MULTILINGUAL GLOSSARY OF TERMS USED IN WOOD ANATOMY

Committee on Nomenclature

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Awn. → Callitrisoid thickening.

Bark. (1) — A non-technical term used to cover all the tissues outside the xylem cylinder. In older trees usually divisible into inner (living), → Phloem, and outer (dead), → Rhytidome.

Bark, early. (2) — The bark formed during the earlier stages of the season (→ early wood). Note: In typical cases (*Alnus*, *Betula*) consisting mainly of sieve tubes with companion cells, or sieve cells.

Bark, hard. (3) — The part of the bark that consists of fibres or other strengthening cells: sometimes in concentric layers that alternate within a growth ring with layers of soft bark, or more irregularly distributed in a ground tissue of soft bark. A layer of hard bark formed at the end of the season (as in *Quercus* and *Castanea*) is called the Terminal layer.

Bark, late. (4) — The bark formed during the later stages of the season (→ late wood). In typical cases consisting mainly of bark parenchyma and only fewer and smaller sieve tubes or sieve cells. At the end of the season there is sometimes a terminal layer (→ Bark, hard) of fibres.

Bark, soft. (5) — The part of the bark that consists of sieve tubes and parenchymatous and suberized cells, but not including fibres or other strengthening cells; present either as concentric layers that alternate within a growth ring with layers of hard bark, or forming a ground tissue in which the cells of the hard bark are irregularly distributed.

Brachysclereid. → Stone cell.

Callitrisoid, thickening. (6) — Pairs of bars of thickening across the pit, as in *Callitris*. Also described as awns when seen in section. Syn. Awn.

Cambial initial. (7) — An individual cell of the cambium (→ Fusiform initial and Ray initial).

Cambial zone. (8) — A term of convenience for the layer of varying width composed of cambial initials and their undifferentiated derivatives.

Cambium. (9) — The actively dividing layer of cells that lies between, and gives rise to, secondary xylem and phloem (vascular cambium).

Cambium, cork. → Phellogen.

Cambium, storied. (10) — Cambium characterized by a horizontal seriation of the initials.

Cell. (11) — A chamber or compartment at some time containing a protoplast; cells form the structural units of plant tissues.

Cell wall. (12) — The limiting membrane of a cell. In mature cells it consists ontogenetically of several superimposed walls, as follows:
Primary wall. The wall of the meristematic cell modified during differentiation (not to be confused with the thin, markedly anisotropic, first-formed part of the secondary wall). → Lamella, compound middle.
Secondary wall. The wall formed inside the primary wall.
Tertiary wall. Innermost layer of the cell wall next to the cell-lumen, often with warts.

Cell wall check. (13) — A fissure in the secondary cell wall, as in the tracheids of compression wood.

Companion cell. (14) — A sister cell of a sieve-tube member, intimately connected with it and retaining the nucleus and dense cytoplasm. Note: Companion cells may undergo some transverse or other divisions preceding their differentiation.

Conjunctive tissue. (15) — A special type of parenchyma associated with included phloem. Note: Sometimes forming anastomosing concentric bands, as in *Avicennia*, or enclosing the phloem strand, as in *Strychnos*.

Cork. (16) — A non-technical term for phellem.

Cortex. (17) — The primary ground tissue of a stem or root between the epidermis or phellem and the vascular system.

Crassula(e). (18) — The thicker portion of the intercellular layer and primary cell walls between primary pit-fields.

Cross-field. (19) — A term of convenience for the rectangle formed by the walls of a ray cell and an axial tracheid, as seen in a radial section. Used mainly for conifers.

Crystal. (20) — The following are among the types commonly distinguished:

Acicular. A slender, needle-shaped crystal. Note: Not to be confused with a styloid, which is a columnar crystal.

Crystal sand. A granular mass of very fine crystals.

Druse. A globular cluster of crystals, sometimes with an organic core, either attached to the cell wall by a peg or lying free in the cell.

Raphid(e), raphis, pl. **raphides.** A needle-shaped (acicular) crystal occurring typically as one of a closely packed, sheaf-like bundle.

Styloid. An elongated crystal, typically about four times as long as broad, with pointed or square ends.

Crystalliferous cell. (21) — A cell containing one or more crystals. Note: Radial and axial parenchyma cells are often crystalliferous; fibres less commonly.

Crystalliferous cell, chambered. (22) — A crystalliferous cell that is divided into compartments by septa.

Druse. → Crystal.

Element. (23) — A general term used for an individual cell. Note: Used in wood anatomy, particularly to distinguish between vessels and the individual cells of which they are composed—the vessel elements or vessel members.

Elements, axial. (24) — A term of convenience in wood anatomy for all the cells other than those of the rays.

