VI)	m
Sorbus aucuparia L. (Rosaceae; gr. V, VI; 80)	m, h
Sorbus intermedia (Ehrh.)Pers. (Rosaceae; 80)	h
Sorbus spec. (Rosaceae; 80)	h
Staphylea colchica Stev. (Staphyleaceae; gr. VI)	m
Syringa vulgaris L. (Oleaceae; gr. IV; 39)	m, h
Tamarix gallica L. (Tamaricaceae; gr. IV)	m
Taxodium distichum (L.) A.Rich. (Taxodiaceae; gr. I)	m
Taxus baccata L. (Taxaceae; gr. I; 8)	m, h
Taxus brevifolia Nutt. (Taxaceae; gr. I)	m
Taxus wallichiana Zucc. (Taxaceae; gr. I)	m
Thuja occidentalis L. (Cupressaceae; gr. I; 11)	m, h
Thuja orientalis L. (Cupressaceae; gr. I)	m
Tilia americana L. (Tiliaceae; gr. VIII)	m
Tilia cordata Mill. (Tiliaceae; gr. VIII; 95)	m, h
Tilea x euchlora K.Koch (Tiliaceae; 95)	h
Tilea europaea L. (syn. of T. x vulgaris Hayne) (Tiliaceae; 95)	h
Tilia platyphyllos Scop. (Tiliaceae; gr. VIII)	m
Torreya grandis Fort. (Taxaceae; gr. I)	m
Torreya nucifera S. et Z. (Taxaceae; gr. I)	m
Tsuga canadensis (L.) Carr. (Pinaceae; gr. I)	m
Tsuga diversifolia (Maxim.) Mast. (Pinaceae; gr. I)	m
Tsuga heterophylla (Raf.) Sarg. (Pinaceae; gr. I; 10, 22)	m, h
Tsuga sieboldii Carr. (Pinaceae; gr. I)	m
Ulex europaeus L. (Leguminosae-Pap.; gr. VIII; 35, 56, 93)	m, h

Ulmus americana L. (Ulmaceae; gr. IV)	m
Ulmus carpinifolia G. Suckow (syn. of U. minor Mill.) (Ulmaceae; gr. IV)	m
Ulmus glabra Huds. (Ulmaceae; gr. IV)	m
Ulmus laevis Pall. (Ulmaceae; gr. IV)	m
Ulmus minor Mill. (Ulmaceae; 57)	h
Ulmus spec. (Ulmaceae; 57)	h
Vaccinium corymbosum L. (Ericaceae; gr. VI)	m
Vaccinium myrtillus L. (Ericaceae; gr. V, VI)	m
Vaccinium vitis-idaea L. (Ericaceae; gr. V)	m
Viburnum lantana L. (Caprifoliaceae; gr. V, VI)	m
Viburnum opulus L. (Caprifoliaceae; gr. VI; 89)	m, h
Vitex agnus-castus L. (Verbenaceae; gr. II)	m
Vitis vinifera L. (Vitaceae; gr. IV; 27)	m, h
Weigela florida (Bunge) A.DC. (Caprifoliaceae; gr. VI)	m
Wisteria sinensis (Sims) Sw. (Leguminosae-Pap.; gr. II, VI; 24, 67)	m, h
Zelkova carpinifolia (Pall.) K.Koch (Ulmaceae; gr. IV; 47)	m, h
Zelkova serrata (Thunb.) Mak. (Ulmaceae; gr. IV)	m
Zizyphus jujuba Lam. (Rhamnaceae; gr. II)	m

4.2. Alphabetical arrangement of the treated West-European woods according to family

Last column: h = included in hand-lens key, m = included in light-microscope key.

Aceraceae	
Acer campestre L.	m
Acer negundo L.	h
Acer palmatum Thunb.	h
Acer platanoides L.	m, h
Acer pseudoplatanus L.	m, h
Acer saccharinum L.	m
Acer saccharum Marsh. (syn. of A. saccharophorum C. Koch)	m
Dipteronia sinensis Oliv.	h
Anacardiaceae	
Rhus typhina L.	m
Apocynaceae	
Nerium oleander L.	m
Aquifoliaceae	
Ilex aquifolium L.	m, h
Araliaceae	
Aralia elata (Miq.) Seemann	h

Hedera helix L.	m, h
Araucariaceae	
Araucaria angustifolia (Bertoloni) O.K.	m
Araucaria cunninghamii D.Don	m
Berberidaceae	
Berberis vulgaris L.	h
Mahonia aquifolium (Pursh) Nutt.	m
Betulaceae. See *Corylaceae*	
Bignoniaceae	
Campsis radicans (L.) Seem.	m
Catalpa bignonioides Walt.	m, h
Buxaceae	
Buxus sempervirens L.	m, h
Caesalpiniaceae. See *Leguminosae-Caesalpinioideae*	
Caprifoliaceae	
Lonicera caprifolium L.	m
Lonicera periclymenum L.	m
Sambucus nigra L.	h
Sambucus racemosa L.	h
Viburnum lantana L.	m
Viburnum opulus L.	m, h
Weigela florida (Bunge) A.DC.	m
Casuarinaceae	
Casuarina equisetifolia L.	m
Celastraceae	
Euonymus europaeus L.	m, h
Cephalotaxaceae	
Cephalotaxus drupacea S. et Z. (syn. of C. harringtonia (Forbes) R. Smith	m, h
Cephalotaxus harringtonia (Forbes) R. Smith	m, h
Cercidiphyllaceae	
Cercidiphyllum japonicum S. et Z.	m
Cornaceae	
Cornus mas L.	m
Cornus sanguinea L.	m
Corylaceae	
Alnus glutinosa (L.) Gaertn.	m, h
Alnus incana (L.) Moench	m
Alnus virides (Chaix) DC.	m
Betula pendula Roth (syn. B. alba sensu Coste, syn. B. verrucosa Ehrh.)	m, h
Betula pubescens Ehrh.	m
Carpinus betulus L.	m, h
Corylus avellana L.	m, h
Ostrya carpinifolia Scop.	m, h
Ostrya virginiana (Mill.) K.Koch	m

Cupressaceae	
Calocedrus decurrens (Torr.) Florin (syn. Libocedrus decurrens Torr.)	h
Chamaecyparis lawsoniana (A.Murr.) Parl.	m, h
Chamaecyparis nootkatensis (D.Don) Spach	m
Chamaecyparis pisifera (S. et Z.) Endl.	h
Juniperus communis L.	m, h
Juniperus virginiana L.	h
Thuja occidentalis L.	m, h
Thuja orientalis L.	m
Ebenaceae	
Diospyros ebenum Koenig	m
Diospyros horsfieldii Hiern	m
Diospyros kaki L.	m
Diospyros lotus L.	m, h
Elaeagnaceae	
Elaeagnus angustifolia L.	m
Hippophae rhamnoides L.	m
Ephedraceae	
Ephedra spec.	m
Ericaceae	
Erica arborea L.	m, h
Rhododendron ferrugineum L.	m
Rhododendron spec.	h
Vaccinium corymbosum L.	m
Vaccinium myrtillus L.	m
Vaccinium vitis-idaea L.	m
Euphorbiaceae	
Euphorbia dendroides L.	m
Fagaceae	
Castanea sativa Mill.	m, h
Fagus orientalis Lipsky	m
Fagus sylvatica L.	m, h
Quercus ilex L.	m
Quercus petraea (Mattuschka) Liebl.	m, h
Quercus robur L.	m, h
Quercus rubra L. (syn. Q. borealis Michx)	m, h
Ginkgoaceae	
Ginkgo biloba L.	m, h
Hamamelidaceae	
Hamamelis virginiana L.	m
Liquidambar styraciflua L.	m, h
Hippocastanaceae	
Aesculus hippocastanum L.	m, h
Juglandaceae	
Juglans cineria L.	m

Juglans nigra L.	m, h
Juglans regia L.	m, h
Leguminosae-Caesalpinioideae	
Ceratonia siliqua L.	m
Cercis siliquastrum L.	m
Gleditsia triacanthos L.	m, h
Gymnocladus dioicus (L.) K. Koch	m
Leguminosae-Mimosoideae	
Albizia julibrissin Durazz.	m
Albizia lebbeck (L.) Benth.	m
Albizia procera Benth.	m
Albizia stipulata Boiv.	m
Leguminosae-Papilionoideae	
Amorpha fruticosa L.	m
Caragana arborescens Lam.	m
Laburnum anagyroides Med.	h
Robinia pseudo-acacia L.	m, h
Sarothamnus scoparius (L.) Wimm. ex Koch (syn. of Cytisus scoparius (L.) Link)	h
Sophora japonica L.	m, h
Ulex europaeus L.	m, h
Wisteria sinensis (Sims) Sw.	m, h
Magnoliaceae	
Liriodendron tulipifera L.	m, h
Magnolia acuminata (L.) L.	m
Magnolia x soulangeana Soul.	m, h
Malvaceae	
Hibiscus syriacus L.	m
Meliaceae	
Melia azedarach L.	m
Mimosaceae. See *Leguminosae-Mimosoideae*	
Moraceae	
Broussonetia papyrifera (L.) Vent.	m
Ficus elastica Roxb.	m
Morus alba L.	m
Morus nigra L.	m
Morus spec.	h
Myricaceae	
Myrica gale L.	m
Myrtaceae	
Eucalyptus globulus Labill.	m
Myrtus communis L.	m
Oleaceae	
Fraxinus americana L.	m
Fraxinus excelsior L.	m, h

Fraxinus ornus L.	h
Ligustrum vulgare L.	m
Syringa vulgaris L.	m, h
Papilionaceae. See *Leguminosae-Papilionoideae*	
Pinaceae	
Abies alba Mill.	m, h
Abies grandis (Dougl. ex D.Don) Lindl.	h
Abies x insignis Carr. ex Bailly	h
Cedrus atlantica (Endl.) Manetti ex Carr.	h
Cedrus deodara (D. Don) G. Don fil.	h
Cedrus libani A.Rich.	m
Larix decidua Mill.	m, h
Larix kaempferi (Lamb.) Carr.	h
Larix leptolepis (Sieb. et Zucc.) Endl. (syn. of L. kaempferi (Lamb.) Carr.)	m
Larix spec.	h
Picea abies (L.) Karst.	m, h
Picea sitchensis (Bong.) Carr.	m
Pinus nigra Arnold ssp. laricio (Poir.) Maire (Corsican pine)	h
Pinus nigra Arnold ssp. nigra (Austrian pine)	h
Pinus strobus L.	h
Pinus sylvestris L.	m, h
Pseudotsuga menziesii (Mirb.) Franco (syn. P. taxifolia Britt.)	m, h
Tsuga canadensis (L.) Carr.	m
Tsuga diversifolia (Maxim.) Mast.	m
Tsuga heterophylla (Raf.) Sarg.	m, h
Tsuga sieboldii Carr.	m
Platanaceae	
Platanus occidentalis L.	m
Platanus orientalis L.	m
Platanus spec.	h
Podocarpaceae	
Podocarpus blumei Endl.	m
Polygonaceae	
Bilderdykia aubertii (L.Henry) Moldenke (syn. Polygonum aubertii L.Henry)	h
Punicaceae	
Punica granatum L.	m
Ranunculaceae	
Clematis vitalba L.	h
Rhamnaceae	
Frangula alnus Mill. (syn. Rhamnus frangula L.)	m, h
Rhamnus catharticus L.	m
Rhamnus frangula L. (syn. of Frangula alnus Mill.)	m
Rhamnus utilis Decne (syn. of R. dahurica Pall.)	m, h

Zizyphus jujuba Lam.	m
Rosaceae	
Amelanchier lamarckii F.G.Schroed.	h
Cotoneaster melanocarpa Lodd. ex C.K. Schneider (syn. of C. niger (Thunb.) Fries)	m
Cotoneaster spec.	h
Crataegus laevigata (Poir.) DC. (syn. C. oxyacantha L.)	m, h
Crataegus x lavallei Herincq ex Lavallee	h
Crataegus monogyna Jacq.	m, h
Malus spec.	h
Malus sylvestris Mill.	m, h
Mespilus germanica L.	m
Prunus avium L.	m, h
Prunus cerasus L.	m
Prunus dulcis (Mill.) D.A.Webb (syn. P. amygdalus Batsch)	m
Prunus padus L.	m, h
Prunus persica (L.) Batsch	h
Prunus serotina Ehrh.	h
Prunus spinosa L.	m, h
Pyracantha coccinea M.J.Roem.	h
Pyrus amygdaliformis Vill.	h
Pyrus communis L.	m, h
Pyrus spec.	h
Rosa canina L.	m
Sorbus aria (L.) Crantz	m
Sorbus aucuparia L.	m, h
Sorbus intermedia (Ehrh.) Pers.	h
Sorbus spec.	h
Rutaceae	
Citrus aurantium L.	m
Citrus macroptera Montrous.	m
Phellodendron amurense Rupr.	h
Poncirus trifoliata (L.) Raf.	m
Salicaceae	
Populus x canadensis Moench	h
Populus nigra L.	m, h
Populus spec.	h
Populus tremula L.	m, h
Salix alba L.	m, h
Salix caprea L.	m
Salix spec.	h
Sapindaceae	
Koelreuteria paniculata Laxm.	m, h
Saxifragaceae	
Hydrangea petiolaris Sieb. et Zucc.	h

