

「樹木の系統分類と材の識別」

(Systematic taxonomy and wood identification)

緒方 健 (Ken Ogata)

1. 標本 (Herbarium and wood specimens)

分類学および木材解剖学にとって標本は不可欠 (Specimens are indispensable for taxonomy and wood anatomy.) ————— Table 1 & 2

- (1) 信頼できる標本 (Reliable specimens with herbarium vouchers)
- (2) 木材標本収集の困難さ (Difficulty of collecting wood specimens)
- (3) 研究者の不足 (Shortage of wood anatomists)

2. 木材組織は外部形態にくらべ変化が少ない (Wood is a conservative part of plant.)

- (1) 木材識別の単位はふつう節または属のレベル (Wood identification is possible generally in the section or genus level.)
- (2) 木材解剖学は節、属、科の分類に貢献できる (Wood anatomy is an important tool for the taxonomy of section, genus or family.)

3. 木材識別は分類学および木材解剖学を基礎としている (Wood identification is made on the basis of taxonomy and wood anatomy.)

- (1) フタバガキ科 (Dipterocarpaceae) ————— Fig. 1, Table 3
- (2) マメ科 (Leguminosae) ————— Fig. 2, Table 4
- (3) Syzygium と Eugenia (フトモモ科、Myrtaceae) ————— Table 5-1
- (4) Lophopetalum, Kokoona と Bhesa (ニシキギ科、Celastraceae)
————— Table 5-2
- (5) Mesua と Kayea (オトギリソウ科、Guttiferae) ————— Table 6-1
- (6) イワツクバネウツギ (Abelia) とイヌツクバネウツギ (Zabelia) (スイカズラ科、Caprifoliaceae) ————— Table 6-2
- (7) Terminalia (シクンシ科、Combretaceae) ————— Table 6-3
- (8) Canarium (カンラン科、Burseraceae) ————— Table 6-4

4. 木材解剖学は魅力ある学問 (Wood anatomy is an attractive science)

- (1) 分類学への貢献 (Contribution to taxonomy)
- (2) 未記載樹種の記載、とくに日本産樹木の図鑑の作成 (Description of unknown species, especially completion of photographic atlas on Japanese woods)
- (3) 木材識別への応用 (Application to wood identification)

TABLE 1 HERBARIA WITH ONE MILLION OR MORE SPECIMENS

腊葉

<i>Herbaria</i>	<i>Year founded</i>	<i>Herbarium abbreviation</i>	<i>Number of specimens</i>
Muséum National d'Histoire Naturelle, Paris, France	1635	P, PC	8 877 300
Royal Botanic Gardens, Kew, England, U.K.	1841	K	6 000 000
Komarov Botanical Institute, Leningrad, U.S.S.R.	1823	LE	5 770 000
Swedish Museum of Natural History, Stockholm, Sweden	1739	S	5 600 000
New York Botanical Garden, Bronx, New York, U.S.A.	1891	NY	5 300 000
The Natural History Museum, London, England, U.K.	1753	BM	5 200 000
Conservatoire et Jardin botaniques, Genève, Switzerland	1824	G	5 000 000
Harvard University, Cambridge, Massachusetts, U.S.A.	1864	A, AMES, ECON, FH, GH, NEBC	4 858 000
Smithsonian Institution, Washington, D.C., U.S.A.	1848	US, USNC	4 368 000
Institut de Botanique, Montpellier, France	1845	MPU	4 000 000
Université de Lyon, Villeurbanne, France	1924	LY	3 800 000
Naturhistorisches Museum, Wien, Austria	1807	W	3 750 000
Missouri Botanical Garden, Saint Louis, Missouri, U.S.A.	1859	MO	3 700 000
Universitatis Florentinae, Museo Botanico, Firenze, Italy	1842	FI	3 600 000
Friedrich-Schiller-Universität, Jena, German Democratic Republic	1895	JE	3 000 000
Rijksherbarium, Leiden, Netherlands	1829	L	3 000 000
Botanical Museum, University of Helsinki, Helsinki, Finland	1750	H	2 720 000
Botanischer Garten, Berlin-Dahlem, Federal Republic of Germany	1815	B	2 500 000
Botanical Museum, Uppsala University, Uppsala, Sweden	1785	UPS	2 500 000
Field Museum of Natural History, Chicago, Illinois, U.S.A.	1893	F	2 415 000
Botanical Museum, Lund, Sweden	1770	LD	2 400 000
Botanische Staatssammlung, München, Federal Republic of Germany	1813	M	2 300 000
Botanical Museum, University of Copenhagen, Copenhagen, Denmark	1759	C	2 223 812
Jardin Botanique National de Belgique, Meise, Belgium	1870	BR	2 040 000
National Museum, Praha, Czechoslovakia	1818	PR	2 000 000
Charles University, Praha, Czechoslovakia	1775	PRC	2 000 000
Royal Botanic Garden, Edinburgh, Scotland, U.K.	1839	E	2 000 000
Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland	1859	ZT	2 000 000
Academia Sinica, Beijing, People's Republic of China	1928	PE	1 800 000
University of California, Berkeley, California, U.S.A.	1872	UC, JEPS	1 725 000
Hungarian Natural History Museum, Budapest, Hungary	1870	BP	1 619 649
University of Michigan, Ann Arbor, Michigan, U.S.A.	1837	MICH	1 613 500
Herbarium Bogoriense, Bogor, Indonesia	1817	BO	1 600 000
California Academy of Sciences, San Francisco, California, U.S.A.	1853	CAS, DS	1 600 000
Academy of Natural Sciences, Philadelphia, Pennsylvania, U.S.A.	1812	PH, PENN, ANSP	1 590 000
Universität Zürich, Zürich, Switzerland	1834	Z	1 500 000
Botanical Gardens, University of Tokyo, Tokyo, Japan	1877	TI	1 450 000