Elements, congeneric. (25) — Cells of the same anatomical type.

Elements, storied. (26) — Cells arranged in tiers as seen on the tangential surface.

Elements, vertical. → Elements, axial.

End wall. (27) — A term of convenience in wood anatomy for (a) A wall at right angles to the longitudinal axis of a parenchyma cell, i.e. for the tangential walls of ray cells or the transverse walls of axial parenchyma cells, and (b) The oblique or transverse

wall between two vessel members.

End wall, nodular. (28) — The end wall of a parenchyma cell having a beaded appearance in sectional view.

Epidermis. (29) — The outermost layer of cells on the primary plant body; often with strongly thickened and cuticularized outer walls; sometimes consisting of more than one layer of cells.

Epithelial cell. (30) — A cell of the epithelium.

Epithelial layer. → Epithelium.

Epithelium. (31) — The layer of secretory parenchymatous cells that surrounds an intercellular canal or cavity. Syn. Epithelial layer.

Fibre, Fiber (Am.). (32) — A general term of convenience in wood anatomy for any long, narrow cell of wood or bast other than vessels and parenchyma. Note: Often further qualified as wood fibres or bast fibres; the former including both the tracheids of gymnosperms and the libriform wood fibres and fibre-tracheids of woody angiosperms. Also used loosely for wood elements in general.

Fibre, bast. (33) — A fibre of the phloem.

Fibre, gelatinous. (34) — A fibre having a more or less unlignified inner wall with a gelatinous appearance (→ Wood, tension).

Fibre, intermediate. → Parenchyma cell, fusiform.

Fibre, libriform wood. (35) — An elongated, commonly thick-walled cell with simple pits; usually distinctly longer than the cambial initial as inferred from the length of vessel members and parenchyma strands.

Fibre, septate wood. (36) — A fibre with thin transverse walls across the lumen. Note: In these elements the protoplast divides after the formation of the secondary cell wall.

Fibre, substitute. → Parenchyma cell, fusiform.

Fibre, wood. (37) — A fibre of the xylem.

Fibre-tracheid. (38) — A fibre-like tracheid; commonly thick-walled with a small lumen, pointed ends, and bordered pit-pairs having lenticular to slit-like apertures. This term is applicable to the late wood tracheids of gymnosperms as well as to the fibre-like tracheids of woody angiosperms.

Fibril. (39) — A thread-like component of cell walls, visible under an optical or light microscope. Note: This term, used without qualification, is equivalent to "macrofibril" as opposed to the ultrastructural "microfibril".

Fibril angle. (40) — The angle between the longitudinal axis of the cell and the direction of the fibrils in the cell wall.

Fusiform initial. (41) — A cambial initial giving rise to an axial element of xylem or phloem; it is spindle-shaped (fusiform) as seen in tangential section.

Glassy wood. → Wood, compression.

Growth layer. (42) — A layer of wood or bark produced apparently during one growing period; frequently, especially in woods of the temperate zones, divisible into early and late wood or bark.

Gum duct. (43) — An intercellular canal containing gum.

Hard streak. → Wood, compression.

Heartwood. (44) — 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 (→ Wood, intermediate).

Idioblast. (45) — A cell differing markedly in form and contents from other constituents of the same tissue. Note: Examples in wood are certain crystalliferous cells, oil cells and mucilage cells.

Indenture. (46) — A narrow groove in the transverse (horizontal) wall of a ray cell along the junction with the tangential (end) wall. In radial section an indenture

appears as a depression in the transverse wall where the tangential wall is inserted. Note: Used only for conifers.

Intercellular canal. (47) — A tubular intercellular space of indeterminate length, generally serving as a repository for resin, gum, etc., secreted by the epithelium. Note: May be (a) axial, or (b) radial (within a ray). Syn. Resin canal, Gum duct (→ Intercellular cavity).

Intercellular canal, radial. (48) — A canal extending across the grain in a radial direction, contained in a fusiform ray.

Intercellular canal, traumatic. (49) — A canal formed in response to injury to the living tree. Note: Often abnormal in size and may be axial or radial.

Intercellular cavity. (50) — An intercellular space of limited length, generally serving as a repository for resin, gum, etc., and generally formed in response to injury to the living tree (→ Intercellular canal).

Intercellular layer. (51) — The layer between adjacent cells; it is isotropic and lacks cellulose. Syn. Middle lamella. Note: The intercellular layer often appears to merge imperceptibly into the primary cell walls (→ Lamella, compound middle), and special techniques may be needed distinguish it.

Intercellular space. (52) — A space between cells. Two types can be distinguished:
Secretory, including intercellular canals and intercellular cavities, which may be schizogenous, lysigenous or schizo-lysigenous.
Non-secretory, i.e. an interstitial space.