Scrophulariaceae	
Paulownia tomentosa (Thunb.) Steud.	m
Simaroubaceae	
Ailanthus altissima (Mill.) Swingle (syn. A. glandulosa Desf.)	m, h
Staphyleaceae	
Staphylea colchica Stev.	m
Tamaricaceae	
Tamarix gallica L.	m
Taxaceae	
Taxus baccata L.	m, h
Taxus brevifolia Nutt.	m
Taxus wallichiana Zucc.	m
Torreya grandis Fort.	m
Torreya nucifera S. et Z.	m
Taxodiaceae	
Cryptomeria japonica (L.f.) D.Don	h
Sciadopitys verticillata (Thunb.) S. et Z.	m, h
Sequoia sempervirens (D.Don) Endl.	m, h
Sequoiadendron giganteum (Lindl.) Buchholz	h
Taxodium distichum (L.) A.Rich.	m
Tiliaceae	
Tilia americana L.	m
Tilia cordata Mill.	m, h
Tilia x euchlora K.Koch	h
Tilia europaea L. (syn. of T. x vulgaris Hayne)	h
Tilia platyphyllos Scop.	m
Ulmaceae	
Celtis australis L.	m, h
Celtis occidentalis L.	m
Celtis sinensis Pers. var. japonica Nak.	m
Ulmus americana L.	m
Ulmus carpinifolia G. Suckow (syn. of U. minor Mill.)	m
Ulmus glabra Huds.	m
Ulmus laevis Pall.	m
Ulmus minor Mill.	h
Ulmus spec.	h
Zelkova carpinifolia (Pall.) K.Koch	m, h
Zelkova serrata (Thunb.) Mak.	m
Verbenaceae	
Vitex agnus-castus L.	m
Vitaceae	
Parthenocissus quinquefolia (L.) Planch.	m
Vitis vinifera L.	m, h

5. Determination key B for the most important West-European woods, with the help of a hand – lens (10x)

1. Vessels absent (Gymnospermae; softwood) 2
   Vessels present (Angiospermae; hardwood) 23

2. Resin ducts present 3
   Resin ducts absent 6

3. Resin ducts all or for the greater part in the late wood (sometimes also against the growth-ring boundary in early wood) 4
   Resin ducts not all or for the greater part in the late wood 5

4. Width early-wood zone slightly wider or equal to the width of the late-wood zone; resin ducts usually solitary . . *Pseudotsuga menziesii* (Mirb.) Franco
   Width early-wood zone 2-3 times larger than that of the late-wood zone; resin ducts often in groups . . . . . *Larix decidua* Mill.
   . . . . . *Larix kaempferi* (Lamb.) Carr.
   . . . . . *Larix spec.*

5. Average diameter resin ducts about 50 µm; on radial surface a slight difference in colour between early- and late wood . . . . *Picea abies* (L.) Karst.
   Average diameter resin ducts about 100 µm; on radial surface a large difference in colour between early- and late wood . . . . . *Pinus sylvestris* L.
   . . . . . *Pinus strobus* L.
   . . . . . *Pinus nigra* Arnold ssp. *nigra*
   . . . . . *Pinus nigra* Arnold ssp. *laricio* (Poir.) Maire

6. Wood rather dark brown to light purple-pink and/or heart- and sapwood different in colour 7
   Wood yellowish-white to light brown; heart- and sapwood without difference in colour 16

7. Heartwood or heart- and sapwood dark red-brown; density about 350 kg per cubic m (at a moisture content of about 15 percent) . . . . . .
   . . . . . *Sequoia sempervirens* (D.Don) Endl.
   . . . . . *Sequoiadendron giganteum* (Lindl.) Buchholz
   Heart- and sapwood with a lighter colour; density higher 8

8. Density more than 750 kg per cubic m (at a moisture content of 15 percent)
   . . . . . *Taxus baccata* L.
   Density less than 750 kg per cubic m 9

9. Heart- and sapwood or only the heartwood brown 10

Heart- and sapwood or only the heartwood violet 13

10. Greatest early-wood tracheid diameter about 30 µm . . . . . *Tsuga heterophylla* (Raf.) Sarg.
Greatest early-wood tracheid diameter much less 11

11. Heartwood composed of different coloured tg bands, arranged independently from the growth rings . . . . . *Thuja occidentalis* L.
Not so 12

12. Axial parenchyma absent . . . *Sciadopitys verticillata* (Thunb.) Sieb. et Zucc.
Axial parenchyma present . . . . . *Juniperus communis* L.

13. Terminal parenchyma cells often with brown contents (use rd surface) . . . . . *Chamaecyparis pisifera* (Sieb. et Zucc.) Endl.
Terminal parenchyma cells sometimes with brown contents or entirely absent (use rd surface) 14

14. Rays in heartwood dark purple-violet to gold-brown and darker coloured than the ground tissue . . . . . *Juniperus virginiana* L.
Not so 15

15. Tg zone late-wood tracheids near the growth-ring boundary in which tracheid lumina are not or hardly visible with a 10 x lens, less than 10 tracheids wide; heartwood hardly darker coloured than the sapwood . . . . . *Calocedrus decurrens* (Torr.) Florin
Tg zone late-wood tracheids near the growth-ring boundary in which tracheid lumina are not or hardly visible with a 10x lens, on the average more than 10 tracheids wide; heartwood much darker coloured than the sapwood . . . . . *Cryptomeria japonica* (L.f.) D.Don

16. Greatest early-wood tracheid diameter much less than 20 µm; lumina not or hardly visible with a 10x lens 17
Greatest early-wood tracheid diameter 20 µm or more; lumina clearly visible with a 10x lens 19

17. On rd surface no difference in colour between wood rays and ground tissue . . . . . *Chamaecyparis lawsoniana* (A.Murr.) Parl.
On rd surface a difference in colour present between wood rays and ground tissue 18

18. Axial parenchyma regularly with brown contents . . . . . *Cephalotaxus drupacea* Sieb. et Zucc. . . . . (syn of *C. harringtonia* (Forbes) R. Smith)
Axial parenchyma nearly always without brown contents . . . . . .

. . . . . *Cephalotaxus harringtonia* (Forbes) R. Smith

19. Some tracheids with white contents . . . . . .*Ginkgo biloba* L.
Not so 20

20. Wood rays and ground tissue with the same colour (use rd surface) . . . 21
Wood rays darker coloured than the ground tissue (use rd surface) . . . 22

21. Axial parenchyma regularly with brown contents . . . . . .
. . . . . *Chamaecyparis lawsoniana* (A. Murr.) Parl.
Axial parenchyma absent or very scanty . . . . . .
. . . . . *Abies grandis* (Dougl. ex D.Don) Lindl.
. . . . . *Abies x insignes* Carr. ex Bailly
. . . . . *Abies alba* Mill.

22. Height high wood rays about 700-800 µm . . . . . .
. . . . . *Cedrus atlantica* (Endl.) Manetti ex Carr.
. . . . . *Cedrus deodara* (D. Don) G. Don fil.
Height high wood rays about 400 µm . . . .*Tsuga heterophylla* (Raf.) Sarg.

23. Wood ring-porous or semi-ring-porous 24
Wood diffuse-porous 58

24. Included phloem present . . . . . *Wisteria sinensis* (Sims) Sweet
Included phloem absent 25

25. Wood ray width more than 100 µm 26
Wood ray width less than 100 µm 36

26. Pores in late wood arranged in radial bands 27
Pores in late wood not arranged in radial bands 29

27. Pores in late wood in radial pore multiples; banded parenchyma absent; most wood rays wide . . . . . *Vitis vinifera* L.
Pores in late wood solitary; banded parenchyma present; most wood rays narrow 28

28. Large pores in early wood forming a tg layer of about two vessel-diameters wide; early-wood vessels in heartwood often with tyloses; wood yellow-brown . . . . . *Quercus robur* L.
. . . . . *Quercus petraea* (Mattuschka) Liebl.
Large vessels in early wood forming a wider tg layer; early-wood vessels in the heartwood often without tyloses; wood red-brown . . . . . .
. . . . . *Quercus rubra* L.

29. Greatest wood ray width about 400 µm 30
Greatest wood ray width much smaller 31

30. Vessel diameter more than 200 µm; division walls of vessels only with simple perforations . . . . . *Clematis vitalba* L.
Vessel diameter less than 100 µm; division walls of vessels also with scalariform perforations . . . . . *Hydrangea petiolaris* Sieb. et Zucc.

31. Greatest wood ray width about 200 µm; pore bands in the late wood not forming a network 32
Greatest wood ray width about 100 µm; pore bands in the late wood forming a network 34

32. Within one growth ring a sharp transition in pore diameter from early – to late wood; large early-wood vessels forming a tg zone of 1-3 vessel diameters wide . . . . . *Ailanthus altissima* (Mill.) Swingle
Within one growth ring a gradual change in pore diameter from early – to late wood; large early-wood vessels forming a tg zone of 3 or more vessel diameters wide 33

33. Terminal layer of small pores absent . . . . . *Bilderdykia aubertii* (L. Henry) Moldenke
Terminal layer of small pores present . . . . . *Gleditsia triacanthos* L.

34. Early-wood zone with large pores about 1 vessel diameter wide; bands late-wood pores about 50 µm wide, forming a network; wood yellow-green . . . . . *Berberis vulgaris* L.
Early-wood zone with large pores 3 or more vessel diameters wide; bands late-wood pores about 100 µm wide or more, forming a network 35

35. Bands late-wood pores forming a network, about 100 µm wide . . . . . *Sarothamnus scoparius* (L.) Wimm. ex Koch . . . . . (syn. of *Cytisus scoparius* (L.) Link)
Bands late-wood pores forming a network, about 200 µm wide . . . . . *Ulex europaeus* L.

36. Wood rays not or hardly visible with the unaided eye (less than 50 µm) . 37
Wood rays clearly visible with the unaided eye (more than 50 µm) . . . 44

37. Late-wood pores scattered or arranged in small groups 38
Late-wood pores arranged in diagonal or tg bands 42

38. Diameter early-wood vessels smaller than 100 µm 39
Diameter early-wood vessels larger than 100 µm 40

39. Vessels 60 or more to the square mm; radial pore multiples composed of 4 pores absent . . . . . *Syringa vulgaris* L.
Vessels less than 60 to the square mm; radial pore multiples composed of 4 pores present . . . . . *Frangula alnus* Mill.

40. Ground tissue late wood dark brown; diameter late-wood vessels slightly smaller than those of early-wood vessels . . . . *Catalpa bignonioides* Walt.
Ground tissue late wood light brown; diameter late-wood vessels much smaller than those of early-wood vessels 41

41. Vasicentric parenchyma sheath around the late-wood vessels 1 cell wide . . . . . *Fraxinus excelsior* L.
Vasicentric parenchyma sheath around the late-wood vessels often more than 1 cell wide, sometimes extending into aliform- and confluent parenchyma . . . . . *Fraxinus ornus* L.

42. About 80 wood rays to the tg cm (use cross surface) . . *Castanea sativa* Mill.
About 40 wood rays to the tg cm (use cross surface) 43

43. Density about 800 kg per cubic m (at a moisture content of about 15 percent); tg pore multiples present all over the late-wood area . . . . . *Robinia pseudo-acacia* L.
Density about 500 kg per cubic m (at a moisture content of about 15 percent); tg pore multiples only present in the last formed late wood . . . . . *Catalpa bignonioides* Walt.

44. Diameter late-wood vessels more than 100 µm 45
(36) Diameter late-wood vessels 100 µm or less 50

45. Pores all or for the greater part with tyloses . . . *Robinia pseudo-acacia* L.
Pores not all or for the greater part with tyloses 46

46. Long tg pore groups in late wood regularly present 47
Long tg pore groups in the late wood absent or sporadically present . . 48

47. Wood rays on cross surface often ending blind, width about 60 µm . . . . . *Phellodendron amurense* Rupr.
Wood rays on cross surface not or hardly ending blind, witdh about 100 µm . . . . . *Zelkova carpinifolia* (Pall.) K.Koch

48. Late-wood pores usually arranged in groups . . . . . *Koelreuteria paniculata* Laxm.
Late-wood pores often arranged more evenly 49

49. Greatest diameter early-wood vessel about 200 µm; aliform parenchyma in late wood present; a conspicious difference in colour between heart- and

sapwood . . . . . *Sophora japonica* L.
Greatest diameter early-wood vessel also more than 200 µm; aliform parenchyma in late wood absent; no difference in colour between heart- and sapwood . . . . . *Bilderdykia aubertii* (L.Henry) Moldenke

50. Tg pore multiples absent or sporadically present 51
(44) Tg pore multiples abundantly present 52

51. Diameter early-wood vessels 100 µm or more; vessels often with tyloses or white substance; wood dark brown . . . . . *Morus spec.*
Diameter early-wood vessels less than 100 µm; vessels without tyloses; wood light brown . . . . . *Prunus spinosa* L.
. . . . . *Prunus persica* (L.) Batsch

52. Within one growth ring a gradual change in vessel diameter going from early- to late wood . . . . . *Aralia elata* (Miq.) Seemann
Within one growth ring an abrupt change in vessel diameter going from early- to late wood 53

53. Diameter early-wood vessels about 100 µm or less 54
Diameter early-wood vessels about 200 µm 57

54. Early-wood zone with large pores, one pore diameter wide; wood yellow-green . . . . . *Berberis vulgaris* L.
Early-wood zone with large pores, 3 or more pore diameters wide . . . 55

55. Diameter early-wood vessels about 100 µm . *Laburnum anagyroides* Med.
Diameter early-wood vessels about 50 µm 56

56. Bands late-wood pores of about 100 µm wide, forming a network . . . . .
. . . . . *Sarothamnus scoparius (L.)* Wimm. ex Koch
. . . . . (syn. of *Cytisus scoparius* (L.) Link)
Bands late-wood pores of about 200 µm wide, forming a network . . . . .
. . . . . *Ulex europaeus* L.