Table 2

W.L. Stern: Index xylariorum. Institutional wood collections
of the world. 3. IAWA Bull. 9(3), p. 203-252 (1988)

- 1 Madison(For. Prod. Lab.): 2,700 genera/98,635 specimens
- 2 Tervuren(Mus. Roy. l'Afrique C.): 2,700/47,000
- 3 Bogor(For. Prod. Res. & Dev. C.): 785/41,679
- 4 Syracuse(St. Univ. NY): 2,100/41,000
- 5 Highett(CSIRO): 2,225/40,200
- 6 Washington(Smithsonian Inst.): 3,033/40,000
- 7 Utrecht(Inst. Syst. Pl. Rijksuniv. Utrecht): 2,500/35,000
- 8 Amsterdam(Koninklijk Inst. Trop.): 10,000/33,000
- 9 Cambridge(Harvard Univ.): over 31,000
- 10 Nogent-Sur-Marne(CTFT): 2,050/30,250
- 11 Princes Risborough(Princes Risb. Lab.): 2,500/30,000
- 12 Kew(Roy. Bot. Gard.): 3,200/28,000
Kew(Jodrell Lab.): 19,000 slides
- 13 Oxford(Univ. Oxford): 2,100/25,000
- 14 Taipei(Taiwan For. Res. Inst.): 530/20,000
- 15 Hamburg(Bundesforschungs. Forst- und Holzw.): 2,000/19,000
- 16 Merida(Univ. Andes): 908/18,000
- 17 Leningrad(Komarov Bot. Inst.): 1,414/17,400
- 18 Beijing(Inst. Wood. Ind.): 970/17,000
- 19 Leiden(Rijksherbarium): 1,300/16,000
- 19 Tokyo(Univ. Tokyo): 760/16,000
- 21 Dehra Dun(For. Res. Inst. & Col.): 1,500/15,000
- 22 Sao Paulo(Inst. Flor. Sao Paulo): 700/14,000
- 23 Boroko(For. Prod. Res. & Dev. C.): 250/13,000
- 24 Tsukuba(For. & For. Prod. Res. Inst.): 1,258/12,900
- 25 Gainesville(Univ. Florida): 12,700
- 26 Beecroft(For. Com. N.S. Wales): 1,380/12,454
- 27 Richmond(Univ. California): 1,180/12,000
- 28 College Laguna(For. Prod. Res. & Dev. Inst.): 1,003/11,318
- 29 Liverpool(Liverpool Mus.): 400-500/11,000
- 30 Delft(Timber Res. Inst.): 850/10,600
- 31 Kyoto(Kyoto Univ.): 1,000/10,500
- 32 Manaus(Inst. Tec. Amazonia): 800/10,120
- 33 Florence(Univ. Flor.): 6,500/10,000
- 33 Kepong(For. Res. Inst. Mal.): 411/10,000
- 33 Munich(Univ. Munchen): 1,250/10,000
- 33 Raleigh(N. Carolina St. Univ.): 2,000/10,000

the most active xylarium.