Interstitial space. (53) — A non-secretory space between cells.

Lamella, compound middle. (54) — In wood anatomy a term of convenience for the compound layer between the secondary walls of adjacent cells, consisting of two primary cell walls and an intercellular layer of varying thickness.

Lamella, middle. → See Intercellular layer.

Latex canal. → Latex tube.

Latex trace. (55) — A term used to describe the slit-like passages (as they appear in seasoned timber) running radially through the wood of certain latex-bearing trees (notably *Alstonia* spp. and *Dyera* spp. of the *Apocynaceae*). They are characterized by the presence of latex tubes and have their origin in the traces from the leaves and axial buds. Incorrectly called latex canals and latex ducts (→ Latex tube).

Latex tube. (56) — A laticifer enclosed in a ray. Note: The tubes are modified cells or series of cells and not intercellular canals.

Laticifer. (57) — A general term for cells containing latex. Note: May be a single cell or a series of tubular cells.

Lenticel. (58) — A specialized portion of the periderm, variously shaped, but often lenticular, consisting of loosely arranged cells that are never more than slightly suberized; serving for the exchange of gases through the otherwise impermeable periderm.

Lumen, pl. lumina. (59) — The cell cavity.

Lysigenous. (60) — Formed by a disorganization or dissolving of cells.

Medullary ray. → Ray.

Meristem. (61) — A tissue capable of active cell division, thereby adding new cells to the plant body (→ Meristem, apical and Cambium).

Meristem, apical. (62) — The meristem at the growing point of shoots and roots.

Metaxylem. (63) — Later-formed primary xylem, with pitted tracheary elements (→ Protoxylem).

Mucilage cell. (64) — A specialized cell of the ray or axial parenchyma containing mucilage; typically rounded in outline. Note: Limited to woody dicotyledons and similar to an oil cell, except for contents.

Oil cell. (65) — A specialized cell of the ray or axial parenchyma containing oil, typically rounded in outline. Note: Limited to woody dicotyledons and similar to a mucilage cell, except for contents.

Parenchyma. (66) — Tissue composed of cells that are typically brick-shaped or isodiametric and have simple pits; formed in wood from (a) fusiform cambial initials by later transverse divisions of the daughter cells (axial parenchyma), or (b) ray initials (ray or radial parenchyma). Syn. Soft tissue, Storage tissue. (→ Parenchyma cell, fusiform). Note: Primarily concerned with the storage and distribution of food materials. Termed wood parenchyma or xylem parenchyma if occurring in the xylem, and phloem parenchyma if in the phloem.

Parenchyma, abaxial. → Parenchyma, unilaterally paratracheal.

Parenchyma, adaxial. → Parenchyma, unilaterally paratracheal.

Parenchyma, aliform. (67) — Paratracheal parenchyma with wing-like lateral extensions, as seen in cross section.

Parenchyma, apotracheal. (68) — Axial parenchyma typically independent of the pores or vessels. Note: This includes Terminal, Diffuse, and Banded apotracheal parenchyma.

Parenchyma, axial. (69) — Parenchyma cells derived from fusiform cambial initials (→ Parenchyma, ray).

Parenchyma, banded. (70) — Axial parenchyma forming concentric lines or bands, as seen in cross section. Note: Termed Apotracheal banded, if typically independent of the vessels; Paratracheal banded, if associated with the vessels.

Parenchyma, confluent. (71) — Coalesced aliform parenchyma forming irregular tangential or diagonal bands, as seen in cross section.

Parenchyma, diffuse. (72) — Single apotracheal parenchyma strands or cells distributed irregularly among fibres, as seen in cross section.

Parenchyma, diffuse-in-aggregates. (73) — Apotracheal parenchyma cells that tend to be grouped in short tangential lines from ray to ray, as seen in cross section. Syn. Diffuse-zonate. Note: This type is often also reticulate (→ Parenchyma, reticulate).

Parenchyma, disjunctive. (74) — Axial or radial parenchyma cells partially disjoined during the process of differentiation; contact is maintained by means of tubular

processes.

Parenchyma, initial. (75) — Apotracheal parenchyma cells occurring either singly or forming a more or less continuous layer of variable width at the beginning of a season's growth. (→ Parenchyma, terminal).

Parenchyma, longitudinal. → Parenchyma, axial.

Parenchyma, metatracheal. → Parenchyma, banded.

Parenchyma, paratracheal. (76) — Axial parenchyma associated with the vessels or vascular tracheids. Note: This includes Scanty paratracheal, Vasicentric, Aliform and Confluent parenchyma.