57. Early-wood zone with large pores, often more than 2 pore diameters wide; tyloses abundant; heart-wood vessels with orange-brown contents absent
. . . . . *Ulmus minor* Mill.
. . . . . *Ulmus spec.*
Early-wood zone with large pores, seldom more than 2 diameters wide; tyloses not abundant; heart-wood vessels with orange-brown contents present
. . . . . *Celtis australis* L.

58. Wide wood rays (aggregate wood rays or not) of more than 200 µm wide,
(23) present 59
Wide wood rays (aggregate wood rays or not) of more than 200 µm wide,

absent 65

59. Wide wood rays are aggregate wood rays; pores for the greater part in pore multiples; radial pore multiples composed of 3 or more pores regularly present 60
Wide wood rays are not aggregate wood rays; pores for the greater part solitary; radial pore multiples composed of 3 or more pores present in a small number 63

60. Radial pore multiples composed of more than 4 pores absent or present in a small number; growth-ring boundary in a wide aggregate wood ray, often strongly bent inwards (indented) (use cross surface); division walls of vessels with simple perforations . . . . . *Carpinus betulus* L.
Radial pore multiples composed of more than 4 pores regularly present; growth-ring boundary in a wide aggregate wood ray not or hardly bent inwards (not indented) (use cross surface); division walls of vessels with scalariform perforations 61

61. Aggregate wood rays arranged regularly with about equal tg distances between them . . . . . *Corylus avellana* L.
Aggregate wood rays present in a small number, arranged irregularly, with variable distances between them 62

62. Wood rays, aggregate ones excluded, usually about 100 µm wide . . . . . *Hydrangea petiolaris* Sieb. et Zucc.
Wood rays, aggregate ones excluded, usually about 30 µm wide . . . . . *Alnus glutinosa* (L.) Gaertn.

63. All wood rays wide; division walls of vessels predominantly with scalariform perforations . . . . . *Platanus spec.*
Besides wide wood rays also very narrow ones present; divison walls of vessels predominantly with simple perforations 64

64. In late wood, pores often arranged in tg bands . . . . . *Hedera helix* L.
In late wood, pores not arranged in tg bands . . . . . *Fagus sylvatica* L.

65. Pores solitary or for the greater part solitary 66
(58) Pores not solitary or for the greater part solitary 90

66. Vessel diameter about 200 µm or more 67
Vessel diameter much less than 200 µm 68

67. Wood dark brown; vessel diameter about 200 µm; many thin metatracheal parenchyma bands; ground-tissue abundant; included phloem absent . . . . . *Juglans nigra* L.

Wood yellowish; vessel diameter about 300 μm; ground tissue hardly present; included phloem (concentric type) present . . . . . *Wisteria sinensis* (Sims) Sweet

68. Less than 40 vessels to the square mm 69
    More than 40 vessels to the square mm 70

69. Vessel diameter about 50 μm; more than 20 vessels to the square mm; wood light brown . . . . . *Acer negundo* L.
    . . . . . *Acer platanoides* L.
    . . . . . *Acer palmatum* Thunb.
    Vessel diameter 80-100 μm; less than 20 vessels to the square mm; wood red-brown to black . . . . . *Diospyros lotus* L.

70. Early wood marked by a very obvious accumulation of vessels or by a row of united somewhat wider vessels near the growth-ring boundary . . . 71
    Such an accumulation or row of united vessels in the early wood absent 74

71. Vessels in early wood much wider than those in late wood, almost ring-porous . . . . . *Prunus persica* (L.) Batsch
    Vessels in early wood not or slightly wider than those in late wood . . . 72

72. Early-wood vessel diameter 50 μm or more . . . . . *Prunus padus* L.
    . . . . . *Prunus avium* L.
    . . . . . *Prunus serotina* Ehrh.
    Early-wood vessel diameter less than 50 μm 73

73. Wood ray width 30-50 μm . . . . . *Rhododendron spec.*
    Wood ray width less than 30 μm . . . . . *Pyracantha coccinea* M.J.Roem.

74. Greatest vessel diameter 50 μm or more 75
    Greatest vessel diameter less than 50 μm 78

75. Wood ray width about 50 μm . . . . . *Malus sylvestris* Mill.
    Wood ray width about 30 μm 76

76. Greatest vessel diameter about 50 μm; terminal (initial) parenchyma absent; division walls of vessels with scalariform perforations . . . . . *Cercidiphyllum japonicum* Sieb. et Zucc.
    Greatest vessel diameter more than 50 μm; terminal (initial) parenchyma present; division walls of vessels with simple and scalariform perforations . . 77

77. About 5 wood rays to the square mm (use tg surfase); division walls of vessels with scalariform perforations . . . . . *Liriodendron tulipifera* L.

About 9 wood rays to the square mm (use tg surfase); division walls of vessels with simple perforations . . . . . *Salix spec.*

78. Radial pore multiples composed of 3 or more pores, present; heartwood dark coloured . . . . . *Prunus padus* L.
Radial pore multiples composed of 3 or more pores, absent 79

79. Density about 500 kg per cubic m (at a moisture content of about 15 percent) 80
Density 800 kg per cubic m or more (at a moisture content of about 15 percent) 81

80. Growth-ring boundaries pronounced, marked among other things by more or somewhat wider vessels in the early wood . . . . . *Sorbus aucuparia* L.
. . . . . *Sorbus intermedia* (Ehrh.) Pers.
. . . . . *Sorbus spec.*
Growth-ring boundaries not pronounced, almost no difference in early- and late wood vessel diameter . . *Cercidiphyllum japonicum* Sieb. et Zucc.

81. Heartwood distinctly visible; wood red-brown . . . . . *Malus spec.*
Heartwood not distinctly visible 82

82. Greatest vessel diameter less than 30 µm 83
Greatest vessel diameter about 30 µm 86

83. Density more than 1000 kg per cubic m (at a moisture content of about 15 percent); vessel diameter very small, almost not visible . . . . . .
. . . . . *Buxus sempervirens* L.
Density less than 1000 kg per cubic m; vessel diameter larger, clearly distinguishable 84

84. Width wood rays about 50 µm, circa 5 per tg mm . . . . . *Erica arborea* L.
Width wood rays about 30 µm, circa 10 per tg mm 85

85. Wood pink to light brown . . . . . *Crataegus monogyna* Jacq.
. . . . . *Crataegus x lavallei* Her. ex Lav.
. . . . . *Crataegus laevigata* (Poir.) DC.
Wood yellowish-white . . . . . *Euonymus europaeus* L.

86. Wood rays darker coloured than the ground tissue (use rd or tg surface) . .
. . . . . *Pyrus communis* L.
. . . . . *Pyrus amygdaliformis* Vill.
. . . . . *Pyrus spec.*
Wood rays not or hardly darker coloured than the ground tissue (use rd or tg surface) 87

87. Pith flecks always present 88
Pith flecks usually not present 89

88. Pith light brown . . . . . *Pyracantha coccinea* M.J.Roem.
Pith dark brown to black . . . . . *Cotoneaster spec.*

89. Number and diameter of vessels gradually diminishing from early- to late wood; growth-ring boundary not lighter coloured than ground tissue; pith light brown . . . . . *Amelanchier lamarckii* F.G. Schroed.
Number and diameter of vessels about equal in early- and late wood; growth-ring boundary lighter coloured than ground tissue; pith white . . . . . *Viburnum opulus* L.

90. Pores of pore multiples not predominantly in rd files 91
(65) Pores of pore multiples predomininantly in rd files 96

91. In the early wood near the growth-ring boundary, a pore zone present of about 5 pore diameters wide; late wood with a network of pore bands . 92
Not so 94

92. In early- and late wood, vessel diameters about equal . . . . . *Rhamnus utilis Decne* . . . . . (syn. of *R. dahurica* Pall.)
In early wood, vessel diameters larger than in late wood 93

93. Bands late-wood pores of about 100 µm wide, forming a network. . . . . *Sarothamnus scoparius* (L.) Wimm. ex Koch . . . . . (syn. of *Cytisus scoparius* (L.) Link)
Bands late-wood pores of about 200 µm wide, forming a network . . . . . *Ulex europaeus* L.

94. Wood ray width more than 100 µm . . . . . *Platanus spec.*
Wood ray width less than 100 µm 95

95. Wood ray width about 50 µm; density about 700 kg per cubic m (at a moisture content of about 15 percent) . . . . . *Prunus padus* L. . . . . *Prunus serotina* Ehrh.
Wood ray width about 25 µm; density about 500 kg per cubic m (at a moisture content of about 15 percent) . . . . . *Tilia cordata* Mill. . . . . *Tilia europaea* L. (syn. of *T. x vulgaris* Hayne) . . . . . *Tilia x euchlora* K. Koch

96. Aggregate wood rays present . . . . . *Carpinus betulus* L.
(90) Aggregate wood rays absent 97

97. Vessel diameter more than 120 µm; tyloses abundant . . . *Juglans regia* L.
Vessel diameter less than 120 µm 98

98. Wood ray width 30 µm or wider 99
Wood ray width less than 30 µm 105

99. In early wood more and/or wider pores than in late wood 100
Negligible difference in number and/or diameter of the pores in early- and late wood 102

100. Short metatracheal parenchyma bands abundantly present; about 20 vessels to the square mm . . . . . *Diospyros lotus* L.
Short metatracheal parenchyma bands absent; about 40 vessels to the square mm 101

101. Wood rays in rd and tg surface not or hardly darker coloured than the ground tissue; tyloses present . . . . . *Sambucus nigra* L.
. . . . . *Sambucus racemosa* L.
Wood rays in rd and tg surface darker coloured than the ground tissue; tyloses absent . . . . . *Prunus padus* L.
. . . . . *Prunus avium* L.
. . . . . *Prunus serotina* Ehrh.

102. About 25 vessels to the square mm . . . . . *Acer negundo* L.
. . . . . *Acer palmatum* Thunb.
. . . . . *Acer pseudoplatanus* L.
. . . . . *Acer platanoides* L.
About 45 vessels to the square mm 103

103. Almost no ground tissue; division walls of vessels predominantly with scalariform perforations . . . . . *Liriodendron tulipifera* L.
Ground tissue much more abundantly present 104

104. Radial pore multiples composed of 4 or more pores regularly present; division walls of vessels with scalariform perforations plates . . . . . *Ilex aquifolium* L.
Radial pore multiples composed of 4 or more pores absent or sometimes present; division walls of vessels with simple perforations (scalariform pitting present) . . . . . *Magnolia x soulangeana* Soul.

105. Greatest vessel diameter 30 µm or less 106
(98) Greatest vessel diameter more than 30 µm 109

106. Radial pore multiples composed of 4 or more pores regularly present; division walls of vessels with scalariform perforations . . *Corylus avellana* L.

Radial pore multiples composed of 4 or more pores absent or sometimes present; division walls of vessels with simple or scalariform perforations 107

107. Near the growth-ring boundary a clear difference in early- and late-wood vessel diameters; division walls of vessels with simple perforations . . . . . *Aesculus hippocastanum* L.
Near the growth-ring boundary no or hardly any difference in early- and late-wood vessel diameters 108

108. Number of vessels to the square mm more than 30; ground tissue sparcely present; metatracheal parenchyma absent; division walls of vessels with scalariform perforations . . . . . *Liquidambar styraciflua* L.
Number of vessels to the square mm less than 30; ground tissue abundantly present; metatracheal parenchyma present; division walls of vessels with simple perforations . . . . . *Acer palmatum* Thunb.

109. Radial pore multiples composed of 4 or more pores regularly present . . 110
Radial pore multiples composed of 4 or more pores absent or sometimes present 111

110. Metatracheal parenchyma in late wood present; division walls of vessels with simple perforations . . . . . *Ostrya carpinifolia* Scop.
Metatracheal parenchyma in late wood absent; division walls of vessels with scalariform perforations . . . . . *Alnus glutinosa* (L.) Gaertn.

111. Density about 700 kg per cubic m (at a moisture content of about 15 percent); pith flecks usually present; division walls of vessels with scalariform perforations . . . . . *Betula pendula* Roth
Density about 400 kg per cubic m; pith flecks absent; division walls of vessels with simple perforations 112

112. Wood rays in rd surface darker coloured than ground tissue; vessels regularly with white substance; fine grain . . . . . *Dipteronia sinensis* Oliv.
Not so 113

113. Margin wood-ray cells upright; some wood-ray parenchyma cells with brown contents . . . . . *Salix alba* L.
. . . . . *Salix spec.*
Margin wood-ray cells procumbent; brown contents absent in wood-ray parenchyma cells . . . . . *Populus tremula* L.
. . . . . *Populus nigra* L.
. . . . . *Populus x canadensis* Moench
. . . . . *Populus spec.*

Alphabetical arrangement of the treated West-European wood species, see 4.1. and 4.2.

6. Determination key C for the most important tropical commercial timbers, with the help of a hand-lens (10x)

1. Vessels absent (Gymnospermae; softwood) 2
   Vessels present (Angiospermae; hardwood) 6

2. Wood rays with brown contents (use rd surface) 3
   Wood rays without brown contents (use rd surface) 4

3. Axial parenchyma with brown contents; ground tissue brown; wood rays dark brown . . . . . *Fitzroya cupressoides* (Mol.) Johnst.
   Axial parenchyma without brown contents 5

4. Maximum wood ray height about 200 µm (use rd surface); axial parenchyma seldom with brown contents . . . . . *Podocarpus spec.*
   Maximum wood ray height about 500 µm (use rd surface); axial parenchyma regularly with brown contents . . . . . *Podocarpus spec.*

5. Wood rays regularly with brown contents (use tg surface); within one growth ring the radial dimensions of the tracheids are about equal to one another; wood rays darker coloured than the ground tissue . . . . . *Agathis palmerstoni* F. Muell.
   Wood rays seldom with brown contents (use tg surface); within one growth ring the radial dimensions of the early wood tracheids are larger than those of the late wood; wood rays and ground tissue with the same colour . . . . . *Araucaria angustifolia* (Bert.) O.Ktze.