→ 15,000

** Reliable specimens with
Anbacious vouchers.*

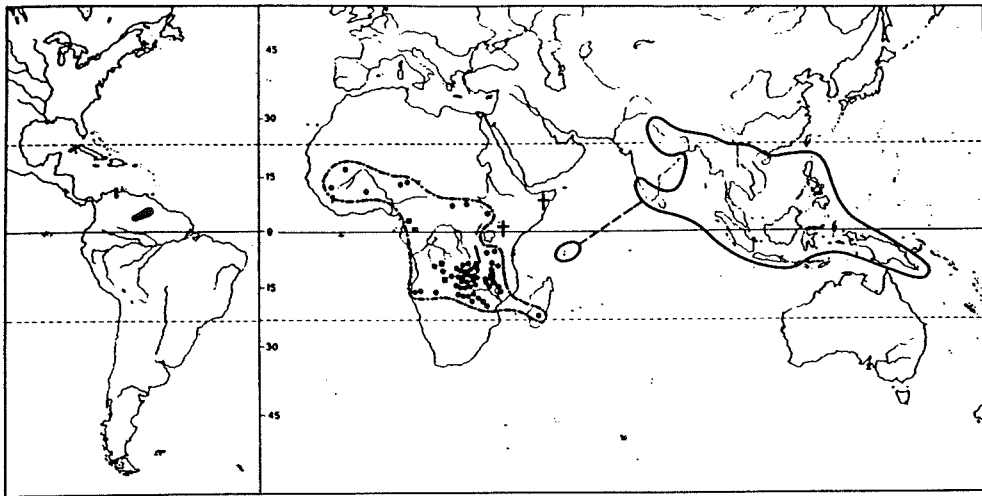
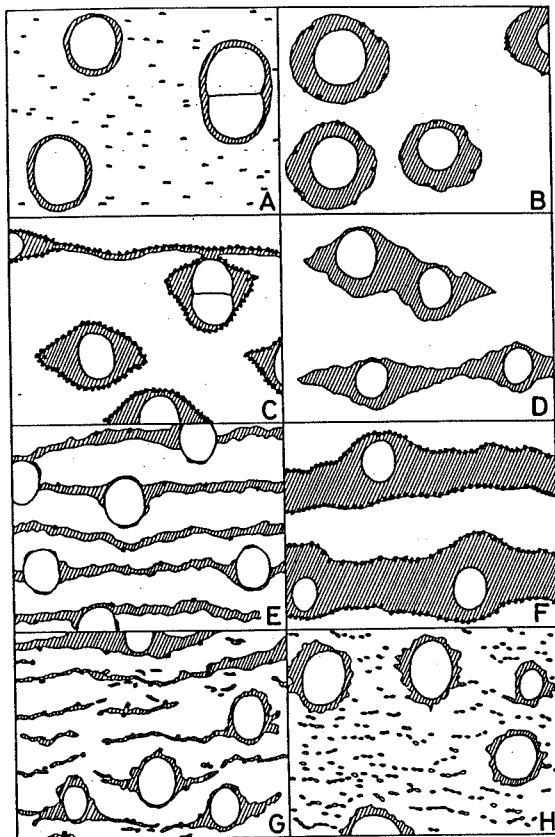


Fig. 1 Range of the Dipterocarpaceae: *Dipterocarpoideae* (line and 2 fossil sites in E. Africa), *Monotoideae* (2 genera, Afro-Madagascan, interrupted line, dots *Monotes*, squares *Marquesia*), *Pakaraimoideae* (monotypic genus in northern South America). (P. S. Ashton: Dipterocarpaceae, 1982)