Parenchyma, phloem. (77) — Parenchyma occurring in the phloem.

Parenchyma, ray. (78) — Parenchyma composing the rays wholly or in part. Syn. Radial parenchyma.

Parenchyma, reticulate. (79) — 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 (→ Parenchyma, scalariform).

Parenchyma, scalariform. (80) — A descriptive term for the ladder-like pattern formed on the cross section by rays and regularly spaced bands or lines of axial parenchyma when the latter are distinctly narrower than the rays (→ Parenchyma, reticulate).

Parenchyma, scanty paratracheal. (81) — Incomplete sheaths or occasional parenchyma cells around the vessels.

Parenchyma, terminal. (82) — Apotracheal parenchyma cells occurring either singly or forming a more or less continuous layer of variable width at the close of a season's growth. Note: Before a distinction was made between "terminal" and "initial" parenchyma, this term was used to include both forms and is still used in this sense as a term of convenience.

Parenchyma, traumatic. (83) — Parenchyma cells of irregular size, shape and distribution resulting from injury to the cambium. Syn. Wound parenchyma.

Parenchyma, unilaterally paratracheal. (84) — Paratracheal parenchyma limited to the outer (abaxial) or inner (adaxial) sides of the vessels. Note: Such parenchyma may be further distinguished as Unilaterally scanty, Unilaterally aliform or Unilaterally confluent. Syn. Abaxial, Adaxial parenchyma.

Parenchyma, vasicentric. (85) — Paratracheal parenchyma forming a complete sheath around a vessel, of variable width and circular or slightly oval in cross section.

Parenchyma, vertical. → Parenchyma, axial.

Parenchyma, wood. → Parenchyma, xylem.

Parenchyma, wound. → Parenchyma, traumatic.

Parenchyma, xylem. (86) — Parenchyma occurring in the xylem. Usually in two systems: (a) axial, and (b) radial (ray parenchyma). Syn. Wood parenchyma.

Parenchyma cell, fusiform. (87) — An axial parenchyma cell, derived from a fusiform initial without subdivision (→ Parenchyma strand).

Parenchyma cell, septate. (88) — An axial or radial parenchyma cell with one or more thin transverse walls across its lumen. Note: In these elements the protoplast divides after the formation of the secondary cell wall.

Parenchyma strand. (89) — An axial series of two or more parenchyma cells derived from a single fusiform initial (→ Parenchyma cell, fusiform).

Perforation, multiple. (90) — A perforated end wall in a vessel element consisting of two or more openings in a perforation plate (→ Perforation, simple).

Perforation, simple. (91) — A single and usually large and more or less rounded opening in the perforation plate (→ Perforation, multiple).

Perforation, vessel. (92) — An opening from one vessel member to another.

Perforation plate. (93) — 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. (94) — A plate having a small group of circular openings (as in *Ephedra*).

Perforation plate, reticulate. (95) — A plate with multiple perforations having a net-like appearance (as in certain *Bignoniaceae*).

Perforation plate, scalariform. (96) — A plate with multiple perforations elongated and parallel. The remnants of the plate between the openings are called Bars.

Perforation rim. (97) — The remnant of a perforation plate forming a border about a simple perforation.

Periderm. (98) — The layers that replace the epidermis as the impermeable covering of older stems and roots, consisting of phellem (cork), phellogen and phelloderm.

Phellem. (99) — A tissue produced externally by the phellogen in a stem or root. The cell walls are generally suberized, and, in thick-walled kinds, there may be additional lignified layers towards the cell lumen. Unsuberized cells of the phellem are known as Phelloid cells.

Phelloderm. (100) — A tissue that generally resembles cortical parenchyma in appearance, but which consists of the inner derivatives of the phellogen. In woody plants the cells may become enlarged and thickened to form stone cells, and are sometimes radially elongated.

Phellogen. (101) — The meristematic layer that produces the periderm. Syn. Cork cambium.

Phelloid cell. → Phellem.

Phloem. (102) — The principal food-conducting tissue of the vascular plants. It occurs both as primary and secondary tissue, and is usually, but not invariably, associated with xylem. In the stems of most gymnosperms and dicotyledons the secondary phloem is separated from the secondary xylem by the cambium from which it is derived. The basic types of cells of which it is composed are sieve elements,

parenchyma cells, fibres and sclereids.

Phloem, included. (103) — Phloem strands or layers included in the secondary xylem of certain dicotyledonous woods. Two types are distinguished:
Concentric *(Corpus lignosum circumvallatum)*. The cambium is short-lived and is replaced by new meristematic tissue, which develops in either the pericycle or the cortex and repeats the structure of the young stem. The stem thus consists of alternating zones of xylem and phloem (*Avicennia* type).
Foraminate *(Corpus lignosum foraminotum)*. 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 imbedded in it (*Strychnos* type).