6. Wood ring-porous or semi-ring-porous 7
   Wood diffuse-porous 9

7. Red-brown contents in vessels present 8
   Red-brown contents in vessels absent; maximum vessel diameter about 250 µm; vasicentric parenchyma present around large vessels . . . . . *Tectona grandis* L.f.

8. Wood red-brown; rd and tg surfaces shining; some vessels with white contents; maximum vessel diameter about 400 µm; thin terminal parenchyma bands present . . . . . *Toona sureni* Merr.
   Wood light brown; many vessels with white contents; maximum vessel dia-

meter about 250 µm . . . . . *Cedrela odorata* L.

9. Pores numerous to very numerous (about 20 or more to the square mm) . . 10
   Pores sparce to moderately numerous (less than 20 to the square mm) . . 20

10. Storied structure of *all* elements always clearly visible 11
    Storied structure absent or hardly visible 15

11. Pores solitary or almost all solitary; maximum vessel diameter 100 µm; vessels often with dark olive-green, resin-like contents; sapwood yellow . . . . . *Guaiacum sanctum* L.
    Pores solitary and in pore multiples 12

12. Pores distributed regularly over the growth ring; wood light pink-brown; 3-4 stories (riple marks) per longitudial mm (use tg surface) . . . . . *Mansonia altissima* (A. Chev.) A. Chev.
    Pores distributed irregularly over the growth ring (at the end of the growing period distinctly fewer pores) 13

13. Maximum vessel diameter less than 50 µm; dark brown gum- and resin ducts clearly visible; about 150 vessels to the square mm; wood brown . . . . . *Brachylaena hutchinsii* Hutch.
    Not so 14

14. Maximum vessel diameter about 50 µm; vessels sometimes with white gum; wood pink-brown . . . . . *Nesogordonia papaverifera* (A. Chev.) R.Cap.
    Maximum vessel diameter about 150 µm; vessels sometimes with dark coloured gum; vasicentric parenchyma present . . . *Afrormosia elata* Harms . . . . . (syn. of *Pericopsis elata* (Harms) v. Meeuwen)

15. Division walls of vessels all or nearly all with scalariform perforations; growth-ring boundary not visible; silver rays about 1 cm high (use rd surface); in heartwood vessels with brown contents . . *Rhizophora conjugata* L. . . . . (syn. of *Bruguiera gymnorhiza* (L.) Lam.)
    Division walls of vessels with simple perforations 16

16. Growth-ring boundaries not visible; wood rays dark brown on light background (use rd surface); radial pore multiples composed of 2-8 pores; maximum vessel diameter about 150 µm; wood brown . . . . . *Protium heptaphyllum* (Aubl.) March.
    Growth-ring boundaries rather clearly to clearly visible 17

17. Tyloses abundant 18
    Tyloses absent or sparcely present 19

18. Maximum vessel diameter about 100 µm; 4-6 wood rays per tg mm; wood-ray parenchyma cells without brown contents; wood light brown with dark stripes . . . . . *Paratecoma peroba* (Record) Kuhlm.
Maximum vessel diameter about 50 µm; about 10 wood rays per tg mm; wood-ray parenchyma cells sometimes with brown contents; wood red-brown . . . . . *Nothofagus dombeyi* Bl.
. . . . . (syn. of *Fagus dombeyi* Mirb.)

19. Pore multiples almost exclusively composed of radial files of 2 and 3 pores, tg files sporadically present; wood-ray parenchyma cells without contents; wood yellow-white . . . . . *Cinnamomum camphora* T. Nees et Eberm.
Pore multiples composed of radial and tangential files of 2-5 pores; wood-ray parenchyma cells with brown contents; wood pink-brown . . . . . *Mitragyna ciliata* Aubrev. et Pellegr.
. . . . . (syn. of *Hallea ciliata* (Aubrev. et Pellegr.) Leroy)

20. Storied structure of *all* elements always clearly visible 21
Not so 33

21. Pores solitary; maximum vessel diameter 100 µm; vessels often with dark olive-green, resin- like contents; sapwood yellow . . *Guaiacum sanctum* L.
Pores solitary and in pore multiples 22

22. Wood ray width 50 µm or more 23
Wood ray width less than 50 µm 24

23. Long and/or short tangential parenchyma bands abundantly present; wood yellow; vessels without contents . . . . . *Simaruba amara* Aubl.
Aliform parenchyma absent; wood red-brown; vessels often with white contents or with red gum; terminal parenchyma clearly visible in concentric bands . . . . . *Swietenia mahagoni* Jacq.

24. Long tangential parenchyma bands of 20 cells wide (about 500 µm), present; wood uniform dark brown; vessels sometimes with dark brown gum or with white contents . . . . . *Millettia laurentii* Wildem.
Long tangential parenchyma bands of 20 cells wide (about 500 µm), absent 25

25. Maximum vessel diameter more than 400 µm 26
Maximum vessel diameter less than 400 µm 28

26. About 25 stories (riple marks) per longitudinal cm (use tg section); pore diameter almost not changing within a growth layer; vessels sometimes with brown gum or white contents; aliform parenchyma with short or long wing-

like lateral extensions often present; banded parenchyma short and interrupted . . . . . *Dicorynia guianensis* Amsh.
About 50 stories (riple marks) per longitudinal cm (use tg section) . . . 27

27. Aliform parenchyma developed into long and short confluent parenchyma, abundantly present 32
Only aliform parenchyma present with very short wing-like lateral extensions; wood dark brown to black, with tg black stripes; dark brown gum present in many vessels; reticulate parenchyma and often terminal parenchyma, present . . . . . *Dalbergia nigra* Allem. ex Benth.

28. Long, undulated tangential bands confluent parenchyma present and/or long apo- (para-) tracheal banded parenchyma regularly present 29
Not so. Terminal parenchyma visible; vasicentric and aliform parenchyma changing into short confluent parenchyma present; tyloses present; wood yellowish-white . . . . . *Distemonanthus benthamianus* Baill.

29. Radial pore multiples of 5-6 pores present; wood dark brown; growth-ring boundaries not visible; vessels sometimes with brown gum or white contents; axial parenchyma usually aliform with short or long wing/liked lateral extensions (banded) . . . . . *Dicorynia guianensis* Amsh.
Radial pore multiples of 5-6 pores absent 30

30. About 35 stories (riple marks) per longitudinal cm (use tg section); wood light brown-pink; growth-ring boundaries visible; vessels without contents; reticulate parenchyma present . . . . . *Mansonia altissima* (A. Chev.) A.Chev.
About 50 stories (riple marks) per longitudinal cm (use tg section) . . . 31

31. Wood dark brown-violet; growth-ring boundaries visible by the presence of terminal parenchyma; vessels often with red-brown gum . . . . . *Dalbergia latifolia* Roxb.
Wood dark brown to black, with tg black stripes; dark brown gum present in many vessels; reticulate parenchyma and often terminal parenchyma present . . . . . *Dalbergia nigra* Allem. ex Benth.

32. Wood red-brown; some vessels with red gum or white contents; aliform parenchyma with short to long wing-like lateral extensions, often coalesced and so forming long tangential bands . . . . . *Pterocarpus soyauxii* Taub.
Wood brown to reddish-brown; some vessels with white contents; aliform parenchyma sometimes with unilateral wing-like extension changing into, often interrupted, tangential bands; thin terminal parenchyma sometimes present . . . . . *Pterocarpus indicus* Willd.

33. Storied structure of only fibres and axial parenchyma 34
No storied structure 37

34. Wood rays less than 50 µm wide; wood yellowish-brown; brown gum sometimes present in vessels; axial parenchyma present as vasicentric parenchyma, sometimes aliform parenchyma with short wing-like extensions, diffuse parenchyma and often diffuse-in-aggregates parenchyma . . . . . *Plathymenia reticulata* Benth.
Wood rays more than 50 µm wide 35

35. Vessels with tyloses; wood yellowish; pore arrangement irregular; growth-ring boundaries often visible; apotracheal parenchyma arranged in short tangential bands or in small groups . . . *Triplochiton scleroxylon* K.Schum.
Vessels without tyloses 36

36. Wood brown; axial parenchyma difficult to distinguish (wet the cross surface), vasicentric, aliform and banded (short) . . . *Tarrietia utilis* Sprague . . . . . (syn. of *Heritiera utilis* (Sprague) Sprague)
Wood grey; axial parenchyma vasicentric and abundantly reticulate . . . . . *Tarrietia spec.*

37. Wood rays 100 µm wide or more 38
Wood rays less than 100 µm wide 46

38. Maximum wood-ray width more than 400 µm; pore multiples almost exclusively composed of 3-6 pores arranged in tg files; scalariform parenchyma clearly and regularly present . . . . . *Grevillea robusta* A.Cunn.
Maximum wood-ray width less than 400 µm 39

39. About one vessel to the square mm 40
More than 2 vessels to the square mm 41

40. Wood yellow-brown; vessels often with blue gum, sometimes with tyloses; reticulate parenchyma abundant . . *Pterygota horsfieldii* (R.Br.) Kosterm.
Wood brown; vessels often with tyloses; pores solitary or in radial multiples of 2-3 pores, arrangement regular . . . *Vochysia tomentosa* (G.F.W. Mey.) DC.

41. Growth-ring boundaries visible, marked by terminal parenchyma . . . 42
Growth-ring boundaries not visible 44

42. Pore clusters of 6 or more pores abundantly present 43
Pore clusters of 6 or more pores absent; pores solitary; wood light coloured; very fine reticulate parenchyma only visible on a wet cross surface . . . . . *Anisoptera spec.*

43. Maximum vessel diameter more than 200 µm; vessels very often with red gum or white contents; terminal parenchyma or traumatic resin ducts arranged in tg bands, sometimes present . . . *Khaya anthotheca* (Welw.) C.DC.
Maximum vessel diameter less than 200 µm; wood pink-brown; terminal parenchyma clearly visible . . . . . *Khaya senegalensis* (Desv.) A.Juss.

44. Vessels solitary; tyloses and/or brown gum sometimes present in vessels; apotracheal parenchyma arranged in short, irregular, tangential bands; wood grey-brown . . . . . *Ceiba pentandra* (L.) Gaertn.
Not so 45

45. Division walls of vessels with simple and scalariform perforations; wood light brown; vasicentric parenchyma sheaths 1-3 cells wide . . . . . *Pycnanthus angolensis* (Welw.) Warb.
Division walls of vessels all with simple perforations; wood grey-pink; tyloses often present; wood-ray parenchyma cells often with brown contents . . . . . *Ochroma lagopus* Sw. . . . . (syn. of *O. pyramidale* Urb.)

46. Division walls of vessels with simple and scalariform perforations or all with scalariform perforations 47
Division walls of vessels all with simple perforations 50

47. Pores almost exclusively solitary; wood yellow-brown to red-brown; growth-ring boundaries visible by a fibre condensation at the end of the growing period; vessels sometimes with red gum or white contents . . . . . *Goupia glabra* Aubl.
Pores often arranged in pore multiples 48

48. Wood ray width less than 30 µm; wood greenish-brown; growth-ring boundaries visible by a fibre condensation at the end of the growing period; scalariform perforation plates sporadically present . . *Nectandra pisi* Miq.
Wood ray width 30 µm or more 49

49. On the average 3 vessels to the square mm; pores usually arranged in pore chains; vasicentric parenchyma sheaths 1-2 cells wide; wood yellow-brown to red-brown; growth-ring boundaries clearly visible . . . . . *Virola surinamensis* Warb. . . . . (syn. of *Myristica surinamensis* Roland ex Rottb.)
On the average 6 vessels to the square mm; wood red-brown; vessels sometimes with red gum . . . . . *Staudtia stipitata* Warb.

50. Tg bands axial resin- or gum ducts with dark contents, clearly visible . 51
Not so 52

51. Maximum vessel diameter about 200 µm; wood greasy, dark brown; vessels sometimes with white contents; wood ray width 50 µm or smaller . . . . . *Eperua jenmani* Oliv.
Maximum vessel diameter about 120 µm; wood light brown; wood ray width about 80 µm . . . . . *Shorea spec.*

52. Vasicentric parenchyma sheaths or parenchyma sheaths around resin ducts, complete or incomplete, more than 3 cells wide; vasicentric parenchyma often changing via confluent parenchyma into banded parenchyma . . 53
Not so 90

53. Terminal parenchyma clearly visible 54
Not so 71

54. Confluent parenchyma changing into banded parenchyma, clearly and abundantly present 55
Not so 65

55. Maximum wood ray width 30 µm or less 56
Maximum wood ray width more than 30 µm 60

56. Maximum vessel diameter more than 250 µm; wood brown; vessels often with dark coloured gum or yellow contents; vessels surrounded by wide sheaths vasicentric parenchyma with wing-like lateral extensions, often changing into confluent parenchyma . . . . . *Intsia bijuga* O.Ktze. (syn. of *Afzelia bijuga* A. Gray)
Maximum vessel diameter less than 250 µm 57

57. Vessels often with white contents or red-brown gum 59
Vessels without white contents 58

58. Vessels often with tyloses; wood yellow-brown; vasicentric parenchyma sheaths with a small width and/or aliform parenchyma changing into confluent parenchyma, present . . . . . *Hopea papuana* Diels
Vessels without contents; wood red-brown; vasicentric parenchyma sheaths with a large width and/or aliform parenchyma, present . . . . . *Mora gonggrijpii* (Kleinh.) Sandw.