A: vascentric (*Albizia falcataria*) **B:** same, parenchyma sheath broad (*Samanea saman*); **C:** aliform and terminal (*Intsia bijuga*); **D:** confluent (*Koompassia malaccensis*); **E:** in narrow bands (*Dialium platysepalum*); **F:** in broad bands (*Cassia siamea*); **G:** aliform, confluent to in discontinuous bands (*Dalbergia cochinchinensis*); **H:** vascentric to aliform and diffuse or reticulate (*Dalbergia retusa*)

Fig. 2 Distribution type of axial parenchyma in Southeast Asian Leguminosae (Black dots showing crystalliferous chambered parenchyma)

Table 3 Anatomical characteristics of the wood of Dipterocarpaceae

	Pores exclusively solitary	Fibres with dis-tinct pits	Width of rays (cells wide)	Crystals		Silica in rays	Resin canals			
				In rays	* In parenchyma		** Vertical	Horizontal		
Dipterocarpoideae	Anisoptera	+	+	5-9	-	-	+	D, C	-	
	Upuna	+	+	5 (6)	-	-	-	D	-	
	Dipterocarpus	+	+	5-7	-	-	+	D	-	
	Dryobalanops	+	+	4-6	(+)	-	+	C	-	
	Vateriopsis	+	+	4	-	-	+	D	-	
	Cotylelobium	+	+	4-6	(+)	-	+	D	-	
	Vatica	±	±	5-8	±	-	-	D	-	
	Stemonoporus	±	±		+	+	-	D	-	
	Vateria	-	-	5-8	±	± S	-	D	-	
	Neobalanocarpus	-	-	3-4	±	-	-	C	-	
	Hopea	-	-	3-7	±	± SC	-	C	-	
	Shorea	Anthoshorea	-	-	4-6	-	-	+	C	-
		Richetioides	-	-	5-6	±	± S	-	C	+
		Rubroshorea	-	-	3-6	(+)	± S	-	C	(+)
Shorea		-	-	4-5	(+)	± C	-	C	-	
Pentacme		-	-	4-6	±	± S	-	C	-	
Doona	-	-	3-5	±	± C	-	C	-		
Parashorea	-	-	4-8	±	± C	-	C	(+)		
Pakaraimoideae	Marquesia	+	+	1	-	-	+	-	-	
	Monotes	+	+	1	-	-	+	-	-	
Pakaraimaea	+	+	2	-	+ C	-	-	-		

*S: solitary; C: in chain **D: diffuse; C: concentric

Characteristics of 3 subfamilies of Dipterocarpaceae

	Axial resin canals	Maximum ray width	Tree size	Distribution
Dipterocarpoideae (フタハカキ亜科)	Always present	3-9	Usu. very large	India to NG, in rain forest
Monotoideae (モノテス亜科)	None	1	Small	Trop. Africa, in dry region
Pakaraimoideae (ハカライマエ亜科)	None	2	Small	Northern part of S. America, in dry region