Phloem, internal. (104) — Primary phloem internal to the primary xylem. Syn. Perimedullary Phloem.

Phloem, perimedullary. → Phloem, internal.

Phloem, primary. (105) — First formed phloem; in stems and roots it is differentiated below the apical meristem before a definite cambium can be recognized.

Phloem, secondary. (106) — Normally, the part of the bark formed by the cambium (→Phloem).

Phloem mother cells. (107) — Cells that are cut off on the outer side by the fusiform cambial initials, but which undergo further periclinal divisions before differentiating into phloem cells.

Pit. (108) — A recess in the secondary wall of a cell, together with its external closing membrane; open internally to the lumen. Note: Essential components are the pit cavity and the pit membrane. The following are terms used in describing pits:
Blind. A pit without a complementary pit in an adjacent cell. Note: A common form occurs opposite to an intercellular space.
Bordered. Typically, a pit in which the membrane is overarched by the secondary cell wall.
Cupressoid. A cross-field pit in early wood with an ovoid, included (→ Pit aperture) aperture that is rather narrower than the lateral space on either side

between the aperture and the border, as in *Cupressus*. Note: Used only for conifers.

Fenestriform. → Pinoid.

Half-bordered. → Pit-pair, half-bordered.

Linear. A pit with an aperture that is long, narrow and of more or less uniform breadth, as seen in surface view.

Piceoid. A cross-field pit in early wood with a narrow, and often slightly extended (→Pit aperture) aperture as in *Picea*. Note: Used only for conifers.

Pinoid. A term of convenience for the smaller types of early wood cross-field pits found in several species of *Pinus* (but excluding the large, window-like, fenestriform pits found in *Pinus silvestris*, *Pinus strobus*, etc.). Characteristically simple or with narrow borders, and often variable in size and shape.

Ramiform. Simple pits with coalescent canal-like pit cavities, as in stone cells.

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.

Taxodioid. A cross-field pit in early wood, with a large, ovoid to circular, included aperture that is wider than the lateral space on either side between the aperture and the border, as in *Sequoia*. Note: Used only for conifers.

Vestured. A bordered pit with the pit cavity wholly or partially lined with projections from the tertiary cell wall.

Window-like. → Pit pinoid.

Pit aperture. (109) — The opening or mouth of a pit. The following terms are used to describe pit apertures:

Coalescent. Slit-like apertures united to form grooves on the inner surface of the secondary cell wall.

Extended. An inner aperture whose outline, in surface view, extends beyond the outline of the pit border.

Included. An inner aperture whose outline, in surface view, is included within the outline of the pit border.

Inner. The opening of the pit canal into the cell lumen.

Lenticular. A slit-like aperture with the appearance in surface view of a double convex lens seen in section.

Outer. The opening of the pit canal into the pit chamber.

Pit border. (110) — The overarching part of the secondary cell wall.

Pit canal. (111) — The passage from the cell lumen to the chamber of any bordered pit. Note: Simple pits in thick walls usually have canal-like cavities.

Pit cavity. (112) — The entire space within a pit from the membrane to the lumen.

Pit chamber. (113) — The space between the pit membrane and the overarching pit border.

Pit membrane. (114) — The part of the intercellular layer and primary cell wall that limits a pit cavity externally. A central, thicker part of a pit membrane is termed the Torus. Note: A torus with an indented or scalloped margin, as in *Cedrus*, is known as a Scalloped torus.

Pit, primordial. → Pit-field, primary.

Pit-field, primary. (115) — A thinner area of the intercellular layer and primary cell walls within the limits of which one or more pit-pairs usually develop. Syn. Primordial pit.

Pit-pair. (116) — Two complementary pits of adjacent cells.

Pit-pair, aspirated. (117) — A bordered pit-pair in which the torus (→ Pit membrane) is laterally displaced so as to block one of the apertures.

Pit-pair, bordered. (118) — An intercellular pairing of two bordered pits.

Pit-pair, half-bordered. (119) — An intercellular pairing of a simple and a bordered pit.

Pit-pair, simple. (120) — An intercellular pairing of two simple pits.

Pith. (121) — The central core of a stem, consisting chiefly of parenchyma or soft tissue.

Pith ray. → Ray.

Pith fleck. (122) — An irregular strand of abnormal (often traumatic) parenchymatous

tissue embedded in the wood and appearing on a longitudinal surface as a streak. Commonly caused by the larvae of cambium miners.

Pitting. (123) — A collective term for pits or pit-pairs.

Pitting, alternate. (124) — Multiseriate pitting in which the pits are in diagonal rows. Note: When the pits are crowded, the outlines of the borders tend to become hexagonal in surface view.