59. Maximum vessel diameter less than 200 µm; wood reddish; wood strongly cross-grained; confluent parenchyma changing into very long tangential bands, frequently present; vessels often with red gum or white contents . . . . . *Mora excelsa* Benth.
Maximum vessel diameter 200 µm or more; wood brown; confluent parenchyma usually enclosing 2-5 pores; vessels often with red gum or yellow contents . . . . . *Intsia bijuga* O.Ktze.

. . . . . (syn. of *Afzelia bijuga* A. Gray)

60. Maximum vessel diameter about 400 µm 61
Maximum vessel diameter about 250 µm 62

61. Wood reddish; vessels nearly always with either red gum, white contents or tyloses; ground tissue existing for about 50% out of axial parenchyma . . . . . *Andira spec.*
Wood brown; vessels often with contents but only tyloses; pores arranged regularly, solitary or in radial series of 2-3 adjacent solitary pores (pore chains) . . . . . *Vochysia tomentosa* (G.F.W. Mey.) DC.

62. Wood purple-red; many vessels with wide sheaths vasicentric parenchyma, often also with wing-like lateral extensions. These lateral extensions may fuse, forming diagonal parenchyma bands (confluent parenchyma) . . . . . *Peltogyne pubescens* Benth.
Wood coloured otherwise 63

63. Aliform parenchyma composed of thin, not always complete, sheaths and pointed wing-like lateral extensions; wood brown; vessels sometimes with red gum . . . . . *Hymenaea courbaril* L.
Aliform parenchyma composed of wide, usually complete, sheaths and blunt wing-like lateral extensions 64

64. Wood ray width 30 µm or less; wood brown; vessels often with red gum or sulphur-yellow contents . . . . . *Intsia bijuga* O.Ktze. . . . . (syn. of *Afzelia bijuga* A. Gray)
Wood ray width more than 30 µm; wood yellow-grey; vessels sometimes with red gum . . . . . *Afzelia africana* Sm.

65. Wood ray width less than 20 µm; wood light- to dark brown; aliform parenchyma with short wing-like extensions present; maximum vessel diameter 250 µm . . . . . *Microberlinia spec.*
Wood ray width more than 20 µm 66

66. On the average less than 5 vessels to the square mm 67
On the average more than 5 vessels to the square mm 68

67. Confluent parenchyma connecting 3-5 vessels present; vasicentric parenchyma with wide sheaths around the vessels; wood brown; vessels often with red gum or sulphur-yellow contents . . . . . *Intsia bijuga* O.Ktze. . . . . (syn. of *Afzelia bijuga* A. Gray)
Confluent parenchyma absent; vasicentric parenchyma with thin sheaths around the vessels; wood brown with dark coloured stripes; gum ducts filled with white gum present . . . . *Oxystigma oxyphyllum* (Harms) J.Léonard

68. Terminal parenchyma bands of 10 cells wide frequently present; vessels sometimes with red gum or white substance; wood light brown . . . . . *Swietenia macrophylla* King
Apotracheal parenchyma absent or sparcely present 69

69. Aliform parenchyma regularly present 70
Aliform parenchyma absent or sporadically present; traumatic resin ducts surrounded by axial parenchyma, arranged in tg bands, frequently present. . . . . *Carapa procera* DC.

70. Confluent parenchyma locally connecting 2-3 vessels; wood dark brown; vessels sometimes with red gum . . . . . *Guibourtia arnoldiana* (De Wild. et Th. Dur.) J.Léonard
Confluent parenchyma frequently connecting 2-3 or more vessels; wood purple-red . . . . . *Peltogyne pubescens* Benth.

71. Confluent parenchyma changing into banded parenchyma clearly and frequently present 72
Not so 81

72. Growth-ring boundaries visible 73
Growth-ring boundaries nor or hardly visible 75

73. Maximum vessel diameter 300 μm or more; wood dark brown; vessels usually with tyloses; aliform and confluent parenchyma changing into undulating tg bands present . . . . . *Chlorophora exelsa* (Welw.) Benth.
Maximum vessel diameter less than 300 μm 74

74. Maximum wood ray width about 30 μm; wood light yellow; vessels often with yellow gum or white contents; vasicentric parenchyma, aliform parenchyma with short wing-like extensions and confluent parenchyma present . . . . . *Fagara macrophylla* (Oliv.) Engl.
Maximum wood ray width about 15 μm; wood dark chocolate-brown; vessels regularly with dark brown gum or white contents; vasicentric parenchyma sheaths 3-12 cells wide; aliform parenchyma with short wing-like extensions and confluent parenchyma changing into 15 cells wide tg parenchyma bands, present . . . . . *Vouacapoua americana* Aubl.

75. Pores almost exclusively solitary 76
Pores also present in pore multiples 77

76. Resin ducts present, surrounded by axial parenchyma, arranged in long tg bands; gum ducts often with contents; tyloses sparely present; wood brown . . . . . *Shorea balangeran* Burck
Resin ducts present, surrounded by axial parenchyma, arranged in short

tg bands; gum ducts seldom with contents; tyloses abundantly present; wood brown . . . . . *Dipterocarpus retusus* Bl.

77. Maximum wood ray width more than 50 µm; wood brown; resin ducts present, surrounded by axial parenchyma and arranged in long tg bands; gum ducts often with contents . . . . . *Shorea balangeran* Burck
Maximum wood ray width less than 50 µm 78

78. Radial pore multiples composed of more than 5 pores, frequently present 79
Radial pore multiples composed of more than 5 pores hardly present . 80

79. Long tg parenchyma bands frequently present; ground tissue consists for about 50% out of axial parenchyma; vessels nearly always with red gum or white substance; wood red . . . . . *Andira spec.*
Long tg parenchyma bands absent or seldom present; vessels sometimes with white contents; heartwood dark brown . . . . . *Diplotropis purpurea* (L.C. Rich.) Amsh.

80. Vessels often with tyloses or brown gum; wood dark brown; aliform parenchyma present changing into confluent parenchyma and undulating tg parenchyma bands . . . . . *Chlorophora excelsa* (Welw.) Benth.
Vessels sometimes with dark brown-black contents; wood yellowish-brown; aliform parenchyma present with long wing-like lateral extensions changing via confluent parenchyma into long, zigzag parenchyma bands . . . . . *Terminalia superba* Engl. et Diels

81. Wood ray width less than 20 µm 82
Wood ray width more than 20 µm 83

82. Maximum vessel diameter more than 200 µm; wood light brown with dark stripes; aliform parenchyma with short wing-like lateral extensions, present; vessels sometimes with brown gum or white substance . . . . . *Microberlinia spec.*
Maximum vessel diameter less than 200 µm; wood olive-green; parenchyma hardly visible, consisting of vasicentric parenchyma, with 1-3 cells wide sheaths and aliform parenchyma with very short wing-like lateral extensions; vessels often with yellow gum or tyloses . . . . . *Ocotea rodiaei* (Rob. Schomb.) Mez

83. Growth-ring boundaries clearly visible 84
Growth-ring boundaries not- or hardly visible 86

84. Maximum vessel diameter about 300 µm 85
Maximum vessel diameter about 200 µm; wood light brown; vessels nearly

always with yellow gum or white contents; vessels arranged regularly, except near the growth-ring boundaries; vasicentric parenchyma and aliform parenchyma with short wing-like lateral extensions, present . . . . . *Fagara macrophylla* (Oliv.) Engl.

85. Growth-ring boundaries visible by a reduction of the number of pores; wood cream-yellow; vessels sporadically with yellow gum or black contents; vasicentric parenchyma with thin sheaths and aliform parenchyma with very short wing-like lateral extensions; traumatic resin ducts sometimes present . . . . . *Terminalia ivorensis* A.Chev.
Growth-ring boundaries visible by fibre condensation; wood yellowish-white; vessels sometimes with dark contents; vasicentric parenchyma with wide sheaths and aliform parenchyma with short wing-like lateral extensions . . . . . *Piptadeniastrum africanum* (Hook.f.) Brenan

86. Wood ray height more than 1500 µm (use rd surface) 87
Wood ray height less than 1500 µm (use rd surface) 88

87. Resin ducts present, surrounded by axial parenchym, arranged in long tg bands; gum ducts often with contents; tyloses sparcely present; wood brown . . . . . *Shorea balangeran* Burck
Resin ducts present, surrounded by axial parenchyma, arranged in short tg bands; gum ducts seldom with contents; tyloses abundantly present; wood brown . . . . . *Dipterocarpus retusus* Bl.

88. Maximum vessel diameter about 300 µm; wood yellowish-white; vasicentric parenchyma present and dark coloured (use cross surface) aliform parenchym with short wing-like lateral extensions; vessels sometimes with dark contents . . . . . *Piptadeniastrum africanum* (Hook.f.) Brenan
Maximum vessel diameter about 200 µm or less 89

89. Maximum vessel diameter more than 200 µm; wood light brown; vessels not always arranged regularly, nearly always with yellow gum or white substance; vasicentric and aliform parenchyma with short wing-like extensions, present . . . . . *Fagara macrophylla* (Oliv.) Engl.
Maximum vessel diameter less than 200 µm; wood green-brown; vessels arranged regularly; axial parenchyma with brown contents present . . . . . *Ocotea rodiaei* (Rob. Schomb.) Mez

90. Apotracheal banded parenchyma (not terminal parenchyma) abundantly present, forming short or long tg bands 91
Not so 105

91. Maximum vessel diameter about 400 µm 92
Maximum vessel diameter less than 400 µm 94

92. Growth-ring boundaries clearly visible by the presence of terminal parenchyma; wood brown; vessels often with tyloses . . . . . *Vochysia tomentosa* (G.F.W. Mey.) DC.
Growth-ring boundaries not or hardly visible 93

93. Wood straw yellow-white; vessels sometimes with tyloses or black contents; dense network present of many, short, thin, tg parenchyma bands . . . . . *Ricinodendron heudelotii* (Baill.) Pierre ex Pax
Wood chocolate-brown; vessels nearly all with red gum or yellow contents; banded parenchyma present, composed of 3-7 cells wide, undulated bands . . . . . *Lophira alata* Banks ex Gaertn.f.

94. Wood ray width about 50 µm 95
Wood ray width less than 50 µm 96

95. Maximum vessel diameter more than 200 µm; wood cream-yellow; tyloses sometimes present; banded parenchyma frequently present, white; scalariform pitting present . . . . . *Alstonia scholaris* R.Br.
Maximum vessel diameter less than 200 µm; wood light brown; traumatic resin ducts surrounded by axial parenchyma, arranged in tg bands, frequently present . . . . . *Carapa procera* DC.

96. Pores almost exclusively in radial pore multiples of maximal 8 pores; wood pink-brown; vessels almost without contents or tyloses (sometimes black contents); banded parenchyma present . . . *Palaquium supfianum* Schlecht.
Not so 97

97. Maximum vessel diameter about 200 µm 98
Maximum vessel diameter 150 µm or less 102

98. Terminal parenchyma clearly visible 99
Terminal parenchyma absent 100

99. Irregular reticulate parenchyma clearly visible on a wet cross surface; wood gold-brown; tyloses frequently present . . . . . *Hopea papuana* Diels
Reticulate parenchyma absent; wood dark brown; nearly all vessels with tyloses . . . . . *Endiandra palmerstoni* C.T. White

100. Banded parenchyma with about 60 tg bands per rd cm (use cross surface); tg parenchyma bands 1-2 cells wide; wood red-brown . . . . . *Baillonella toxisperma* Pierre
Banded parenchyma with about 35 tg bands per rd cm (use cross surface); tg parenchyma bands also more than 2 cells wide 101

101. Tg parenchyma bands about 5 cells wide; vessels sometimes with red-brown gum; some tyloses present; wood red-brown; wood ray width smaller than 30 µm . . . . . *Tieghemella heckelii* (A. Chev.) Roberty
Tg parenchyma bands about 3 cells wide; vessels sporadically with red-brown gum; tyloses locally abundant; wood red-brown; wood ray width about 30 µm . . . . . *Mimusops heckelii* (A. Chev.) Hutch. et Dalz.
. . . . . (syn. of *Tieghemella heckelii* (A. Chev.) Roberty)

102. Maximum vessel diameter about 150 µm; banded parenchyma composed of 5 cells wide tg bands present; wood red-brown; vessels sometimes with red-brown gum and/or tyloses . . *Tieghemella heckelii* (A. Chev.) Roberty
Maximum vessel diameter much smaller than 150 µm 103

103. Banded parenchyma with about 12 tg bands per rd mm (use cross surface); wood yellow-white to black, all heartwood vessels with black gum; density more than 1000 kg per cubic m . . . . . *Diospyros ebenum* Koenig
Banded parenchyma with about 6 tg bands per rd mm (use cross surface) .
. 104

104. Wood dark red-brown; density more than 1000 kg per cubic m; tyloses present; vessels sometimes with red gum; banded parenchyma composed of 1-2 cells wide, undulated, tg bands, frequently present . . . . . .
. . . . . *Autranella congolensis* A.Chev.
Wood light coloured; density less than 1000 kg per cubic m; vessels sometimes with red gum; banded parenchyma composed of 2-4 cells wide tg bands, frequently present . . . . . *Guarea thompsonii* Sprag. et Hutch.