Pitting, cross-field. (125) — The pitting occurring in the rectangle formed in a radial section by the walls of a ray cell and those of an axial tracheid. Note: A term used mainly for conifers.

Pitting, intervascular. (126) — A term used (a) in a wide sense for pitting between tracheary elements, and (b) in a narrower sense in wood anatomy for pitting between vessel members.

Pitting, opposite. (127) — Multiseriate pitting in which the pits are in horizontal pairs or in short horizontal rows. Note: When the pits are crowded the outlines of the borders tend to become rectangular in surface view.

Pitting, ray-vessel. (128) — Pitting between a ray cell and a vessel member. Note: Certain anatomists distinguish the following types: Gash-like, horizontal; Gash-like, vertical; Kidney-shaped; Large rounded; Similar to the intervascular pitting.

Pitting, scalariform. (129) — Pitting in which elongated or linear pits are arranged in a ladder-like series.

Pitting, sieve. (130) — An arrangement of small pits in sieve-like clusters.

Pitting, unilaterally compound. (131) — Pitting in which one pit subtends two or more smaller pits in the cell adjacent.

Pore. (132) — A term of convenience for the cross section of a vessel or of a vascular tracheid.

Pore, solitary. (133) — A pore completely surrounded by other elements.

Pore chain. (134) — A series or line of adjacent solitary pores.

Pore cluster. → Pore multiple.

Pore multiple. (135) — 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. Note: 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.

Prosenchyma. (136) — A general term for elongated cells with tapering ends. Note: Used in the past as a collective term for the fibres and tracheids, and sometimes the vessel members, as opposed to the parenchyma.

Protoplast. (137) — The mass of protoplasm enclosed by a cell wall.

Protoxylem. (138) — First-formed primary xylem, with tracheary elements characterized by annular or spiral thickenings (→ Metaxylem).

Radial multiple. → Pore multiple.

Radial parenchyma. → Parenchyma, ray.

Raphid(es). → Crystal.

Ray. (139) — A ribbon-like aggregate of cells extending radially in the xylem and phloem. Note: The terms Medullary ray and Pith ray are now restricted to the parenchyma connecting the primary cortex with the pith.

Ray tissue, heterogeneous. Ray tissue in which the individual rays are composed wholly or in part of square or upright cells (Heterogeneous ray). Note: Not to be applied to conifers.

Ray tissue, homogeneous. Ray tissue in which the individual rays are composed wholly of procumbent cells (Homogeneous ray). Note: Not to be applied to conifers.

Ray, aggregate. (140) — A group of small, narrow, xylem rays appearing to the unaided eye or at low magnification as a single large ray.

Ray, fusiform. (141) — Literally a ray that is spindle-shaped in tangential section. Used

especially for the rays that contain resin canals in conifers. Syn. Lenticular ray.

Ray, heterogeneous. → Ray.

Ray, homogeneous. → Ray.

Ray, lenticular. → Ray, fusiform.

Ray, multiseriate. (142) — A ray two or more cells wide as seen in tangential section.

Ray, phloem. (143) — The part of a ray external to the cambium.

Ray, primary. (144) — In wood anatomy, a ray originating in the primary tissues and extended by cambial growth (→ Ray, secondary). Note: Commonly used for any ray that can be traced inwards to the pith.

Ray, secondary. (145) — In wood anatomy a ray derived from the cambium (i.e. originating after the development of secondary xylem), and not extending inwards as far as the pith (→ Ray, primary).

Ray, uniseriate. (146) — A ray one cell wide as seen in tangential section.

Ray, wood or xylem. (147) — The part of a ray internal to the cambium (→ Ray, phloem).

Ray cell, procumbent. (148) — A ray cell with its longest axis radial.

Ray cell, square. (149) — A ray cell approximately square as seen in radial section. Note: Such cells compose certain uniseriate rays and parts, typically the margins, of some multiseriate rays (→Ray cell, upright).

Ray cell, upright. (150) — A ray cell with its longest dimension axial. Note: Such cells compose certain uniseriate rays and parts, typically the margins, of some multiseriate rays.

Ray initial. (151) — A cambial initial giving rise to a ray cell; usually one of a group and often more or less isodiametric as seen in tangential section (→ Fusiform initial).

Redwood. → Wood, compression.

Ray tracheid. (152) — A tracheid forming part of a ray.

Resin canal. (153) — An intercellular canal containing resin. Syn. Resin duct.

Resin duct. → Resin canal.

Rhytidome. (154) — The phellem and tissues isolated by it; often enclosing pockets of cortical or phloem tissues. A technical term for the outer bark. Note: The rhytidome may be shed to leave a smooth trunk, or retained as a thick, fibrous or corky layer.

Ring, annual. (155) — In wood and bark, a growth layer of one year as seen in cross section (→ Ring, growth).

Ring, discontinuous growth. (156) — A growth ring that is not present all around the stem.

Ring, double (or multiple). (157) — An annual ring consisting of two (or more) growth rings. Syn. Multiple annual ring.

Ring, drought. → Ring, traumatic.

Ring, false annual. (158) — One of the growth rings of a double (or multiple) ring.

Ring, frost. → Ring, traumatic.

Ring, growth. (159) — In wood and bark a growth layer as seen in cross section.

Ring, multiple annual. → Ring, double.

Ring, traumatic. (160) — A zone of traumatic tissue produced by a cambium that has been injured. Note: Common causes are frost (usually late frost), drought and fire. The tissues tend to include irregularly-shaped wound parenchyma and to be coloured dark by the presence of gums and resins; intercellular canals and drought cracks are sometimes present. Such rings may be distinguished as Frost rings or Drought rings, if the cause is known.

Ring boundary, growth. (161) — The outer limit of a growth ring.

Ripple marks. (162) — Fine horizontal striations visible on the tangential longitudinal surfaces of certain woods, due to the storied arrangement of the rays or of the axial

elements or of both.

Sand, crystal. → Crystal.

Sapwood. (163) — The portion of the wood that in the living tree contains living cells and reserve materials (e.g. starch) (→ Heartwood).

Sapwood, included. (164) — Wood included in the heartwood, having the appearance and properties of sapwood. Living cells are no longer present as in normal sapwood but reserve materials may remain. Syn. Internal sapwood.

Sapwood, internal. → Sapwood, included.

Scalloped torus. → Pit membrane.

Schizogenous. (165) — Formed by the separation of tissue elements owing to the splitting of the common wall between adjacent cells.

Schizo-lysigenous. (166) — Originating by the splitting of the cell wall, and developing by the breakdown of surrounding tissues.

Sclereid. (167) — A strengthening element that is not markedly prosenchymatous, but which has thick, often lignified secondary walls and which commonly lacks a protoplast when mature. Syn. Sclerotic cell. Note: Sclereids vary in shape from polyhedral to somewhat elongated and are often branched. The type commonly found in wood and bark is the brachysclereid or stone cell. Such cells are often described as sclerotic, e.g. "sclerotic ray cells".

Sclerotic cell. → Sclereid.

Sheath cell. (168) — One of a series of upright cells (→ Ray cell, upright) on the margins of, and tending to form a sheath around, the procumbent cells of a multi-seriate ray as seen in tangential section.

Sieve area. (169) — A depressed area in the wall of a sieve element, perforated by a sieve-like cluster of minute pores through which the protoplast is connected with that of a contiguous sieve element. Syn. Sieve field.

Sieve cell. (170) — A long, slender, conducting cell of the phloem, that does not form a constituent element of a sieve tube, but which is provided with relatively unspecialized sieve areas, especially in the tapering ends of the cells that overlap those of other sieve cells.

Sieve field. → Sieve area.

Sieve plate. (171) — A specialized part of the wall of a sieve tube member that has a solitary sieve area (simple sieve plate), or several closely placed sieve areas, often arranged in a scalariform or reticulate manner (compound sieve plate).

Sieve tube. (172) — A food-conducting tube of the phloem made up of an axial series of sieve tube members.

Sieve tube member. (173) — A long, conducting cell of the phloem that forms one of an axial series of such cell arranged end to end to form a sieve tube, the common walls, which may be inclined or transverse, being sieve plates; sometimes with additional, less specialized sieve areas elsewhere in the walls.

Soft tissue. → Parenchyma.

Spiral thickening. (174) — Helical ridges on the inner face of, and part of, the secondary wall.

Stone cell. (175) — An approximately isodiametric cell with a massive lignified secondary wall, which is often conspicuously laminated, and which may contain ramiform pits, e.g. sclerotic tyloses. Syn. Branchysclereid (→ Sclereid).

Storage tissue. → Parenchyma.

Storied (storeyed). (176) — A term applied to the axial cells and rays in wood when these are arranged in horizontal series on tangential surfaces. Note: The term is applied to particular tissues, e.g. "storied parenchyma" or used in a general sense, as in "woods with storied structure". The presence of storied structure is the cause of the ripple marks visible with the unaided eye.

Styloid. → Crystal.

Terminal layer. → Bark, hard.

Tile cell. (177) — A special type of apparently empty upright ray cell of approximately the same height as the procumbent ray cells and occurring in indeterminate horizontal series usually interspersed among the procumbent cells. Note: Common in certain of the *Tiliales* and *Malvales*.