105. Growth-ring boundaries visible 106
Growth-ring boundaries not visible 125

106. Wood ray width 50 µm or more 107
Wood ray width 40 µm or less 110

107. Division walls of vessels sometimes with scalariform perforations; wood red-brown; vessels sometimes with red gum or tyloses . . . . . .
. . . . . *Staudtia stipitata* Warb.
Division walls of vessels only with simple perforations 108

108. Pore clusters composed of 10 pores, present; wood pink-red-brown; vessels frequently with red gum or white substance; sometimes terminal parenchyma present or traumatic resin ducts arranged in tg bands . . . . . .
. . . . . *Khaya anthotheca* (Welw.) C.DC.
Pore clusters composed of 10 pores, absent 109

109. Wood rays dark brown (use rd surface); wood light red-brown; tyloses ab-

sent; terminal parenchyma present in concentric bands . . . . . *Entandrophragma angolense* (Welw.) C.DC.
Wood rays light coloured (use rd surface); pores almost all solitary; wood light coloured; very fine reticulate parenchyma visible on wet cross surface . . . . . *Anisoptera spec.*

110. Pores solitary, often arranged in diagonal pore chains; wood light yellow-brown; vessels practically without contents or tyloses; tendency to ring-porous arrangement of the pores . . . . . *Eucalyptus globulus* Labill.
Not so 111

111. Maximum vessel diameter 400 µm or more 112
Maximum vessel diameter less than 400 µm 113

112. Tyloses frequently present; wood pink-brown with dark coloured spots and stripes; some paratracheal parenchyma present; growth-ring boundaries visible by condensation of fibres . . . . . *Dracontomelon magniferum* Bl. . . . . (syn. of *D. dao* (Blanco) Merr. et Rolfe)
Tyloses sporadically present or absent; wood white coarse grained; fine reticulate parenchyma present; growth-ring boundaries present by condensation of fibres . . . . . *Ricinodendron heudelotii* (Baill.) Pierre ex Pax

113. Maximum vessel diameter more than 200 µm 114
Maximum vessel diameter less than 200 µm 119

114. All vessels with tyloses; wood dark red-brown with dark stripes; growth-ring boundaries visible by reduction of the number of pores in the late wood; some aliform parenchyma present . . . *Combretodendron africanum* Exell
Not so 115

115. Terminal and vasicentric parenchyma regularly present; wood light red, cross-grained; vessels often with red gum or white contents . . . . . *Pometia pinnata* Forst.
Terminal parenchyma absent 116

116. Ground tissue brown to dark brown (use rd surface) 117
Ground tissue white to light brown (use rd surface) 118

117. Wood yellowish-brown; about 6 wood rays per tg mm; about 4 vessels to the square mm; radial pore multiples composed of 6 pores, sporadically present . . . . . *Plathymenia reticulata* Benth.
Wood pinkish; about 4 wood rays per tg mm; about 6 vessels to the square mm; radial pore multiples composed of 6 pores, regularly present . . . . . *Aucoumea klaineana* Pierre

118. Growth-ring boundaries indistinct; maximum vessel diameter 250 µm; vessels usually solitary or in pore multiples composed of 4-5 pores; tyloses often present; wood light brown-pink; some paratracheal parenchyma present . . . . . *Canarium schweinfurthii* Engl.
Growth-ring boundaries distinct; maximum vessel-diameter about 200 µm; pores often solitary but also regularly in pore multiples composed of 4-5 pores; tyloses often present; wood yellow-brown; tendency to ring-porous arrangement of the pores . . . . . *Ocotea guianensis* Aubl.

119. Terminal parenchyma clearly visible; wood dark brown; vessels nearly always with tyloses or dark red gum . . . *Endiandra palmerstoni* C.T. White
Terminal parenchyma absent 120

120. All vessels with tyloses; wood dark red-brown with dark stripes; growth-ring boundaries visible by reduction of the number of pores in the late wood; some aliform parenchyma present . . . *Combretodendron africanum* Exell
Not all vessels with tyloses 121

121. Division walls of vessels sometimes with scalariform perforations; wood greenish-brown; growth-ring boundaries visible by condensation of fibres . . . . . *Nectandra pisi* Miq.
Scalariform perforation plates absent 122

122. Maximum vessel diameter about 100 µm; wood dark brown-black; vessels sometimes with tyloses; growth-ring boundaries visible by condensation of fibres; ground tissue darker than wood rays (use rd surface) . . *Ocotea spec.*
Maximum vessel diameter more than 100 µm; wood light coloured . . 123

123. Tyloses absent; wood yellow-white; pores predominantly solitary; growth-ring boundaries visible by a tg file of large pores in the early wood . . . . . *Turraeanthus africanus* (Welw. ex DC.) Pellegr.
Tyloses present 124

124. Growth-ring boundaries visible by condensation of fibres and reduction of the number of pores in the late wood (tendency to ring-porous arrangement of the pores); wood yellow-brown; pore multiples composed of 4-5 pores regularly present . . . . . *Ocotea guianensis* Aubl.
Growth-ring boundaries only visible by condensation of fibres; wood grey-brown; pore multiples composed of 4-5 pores sporadically present or absent . . . . . *Dacryodes buettneri* (Engl.) H.J.Lam

125. Maximum vessel diameter 400 µm or more 126
Maximum vessel diameter less than 400 µm 127

126. Tyloses frequently present; wood pink-brown with dark spots and stripes;

some vasicentric parenchyma present . . *Dracontomelon magniferum* Bl.
. . . . . (syn. of *D. dao* (Blanco) Merr. et Rolfe)
Tyloses sporadically present; wood white to straw-yellow; coarse-grained; fine network of banded parenchyma present . . . . . .
. . . . . *Ricinodendron heudelotii* (Baill.) Pierre ex Pax

127. Wood ray width more than 30 µm 128
Wood ray width 30 µm or less 133

128. Tyloses sporadically present or absent 129
Tyloses frequently or always present 130

129. Wood rays brown; wood red-brown; division walls of vessels sometimes with scalariform perforations; vessels sporadically with red gum . . . . . .
. . . . . *Staudtia stipitata* Warb.
Wood rays light coloured; wood light yellow-white; pores predominantly solitary . . . . . *Turraeanthus africanus* (Welw. ex DC.) Pellegr.

130. Pores nearly all solitary; wood light coloured; very fine network of banded parenchyma visible on wet cross surface . . . . . *Anisoptera spec.*
Pores also in radial pore multiples 131

131. Wood rays white to light brown; wood pinkish-brown; tyloses present . . .
. . . . . *Canarium schweinfurthii* Engl.
Wood rays dark brown 132

132. Nearly all vessels with tyloses or grey contents; wood light red-brown with dark spots; aliform parenchyma with blunt wing-like extensions, sometimes present . . . . . *Ocotea rubra* Mez
Vessels usually empty; wood pink-brown; pores multiples composed of 2-6 pores, regularly present . . . . . *Aucoumea klaineana* Pierre

133. Tyloses sporadically present or absent 134
Tyloses regularly to abundantly present 136

134. Wood rays white; wood light yellow-white; vessels without contents . . . .
. . . . . *Turraeanthus africanus* (Welw. ex DC.) Pellegr.
Wood rays not white coloured 135

135. Maximum vessel-diameter more than 200 µm; wood gold-yellow; vessels often with red gum or white contents; pores for the greater part solitary; network of banded parenchyma, present . . . . . .
. . . . . *Nauclea diderrichii* (De Wild. et Th. Dur.) Merr.
Maximum vessel-diameter less than 200 µm; wood greenish-brown; division walls of vessels sporadically with scalariform perforations . . . . . .
. . . . . *Nectandra pisi* Miq.

136. Maximum vessel diameter more than 200 µm 137
Maximum vessel diameter 200 µm or less 138

137. Wood rays brown; wood pink-brown; radial pore multiples composed of 5 pores, regularly present; about 7 vessels to the square mm . . . . . *Aucoumea klaineana* Pierre
Wood rays light coloured; wood light brown; radial pore multiples composed of 5 pores sporadically present; about 5 vessels to the square mm . . . . . *Canarium schweinfurthii* Engl.

138. Growth-ring boundaries visible; wood-ray parenchyma cells with red-brown contents; fibre lumen not visible; about 4 wood rays to the tg mm . . . . . *Dacryodes buettneri* (Engl.) H.J.Lam
Growth-ring boundaries not visible 139

139. Radial pore multiples composed of 4 pores regularly present; wood light brown-grey; axial parenchyma absent . . . . *Triplaris surinamensis* Cham.
Radial pore multiples composed of 4 pores absent; wood green-brown; axial parenchyma with brown contents present . . . . . *Ocotea rodiaei* (Rob. Schomb.) Mez

6.1. Alphabetical arrangement of the treated tropical commercial timbers according to trade name

Trade name	*Scientific name*
Abura	Mitragyna ciliata Aubrev. et Pellegr. (syn. of Hallea ciliata (Aubrev. et Pellegr.) Leroy) (Rubiaceae)
Afara; Limba	Terminalia superba Engl. et Diels (Combretaceae)
Afrormosia	Afrormosia elata Harms (syn. of Pericopsis elata (Harms) v. Meeuwen) (Leguminosae-Pap.)
Afzelia	Afzelia africana Sm. (Leguminosae-Caes.)
Alerce	Fitzroya cupressoides (Mol.) Johnst. (Cupressaceae)
Amboyna; Manila padauk	Pterocarpus indicus Willd. (Leguminosae-Pap.)
Andira	Andira spec. (Leguminosae-Pap.)
Andiroba; Guiana crabwood	Carapa procera DC. (Meliaceae)
Anisoptera	Anisoptera spec. (Dipterocarpaceae)

Araucaria, Brazilian; Parana pine	Araucaria angustifolia (Bert.) O. Ktze. (Araucariaceae)
Avodiré	Turraeanthus africanus (Welw. ex DC.) Pellegr. (Meliaceae)
Awong; Wengé	Millettia laurentii Wildem. (Leguminosae-Pap.)
Ayan; Nigerian satinwood	Distemonanthus benthamianus Baill. (Leguminosae-Caes.)
Azobé; Red ironwood; Ekki	Lophira alata Banks ex Gaertn. f. (Ochnaceae)
Balam	Palaquium supfianum Schlecht. (Sapotaceae)
Balau; Meranti, light red; Meranti, white	Shorea spec. (Dipterocarpaceae)
Balsa; Corkwood	Ochroma lagopus Sw. (syn. of O. pyramidale Urb.) (Bombacaceae)
Basralocus	Dicorynia guianensis Amsh. (Leguminosae-Caes.)
Beech, Chilean; Coigue	Nothofagus dombeyi Bl. (syn. of Fagus dombeyi Mirb.) (Fagaceae)
Balangeran; Belangeran	Shorea balangeran Burck (Dipterocarpaceae)
Belangeran; Balangeran	Shorea balangeran Burck (Dipterocarpaceae)
Bété; Mansonia	Mansonia altissima (A. Chev.) A. Chev. (Sterculiaceae)
Bilinga; Opepe	Nauclea diderrichii (De Wild. et Th. Dur.) Merr. (syn. of N. trillesii (Pierre ex De Wild.) Merr.) (Rubiaceae)
Camashi; Niové	Staudtia stipitata Warb. (Myristicaceae)
Camphor tree, Japanese	Cinnamomum camphora T. Nees et Eberm. (Lauraceae)
Canarium, African	Canarium schweinfurthii Engl. (Burseraceae)
Canela	Ocotea guianensis Aubl. (Lauraceae)
Cedar, Central American; Cigarbox cedar	Cedrela odorata L. (Meliaceae)
Ceiba; Silk-cotton tree	Ceiba pentandra (L.) Gaertn. (Bombacaceae)
Cheesewood, white; Pulai	Alstonia scholaris R. Br. (Apocynaceae)
Cirouaballi, yellow	Nectandra pisi Miq. (Lauraceae)
Coigue; Chilean beech	Nothofagus dombeyi Bl. (syn. of Fagus dombeyi Mirb.) (Fagaceae)
Copal; Haiawa	Protium heptaphyllum (Aubl.) March. (Burseraceae)
Corkwood; Balsa	Ochroma lagopus Sw. (syn. of O. pyramidale Urb.) (Bombacaceae)
Courbaril; West Indian locust	Hymenaea courbaril L. (Leguminosae-Caes.)

Crabwood, Guiana; Andiroba	Carapa procera DC. (Meliaceae)
Dabema; Dahoma	Piptadeniastrum africanum (Hook.f.) Brenan (Leguminosae-Mim.)
Dahoma; Dabema	Piptadeniastrum africanum (Hook.f.) Brenan (Leguminosae-Mim.)
Dalli; Virola	Virola surinamensis Warb. (syn. of Myristica surinamensis Roland ex Rottb.) (Myristicaceae)
Danta	Nesogordonia papaverifera (A. Chev.) R.Cap. (Tiliaceae)
Dao	Dracontomelon magniferum Bl. (syn. of D. dao (Blanco) Merr. et Rolfe) (Anacardiaceae)
Determa; Red louro	Ocotea rubra Mez (Lauraceae)
Dipterocarpus	Dipterocarpus retusus Bl. (Dipterocarpaceae)
Ebony, Ceylon; East Indian ebony	Diospyros ebenum Koenig (Ebenaceae)
Ebony, East Indian; Ceylon ebony	Diospyros ebenum Koenig (Ebenaceae)
Ekki, Red ironwood; Azobé	Lophira alata Banks ex Gaertn. f. (Ochnaceae)
Endiandra,Australian; Queensland walnut	Endiandra palmerstoni C.T. White (Lauraceae)
Erimado; Essessang	Ricinodendron heudelotii (Baill.) Pierre ex Pax (Euphorbiaceae)
Essessang; Erimado	Ricinodendron heudelotii (Baill.) Pierre ex Pax (Euphorbiaceae)
Essia; Wulo	Combretodendron africanum Exell (Lecythidaceae)
Gaboon; Okoumé	Aucoumea klaineana Pierre (Burseraceae)
Gedu nohor; Tiama	Entandrophragma angolense (Welw.) C.DC. (Meliaceae)
Greenheart, demerara	Ocotea rodiaei (Rob. Schomb.) Mez (Lauraceae)
Grevillea; Silky oak	Grevillea robusta A. Cunn. (Proteaceae)
Guarea, black	Guarea thompsonii Sprague et Hutch. (Meliaceae)
Gum, Shouthern blue	Eucalyptus globulus Labill. (Myrtaceae)
Haiawa; Copal	Protium heptaphyllum March. (Burseraceae)
Idigbo	Terminalia ivorensis A.Chev. (Combretaceae)
Ilomba	Pycnanthus angolensis (Welw.) Warb. (Myristicaceae)
Impa	Pterygota horsfieldii (R. Br.) Kosterm. (Sterculiaceae)
Iroko, Kambala	Chlorophora excelsa (Welw.) Benth. (Moraceae)
Ironwood, red; Azobé; Ekki	Lophira alata Banks ex Gaertn. f. (Ochnaceae)

Kabukalli	Goupia glabra Aubl. (Celastraceae)
Haiawa; Copal	Protium heptaphyllum (Aubl.) March. (Burseraceae)
Kambala; Iroko	Chlorophora excelsa (Welw.) Benth. (Moraceae)
Kasai; Matoa; Megan	Pometia pinnata Forst. (Sapindaceae)
Kauri, North Queensland	Agathis palmerstoni F. Muell. (Araucariaceae)
Khaya, white; African mahagony; Krala	Khaya anthotheca (Welw.) C.DC. (Meliaceae)
Krala; White khaya; African mahagony	Khaya anthotheca (Welw.) C.DC. (Meliaceae)
Lignum vitae	Guaiacum sanctum L. (Zygophyllaceae)
Limba; Afara	Terminalia superba Engl. et Diels (Combretaceae)
Limpaga; Toon	Toona sureni Merr. (Meliaceae)
Locust, West Indian; Courbaril	Hymenaea courbaril L. (Leguminosae-Caes.)
Lolagbola; Tchitola	Oxystigma oxyphyllum (Harms) J. Léonard (Leguminosae-Caes.)
Long John	Triplaris surinamensis Cham. (Polygonaceae)
Louro, red; Determa	Ocotea rubra Mez (Lauraceae)
Mahogany, African; Senegal mahogeny	Khaya senegalensis (Desv.) A. Juss. (Meliaceae)
Mahogany, African; White Khaya; Krala	Khaya anthotheca (Welw.) C.DC. (Meliaceae)
Mahogany, Central American	Swietenia macrophylla King (Meliaceae)
Mahogany, Cuban	Swietenia mahagoni (L.) Jacq. (Meliaceae)
Mahogany, Senegal; African mahogeny	Khaya senegalensis (Desv.) A. Juss. (Meliaceae)
Makoré	Tieghemella heckelii (A. Chev.) Roberty (syn. Mimusops heckelii (A. Chev.) Hutch. et Dalz.) (Sapotaceae)
Mangrove, Asiatic	Rhizophora conjugata L. (syn. of Bruguiera gymnorhiza (L.) Lam.) (Rhizophoraceae)
Mansonia; Bété	Mansonia altissima (A. Chev.) A. Chev. (Sterculiaceae)
Matoa; Megan; Kasai	Pometia pinnata Forst. (Sapindaceae)
Megan; Matoa; Kasai	Pometia pinnata Forst. (Sapindaceae)
Meranti, light red; Meranti, white; Balau	Shorea spec. (Dipterocarpaceae)
Merawan	Hopea papuana Diels (Dipterocarpaceae)
Merbau; Mirabow	Intsia bijuga O. Ktze. (syn. of Afzelia bijuga A. Gray) (Leguminosae-Caes.)
Mirabow; Merbau	Intsia bijuga O. Ktze. (syn. of Afzelia bijuga A. Gray) (Leguminosae-Caes.)

Moabi	Baillonella toxisperma Pierre (syn. Mimusops djave Engl.) (Sapotaceae)
Mora; Moraballi	Mora excelsa Benth. (Leguminosae-Caes.)
Moraballi; Mora	Mora excelsa Benth. (Leguminosae-Caes.)
Morabukea	Mora gonggrijpii (Kleinh.) Sandw. (Leguminosae-Caes.)
Muhuhu	Brachylaena hutchinsii Hutch. (Asteraceae)
Mukulungu; Yoli	Autranella congolensis A.Chev. (Sapotaceae)
Mutenye	Guibourtia arnoldiana (De Wild. et Th. Dur.) J. Léonard (Leguminosae-Caes.)
Niangon	Tarrietia utilis Sprague (syn. of Heritiera utilis (Sprague) Sprague) (Sterculiaceae)
Niové; Camashi	Staudtia stipitata Warb. (Myristicaceae)
Oak, silky; Grevillea	Grevillea robusta A. Cunn. (Proteaceae)
Obeche; Wawa	Triplochiton scleroxylon K. Schum. (Sterculiaceae)
Ocotea	Ocotea spec. (Lauraceae)
Okoumé; Gaboon	Aucoumea klaineana Pierre (Burseraceae)
Olon; East African satinwood	Fagara macrophylla (Oliv.) Engl. (Rutaceae)
Opepe; Bilinga	Nauclea diderrichii (De Wild. et Th. Dur.) Merr. (syn. of N. trillesii (Pierre ex De Wild.) Merr.) (Rubiaceae)
Ozigo	Dacryodes buettneri (Engl.) H.J. Lam (Burseraceae)
Padauk, African	Pterocarpus soyauxii Taub. (Leguminosae-Pap.)
Padauk, Manila; Amboyna	Pterocarpus indicus Willd. (Leguminosae-Pap.)
Peroba de campos; White peroba	Paratecoma peroba (Record) Kuhlm. (Bignoniaceae)
Peroba, white; Peroba de campos	Paratecoma peroba (Record) Kuhlm. (Bignoniaceae)
Pine, parana; Brazilian araucaria	Araucaria angustifolia O. Ktze. (Araucariaceae)
Podocarpus	Podocarpus spec. (Podocarpaceae)
Pulai; White cheesewood	Alstonia scholaris R. Br. (Apocynaceae)
Purpleheart	Peltogyne pubescens Benth. (Leguminosae-Pap.)
Quaruba	Vochysia tomentosa (G.F.W. Mey.) DC. (Vochysiaceae)
Rosewood, Brazilian; Rio rosewood	Dalbergia nigra Allem. ex Benth. (Leguminosae-Pap.)
Rosewood, Indian	Dalbergia latifolia Roxb. (Leguminosae-Pap.)

Rosewood, Rio; Brazilian rosewood	Dalbergia nigra Allem. ex Benth. (Leguminosae-Pap.)
Satinwood, East African; Olon	Fagara macrophylla (Oliv.) Engl. (Rutaceae)
Satinwood, Nigerian; Ayan	Distemonanthus benthamianus Baill. (Leguminosae-Caes.)
Shorea	Shorea spec. (Dipterocarpaceae)
Silk-cotton tree; Ceiba	Ceiba pentandra (L.) Gaertn. (Bombacaceae)
Simaruba	Simaruba amara Aubl. (Simarubaceae)
Sucupira; Tatabu	Diplotropis purpurea (L.C. Rich.) Amsh. (Leguminosae-Pap.)
Tarrietia	Tarrietia spec. (Sterculiaceae)
Tatabu; Sucupira	Diplotropis purpurea (L.C. Rich.) Amsh. (Leguminosae-Caes.)
Tchitola; Lolagbola	Oxystigma oxyphyllum (Harms) J. Léonard (Leguminosae-Caes.)
Teak	Tectona grandis L.f. (Verbenaceae)
Tiama; Gedu nohor	Entandrophragma angolense (Welw.) C.DC. (Meliaceae)
Toon; Limpaga	Toona sureni Merr. (Meliaceae)
Vinhatico	Plathymenia reticulata Benth. (Leguminosae-Mim.)
Virola; Dalli	Virola surinamensis Warb. (syn. of Myristica surinamensis Roland ex Rottb.) (Myristicaceae)
Wacapou	Vouacapoua americana Aubl. (Leguminosae-Caes.)
Wallaba, soft	Eperua jenmani Oliv. (Leguminosae-Caes.)
Walnut, Queensland; Australian endiandra	Endiandra palmerstoni C.T. White (Lauraceae)
Wawa; Obeche	Triplochiton scleroxylon K. Schum. (Sterculiaceae)
Wengé; Awong	Millettia laurentii Wildem. (Leguminosae-Pap.)
Wulo; Essia	Combretodendron africanum Exell (Lecythidaceae)
Yoli; Mukulungu	Autranella congolensis A. Chev. (Sapotaceae)
Zebrano; Zingana	Microberlinia spec. (Leguminosae-Caes.)
Zingana; Zebrano	Microberlinia spec. (Leguminosae-Caes.)

6.2. Alphabetical arrangement of the treated tropical commercial timbers according to genus and species

Between brackets behind scientific name: family; serial number in key.

Scientific name	*Trade name*
Afrormosia elata Harms (syn. of Pericopsis elata (Harms) v. Meeuwen) (Leguminosae-Pap.; 14)	Afrormosia
Afzelia africana Sm. (Leguminosae-Caes.; 64)	Afzelia
Agathis palmerstoni F. Muell. (Araucariaceae; 5)	North Queensland kauri
Alstonia scholaris R.Br. (Apocynaceae; 95)	Pulai; White cheesewood
Andira spec. (Leguminosae-Pap.; 61, 79)	Andira
Anisoptera spec. (Dipterocarpaceae; 42, 109, 130)	Anisoptera
Araucaria angustifolia (Bert.) O. Ktze. (Araucariaceae; 5)	Parana pine; Brazilian araucaria
Aucoumea klaineana Pierre (Burseraceae; 117, 132, 137)	Okoumé; Gaboon
Autranella congolensis A.Chev. (Sapotaceae; 104)	Mukulungu; Yoli
Baillonella toxisperma Pierre (syn.Mimusops djave Engl.) (Sapotaceae; 100)	Moabi
Brachylaena hutchinsii Hutch. (Asteraceae; 13)	Muhuhu
Canarium schweinfurthii Engl. (Burseraceae; 118, 131, 137)	African canarium
Carapa procera DC. (Meliaceae; 69, 59)	Guiana crabwood; Andiroba
Cedrela odorata L. (Meliaceae; 8)	Cigarbox cedar; Central American cedar
Ceiba pentandra (L.) Gaertn. (Bombacaceae; 44)	Ceiba; Silk-cotton tree
Chlorophora exelsa (Welw.) Benth. (Moraceae; 73, 80)	Iroko; Kambala
Cinnamomum camphora T. Nees et Eberm. (Lauraceae; 19)	Japanese camphor tree
Combretodendron africanum Exell (Lecythidaceae; 114, 120)	Essia; Wulo
Dacryodes buettneri (Engl.) H.J.Lam (Burseraceae; 124, 138)	Ozigo
Dalbergia latifolia Roxb. (Leguminosae-Pap.; 31)	Indian rosewood

Dalbergia nigra Allem. ex Benth. (Leguminosae-Pap.; 27, 31	Rio rosewood; Brazilian rosewood
Dicorynia guianensis Amsh. (Leguminosae-Caes.; 26, 29)	Basralocus
Diospyros ebenum Koenig (Ebenaceae; 103)	East Indian ebony; Ceylon ebony
Diplotropis purpurea (L.C. Rich.) Amsh. (syn. Diplotropis guianensis Benth.) (Leguminosae-Pap.; 79)	Tatabu; Sucupira
Dipterocarpus retusus Bl. (Dipterocarpaceae; 76, 87)	Dipterocarpus
Distemonanthus benthamianus Baill. (Leguminosae-Caes.; 28)	Ayan; Nigerian satinwood
Dracontomelon magniferum Bl. (syn. of D. dao (Blanco) Merr. et Rolfe) (Anacardiaceae; 112, 126)	Dao
Endiandra palmerstoni C.T.White (Lauraceae; 99, 119)	Australian endiandra; Queensland walnut
Entandrophragma angolense (Welw.) C.DC. (Meliaceae; 109)	Tiama; Gedu nohor
Eperua jenmani Oliv. (Leguminosae-Caes.; 51)	Soft wallaba
Eucalyptus globulus Labill. (Myrtaceae; 110)	Southern blue gum
Fagara macrophylla (Oliv.) Engl. (Rutaceae; 74, 84, 89)	Olon; East African satinwood
Fitzroya cupressoides (Mol.) Johnst. (Cupressaceae; 3)	Alerce
Goupia glabra Aubl. (Celastraceae; 47)	Kabukalli
Grevillea robusta A.Cunn. (Proteaceae; 38)	Silky oak; Grevillea
Guaiacum sanctum L. (Zygophyllaceae; 11, 21)	Lignum vitae
Guarea thompsonii Sprague et Hutch. (Meliaceae; 104)	Black guarea
Guibourtia arnoldiana (De Wild. et Th. Dur.) J. Léonard (Leguminosae-Caes.; 70)	Mutenye
Hopea papuana Diels (Dipterocarpaceae; 58, 99)	Merawan
Hymenaea courbaril L. (Leguminosae-Caes.; 63)	Courbaril; West Indian locust
Intsia bijuga O.Ktze. (syn. of Afzelia bijuga A. Gray) (Leguminosae-Caes.; 56, 59, 64, 67)	Merbau; Maribow
Khaya anthotheca (Welw.) C.DC. (Meliaceae; 43, 108)	Krala; White khaya; African mahogany