Torus. → Pit membrane.

Trabecula, pl. trabeculae. (178) — A rod-like or spool-shaped part of a cell wall which projects radially across the lumen.

Trachea. → Vessel.

Tracheary elements. (179) — The principal water conducting elements of the xylem, mostly vessel members and tracheids. Note: In primary xylem the tracheary elements may have only annular, spiral, or reticulate thickenings and no pits.

Tracheid. (180) — An imperforate wood cell with bordered pits to congeneric elements.

Tracheid, disjunctive. (181) — A tracheid partly disjoined laterally from another during differentiation; contact is maintained by means of tubular processes.

Tracheid, septate. → Tracheid, strand.

Tracheid, septate fibre-. (182) — A fibre-tracheid with thin transverse walls across the lumen. Note: In these elements the protoplast divides after the formation of the secondary walls.

Tracheid, strand. (183) — A tracheid of an axial series (strand) of tracheids (or of mixed tracheids and parenchyma cells), each series originating from a single cambial initial.

Tracheld, vascular. (184) — An imperforate cell resembling in form and position a small vessel member. Syn. Imperfect vessel member.

Tracheid, vasicentric. (185) — A short, irregularly-formed tracheid in the immediate proximity of a vessel and not forming part of a definite axial row.

Tylosis, pl. tyloses. (186) — 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. Note: Tyloses may be few or many crowded together; thin- or thick-walled; pitted or unpitted; with or without starch, crystals, resins, gums, etc.

Tylosis, sclerotic. (187) — A tylosis, with an exceptionally thick, laminated, lignified wall and ramiform pits. A form of stone cell.

Tylosoid. (188) — A proliferation of a thin-walled epithelial cell into an intercellular canal. Note: A tylosoid differs from a tylosis in that it does not pass through a pit cavity.

Vessel. (189) — 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. Syn. Trachea.

Vessel member, imperfect. → Tracheid, vascular.

Vessel member or element. (190) — One of the cellular components of a vessel.

Vessel member or element, fibriform. (191) — A vessel member of relatively small diameter bearing a resemblance to a fibre-tracheid.

Wood. (192) — The principal strengthening and water-conducting tissue of stems and roots. Characterized by the presence of tracheary elements. Syn. Xylem.

Wood, compression. (193) — Reaction wood formed typically on the lower sides of branches and leaning or crooked stems of coniferous trees and characterized anatomically by heavily lignified tracheids that are rounded in transverse section and bear spiral cell wall checks; zones of compression wood are typically denser and darker than the surrounding tissue. Syn. Glassy wood, Hard streak, Redwood (→ Wood, tension).

Wood, diffuse-porous. (194) — Wood in which the pores are of fairly uniform or only gradually changing size and distribution throughout a growth ring.

Wood, early. (195) — The less dense, larger-celled, first-formed part of a growth ring. Syn. Spring wood.

Wood, intermediate. (196) — Inner layers of the sapwood that are transitional between sapwood and heartwood in colour and general character.

Wood, late. (197) — The denser, smaller-celled, later-formed part of a growth ring. Syn. Summer wood.

Wood, non-pored. (198) — Wood devoid of pores or vessels; characteristic of conifers (→ Wood, pored).

Wood, pored. (199) — Wood with vessels; typical of woody dicotyledons as opposed to conifers.

Wood, primary. → Xylem, primary.

Wood, reaction. (200) — Wood with more or less distinctive anatomical characters, formed typically in parts of leaning or crooked stems and in branches and tending to restore the original position, if this has been disturbed. Note: In dicotyledons this consists of tension wood and in conifers of compression wood.

Wood, ring-porous. (201) — Wood in which the pores of the early wood are distinctly larger than those of the late wood and form a well-defined zone or ring (→ Wood, diffuse-porous).

Wood, semi-ring-porous. (202) — Wood in which the early wood is marked by a zone of (a) occasional large vessels, or (b) numerous small vessels.

Wood, spring. → Wood, early.

Wood, summer. → Wood, late.

Wood, tension. (203) — Reaction wood formed typically on the upper sides of branches and leaning or crooked stems of dicotyledonous trees and characterized anatomically by lack of cell wall lignification and often by the presence of an internal gelatinous layer in the fibres. (→ Wood, compression).

Xylem. → Wood.

Xylem, primary. (204) — First formed xylem, differentiated from an apical meristem. Note: Ordinarily at the edge of the pith.

Xylem, secondary. (205) — Wood produced by a cambium.

Xylem mother cell. (206) — A cell that is cut off on the inner side by a fusiform cambial initial, but which undergoes further periclinal division before differentiating into a xylem cell.