Khaya senegalensis (Desv.) A. Juss. (Meliaceae; 43)	African mahogany; Senegal mahogany
Lophira alata Banks ex Gaertn. f. (Ochnaceae; 93)	Azobé; Ekki; Red ironwood
Mansonia altissima (A. Chev.) A.Chev. (Sterculiaceae; 12, 30)	Mansonia; Bété
Microberlinia spec. (Leguminosae-Caes.; 65, 82)	Zebrano, Zingana
Millettia laurentii Wildem. (Leguminosae-Pap.; 24)	Wengé; Awong
Mimusops heckelii (A. Chev.) Hutch. et Dalz. (syn. of Tieghemella heckelii (A. Chev.) Roberty) (Sapotaceae; 101)	Makoré
Mitragyna ciliata Aubrev. et Pellegr. (syn. of Hallea ciliata (Aubrev. et Pellegr.) Leroy) (Rubiaceae; 19)	Abura
Mora excelsa Benth. (Leguminosae-Caes.; 59)	Mora; Moraballi
Mora gonggrijpii (Kleinh.) Sandw. (Leguminosae-Caes.; 58)	Morabukea
Nauclea diderrichii (De Wild. et Th. Dur.) Merr. (syn. of N. trillesii (Pierre ex De Wild.) Merr.) (Rubiaceae; 135)	Opepe; Bilinga
Nectandra pisi Miq. (Lauraceae; 48, 121, 135)	Yellow cirouaballi
Nesogordonia papaverifera (A. Chev.) R.Cap. (Tiliaceae; 14)	Danta
Nothofagus dombeyi Bl. (syn. of Fagus dombeyi Mirb.) (Fagaceae; 18)	Coigue; Chilean beech
Ochroma lagopus Sw. (syn. of O. pyramidale Urb.) (Bombacaceae; 45)	Balsa; Corkwood
Ocotea guianensis Aubl. (Lauraceae; 118, 124)	Canela
Ocotea rodiaei (Rob. Schomb.) Mez (Lauraceae; 82, 89, 139)	Demerara greenheart
Ocotea rubra Mez (Lauraceae; 132)	Red louro; Determa
Ocotea spec. (Lauraceae; 122)	Ocotea
Oxystigma oxyphyllum (Harms) J.Léonard (Leguminosae- Caes.; 67)	Tchitola; Lolagbola
Palaquium supfianum Schlecht. (Sapotaceae; 96)	Balam
Paratecoma peroba (Record) Kuhlm. (Bignoniaceae; 18)	Peroba de campos; White peroba
Peltogyne pubescens Benth. (Leguminosae-Pap.; 62, 70)	Purpleheart
Piptadeniastrum africanum (Hook.f.) Brenan (Leguminosae-Mim.; 85, 88)	Dabema; Dahoma

Plathymenia reticulata Benth. (Leguminosae-Mim.; 34, 117)	Vinhatico
Podocarpus spec. (Podocarpaceae; 4)	Podocarpus
Pometia pinnata Forst. (Sapindaceae; 115)	Matoa; Megan; Kasai
Protium heptaphyllum (Aubl.) March. (Burseraceae; 16)	Copal; Haiawa
Pterocarpus indicus Willd. (Leguminosae-Pap.; 32)	Manila padauk; Amboyna
Pterocarpus soyauxii Taub. (Leguminosae-Pap.; 32)	African padauk
Pterygota horsfieldii (R. Br.)Kosterm. (Sterculiaceae; 40)	Impa
Pycnanthus angolensis (Welw.) Warb. (Myristicaceae; 45)	Ilomba
Rhizophora conjugata L. (syn. of Bruguiera gymnorhiza (L.) Lam.) (Rhizophoraceae; 15)	Asiatic mangrove
Ricinodendron heudelotii (Baill.) Pierre ex Pax (Euphorbiaceae; 93, 112, 126)	Essessang; Erimado
Shorea balangeran Burck (Dipterocarpaceae; 76, 77, 87)	Belangeran, Balangeran
Shorea spec. (Dipterocarpaceae; 51)	Shorea; Meranti light red; Meranti white; Balau
Simaruba amara Aubl. (Simarubaceae; 23)	Simaruba
Staudtia stipitata Warb. (Myristicaceae; 49, 107, 129)	Niové; Camashi
Swietenia macrophylla King (Meliaceae; 68)	Central American mahogany
Swietenia mahagoni (L.) Jacq. (Meliaceae; 23)	Cuban mahogany
Tarrietia spec. (Sterculiaceae; 36)	Tarrietia
Tarrietia utilis Sprague (syn. of Heritiera utilis (Sprague) Sprague) (Sterculiaceae; 36)	Niangon
Tectona grandis L.f. (Verbenaceae; 7)	Teak
Terminalia ivorensis A.Chev. (Combretaceae; 85)	Idigbo
Terminalia superba Engl. et Diels (Combretaceae; 80)	Limba; Afara
Tieghemella heckelii (A. Chev.) Roberty (syn. Mimusops heckelii (A. Chev.) Hutch. et Dalz.) (Sapotaceae; 101, 102)	Makoré
Toona sureni Merr. (Meliaceae; 8)	Limpaga; Toon
Triplaris surinamensis Cham. (Polygonaceae; 139)	Long John
Triplochiton scleroxylon K.Schum. (Sterculiaceae; 35)	Obeche; Wawa

Turraeanthus africanus (Welw. ex DC.) Pellegr. (Meliaceae; 123, 129, 134)	Avodiré
Virola surinamensis Warb. (syn. of Myristica surinamensis Roland ex Rottb.) (Myristicaceae; 49)	Virola; Dalli
Vochysia tomentosa (G.F.W. Mey.) DC. (Vochysiaceae; 40, 61, 92)	Quaruba
Vouacapoua americana Aubl. (Leguminosae-Caes.; 74)	Wacapou

6.3. Alphabetical arrangement of the treated tropical commercial timbers according to family

Between brackets behind scientific name: trade name(s)

Anacardiaceae
Dracontomelon magniferum Bl. (syn. of D. dao (Blanco) Merr. et Rolfe) (Dao)
Apocynaceae
Alstonia scholaris R.Br. (Pulai; White cheesewood)
Araucariaceae
Agathis palmerstoni F. Muell. (North Queensland kauri)
Araucaria angustifolia (Bert.) O.Ktze. (Parana pine; Brazilian araucaria)
Asteraceae
Brachylaena hutchinsii Hutch. (Muhuhu)
Bignoniaceae
Paratecoma peroba (Record) Kuhlm. (Peroba de campos; White peroba)
Bombacaceae
Ceiba pentandra (L.) Gaertn. (Ceiba; Silk-cotton tree)
Ochroma lagopus Sw. (syn. of O. pyramidale Urb.) (Balsa; Corkwood)
Burseraceae
Aucoumea klaineana Pierre (Okoumé; Gaboon)
Canarium schweinfurthii Engl. (African canarium)
Dacryodes buettneri (Engl.) H.J.Lam (Ozigo)
Protium heptaphyllum (Aubl.) March. (Copal; Haiawa)
Caesalpiniaceae. See *Leguminosae – Caesalpinioideae*
Celastraceae
Goupia glabra Aubl. (Kabukalli)
Combretaceae
Terminalia ivorensis A.Chev. (Idigbo)
Terminalia superba Engl. et Diels (Limba; Afara)

Cupressaceae
Fitzroya cupressoides (Mol.) Johnst. (Alerce)
Dipterocarpaceae
Anisoptera spec. (Anisoptera)
Dipterocarpus retusus Bl. (Dipterocarpus)
Hopea papuana Diels (Merawan)
Shorea balangeran Burck (Belangeran; Balangeran)
Shorea spec. (Shorea; Meranti light red; Meranti white; Balau)
Ebenaceae
Diospyros ebenum Koenig (Ceylon ebony; East Indian ebony)
Euphorbiaceae
Ricinodendron heudelotii (Baill.) Pierre ex Pax (Erimado; Essessang)
Fagaceae
Nothofagus dombeyi Bl. (syn. of Fagus dombeyi Mirb.) (Coigue; Chilean beach)
Lauraceae
Cinnamomum camphora T. Nees et Eberm. (Japanese camphor tree)
Endiandra palmerstoni C.T. White (Australian endiandra; Queensland walnut)
Nectandra pisi Miq. (Yellow cirouaballi)
Ocotea guianensis Aubl. (Canela)
Ocotea rodiaei (Rob. Schomb.) Mez (Demerara greenheart)
Ocotea rubra Mez (Red louro; Determa)
Ocotea spec. (Ocotea)
Lecythidaceae
Combretodendron africanum Exell (Essia; Wulo)
Leguminosae – Caesalpinioideae
Afzelia africana Sm. (Afzelia)
Dicorynia guianensis Amsh. (Basralocus)
Distemonanthus benthamianus Baill. (Ayan; Nigerian satinwood)
Eperua jenmani Oliv. (Soft wallaba)
Guibourtia arnoldiana (De Wild. et Th. Dur.) J.Léonard (Mutenye)
Hymenaea courbaril L. (Courbaril; West Indian locust)
Intsia bijuga O.Ktze. (syn. of Afzelia bijuga A. Gray) (Merbau; Mirabow)
Microberlinia spec. (Zebrano; Zingana)
Mora excelsa Benth. (Mora; Moraballi)
Mora gonggrijpii (Kleinh.) Sandw. (Morabukea)
Oxystigma oxyphyllum (Harms) J.Léonard (Tchitola; Lolagbola)
Vouacapoua americana Aubl. (Wacapou)
Leguminosae – Mimosoideae
Piptadeniastrum africanum (Hook.f.) Brenan (Dahoma; Dabema)
Plathymenia reticulata Benth. (Vinhatico)
Leguminosae – Papilionoideae
Afrormosia elata Harms (syn. of Pericopsis elata (Harms) v. Meeuwen) (Afrormosia)
Andira spec. (Andira)
Dalbergia latifolia Roxb. (Indian rosewood)

Dalbergia nigra Allem. ex Benth. (Rio rosewood; Brazilian rosewood)
Diplotropis purpurea (L.C. Rich.) Amsh. (Tatabu; Sucupira)
Millettia laurentii Wildem. (Wengé; Awong)
Peltogyne pubescens Benth. (Purpleheart)
Pterocarpus indicus Willd. (Manila padauk; Amboyna)
Pterocarpus soyauxii Taub. (African padauk)
Meliaceae
Carapa procera DC. (Guiana crabwood; Andiroba)
Cedrela odorata L. (Cigarbox cedar; Central American cedar)
Entandrophragma angolense (Welw.) C.DC. (Tiama; Gedu nohor)
Guarea thompsonii Sprague et Hutch. (Black guarea)
Khaya anthotheca (Welw.) C.DC. (White khaya; Krala; African mahogany)
Khaya senegalensis (Desv.) A.Juss. (African mahogany; Senegal mahogany)
Swietenia macrophylla King (Central American mahogany)
Swietenia mahagony (L.) Jacq. (Cuban mahogany)
Toona sureni Merr. (Limpaga; Toon)
Turraeanthus africanus (Welw. ex DC.) Pellegr. (Avodiré)
Mimosaceae. See *Leguminosae – Mimosoideae*
Moraceae
Chlorophora exelsa (Welw.) Benth. (Iroko, Kambala)
Myristicaceae
Pycnanthus angolensis (Welw.)Warb. (Ilomba)
Staudtia stipitata Warb. (Niové; Camashi)
Virola surinamensis Warb. (syn. of Myristica surinamensis Roland ex Rottb.) (Virola; Dalli)
Myrtaceae
Eucalyptus globulus Labill. (Southern blue gum)
Ochnaceae
Lophira alata Banks ex Gaertn. f. (Azobé; Red ironwood; Ekki)
Papilionaceae. See *Leguminosae – Papilionoideae*
Podocarpaceae
Podocarpus spec. (Podocarpus)
Polygonaceae
Triplaris surinamensis Cham. (Long John)
Proteaceae
Grevillea robusta A.Cunn. (Silky oak; Grevillea)
Rhizophoraceae
Rhizophora conjugata L. (syn. of Bruguiera gymnorhiza (L.) Lam.) (Asiatic mangrove)
Rubiaceae
Mitragyna ciliata Aubrev. et Pellegr. (syn. of Hallea ciliata (Aubrev. et Pellegr.) Leroy) (Abura)
Nauclea diderrichii (De Wild. et Th. Dur.) Merr. (syn. of N. trillesii (Pierre ex De Wild.) Merr.) (Bilinga; Opepe)

Rutaceae
Fagara macrophylla (Oliv.) Engl. (Olon; East African satinwood)
Sapindaceae
Pometia pinnata Forst. (Matoa; Megan; Kasai)
Sapotaceae
Autranella congolensis A. Chev. (Mukulungu; Yoli)
Baillonella toxisperma Pierre (syn. Mimusops djave Engl.) (Moabi)
Mimusops heckelii (A. Chev.)Hutch. et Dalz. (syn. of Tieghemella heckelii (A. Chev.) Roberty) (Makoré)
Palaquium supfianum Schlecht. (Balam)
Tieghemella heckelii (A. Chev.) Roberty (Makoré)
Simarubaceae
Simaruba amara Aubl. (Simaruba)
Sterculiaceae
Mansonia altissima (A. Chev.) A. Chev. (Mansonia; Bété)
Pterygota horsfieldii (R. Br.) Kosterm. (Impa)
Tarrietia spec. (Tarrietia)
Tarrietia utilis Sprague (syn. of Heritiera utilis (Sprague) Sprague) (Niangon)
Triplochiton scleroxylon K.Schum. (Obeche; Wawa)
Tiliaceae
Nesogordonia papaverifera (A. Chev.) R.Cap. (Danta)
Verbenaceae
Tectona grandis L.f.(Teak)
Vochysiaceae
Vochysia tomentosa (G.F.W. Mey.) DC. (Quaruba)
Zygophyllaceae
Guaiacum sanctum L. (Lignum vitae)

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