Table 4 Characteristics of the wood of Southeast Asian Leguminosae

	Diam. of V-pits (μm)	Septate fibres	Parenchyma type	Rays		Crystals		Sp. gr. ad. (100 x)	
				Width (cells wide)	Stored	Distribution pattern	In rays		
Mimosoideae	Adenantha	7-8	-	B-C	2	-	C-D	-	80-107
	Albizia (A)	5-6	-	A	1-2	-	C-D	-	23-49
	Albizia (B)	6-7	\pm	B-C	2-5	-	C-D	-	52-88
	Leucaena	-6-	\pm	C, T	3	-	C-D	-	69-86
	Parenterolobium	-5-	+	C-D	3	-	C-P*	-	74
	Parkia	7-8	-	C, T	2-5	-	C-D, P	-	23-61
	Pithecellobium	4-7	\pm	A-C-D, T	1-3	-	C-D	-	31-88
	Samanea	7-8	-	B	2-3	-	C-P*	-	50-65
	Serianthes	-4-	-	B	2	-	C-D	-	66
	Walaceodendron	4-5	-	B	2	-	C-D	-	62-70
	Xylia	5-6	\pm	C-D	2-3	-	C-D	-	75-113
Caesalpinoideae	Acrocarpus	7-9	+	B	5	-	S-P	+	52-70
	Afzelia	5-7	-	C-D, T	3	-	C-P*	-	69-95
	Bauhinia	6-7	\pm	E-F	1-2	\pm	S-P, C-D	-	54-80
	Cassia	-7-	-	(D-) F	3-4	(\pm)	C-P*	-	82-102
	Cynometra	3-4	-	E	2-3	(\pm)	S-P	+	72-116
	Dialium	7-8	-	E	2-3	+	C-P*	-	76-110
	Intsia	5-6	-	C, T	2-3	(\pm)	C-P*	-	52-105
	Kalapia	5-7	-	C(-D)	3	+	C-P*	-	54-66
	Kingiodendron	-4-	-	A-C, T	2	-	C, S-P	+	58-73
	Koompassia	7-9	-	C-D, D-E	2-5	(+)	C-P*	\pm	67-128
	Maniltoa	4-5	-	E	2-3	-	C-P*, S-P	+	76-84
	Peltophorum	4-5	+	A-C-D, T	2-3	-	C-D	-	48-77
	Pseudosindora	6-8	-	C, T	2	-	C-D	-	51-78
	Sindora	6-8	-	C, T	2-4	-	C-D	-	46-108
Sympetalandra	5-7	-	(B-) C-D	2	-	C-P*	-	61-72	
Papilionoideae	Castanosperum	6-8	-	C-D	3	(\pm)	(C-P*)	-	70-83
	Dalbergia	7-9	-	D-E, G, H	1-3	+	C-P*	-	74-120
	Erythrina	-8-	-	F	10-12	-	C-P*	-	24-35
	Millettia	6-9	-	D-F	3-4	+	C-P*	-	80-116
	Ormosia	-6-	-	C-D-E	3	+	C-P*	-	67-79
	Pericopsis	7-8	-	(C-) D	3	+	C-P*	-	75-84
	Pongamia			D-E, T	3-4	+			59-74
	Pterocarpus	7-8	-	D-E-G	1-2	+	C-D	-	58-94

Parenchyma type A~H: as in Fig. 2; T: terminal

Crystals C: in chain (or in chambered parenchyma); S: solitary;

D: diffuse; P: in parenchyma; P*: marginal in parenchyma

Table 5-1 Anatomical characteristics of the wood of *Syzygium* and *Eugenia*
(Myrtaceae)

	<i>Syzygium</i> (Old world)	<i>Eugenia</i> (New world)
① Vessels	Pores larger (max. 100-200 μm); solitary and in radial multiples of 2-8	Pores smaller (max. 75-90 μm); exclusively solitary
② Vascentric tracheids	Absent	Present
③ V-R pits	Round to elongated, simple	Small (4-5 μm), bordered, similar to V pits
④ Axial parenchyma	Paratracheal, vascentric, aliform to confluent, or in wavy bands	Apotracheal, diffuse and in narrow bands
⑤ Fibres	Pits small and not distinct	With numerous bordered pits

Table 5-2 Some characteristics of the wood of *Lophopetalum*, *Kokoona* and *Bhesa*
(Celastraceae)

	<i>Lophopetalum</i>	<i>Kokoona</i>	<i>Bhesa</i>
① Vessels	Solitary and in radial multiples of 2-3; perforations simple	Exclusively solitary; perforations simple	Mostly in radial multiples of 2-4; perforations scariform
② VR-pits	Similar to v-pits, very small, 3-4 μm in diam.	Same as <i>Lophopetalum</i>	round or elongated
③ Rays	Uniseriate only	Same as <i>Lophopetalum</i>	1-3 seriate
④ Axial parenchyma	In regularly spaced narrow bands	In regularly spaced broad bands	Irregularly reticulate
⑤ Pits on fibres	Not distinct	Distinct	Not distinct
⑥ Weight	Light (Sp. gr. ad: 0.34-0.58)	Heavy (Sp. gr. ad: 0.80-1.10)	

Table 6-1 Anatomical characteristics of the wood of Mesua and Kayea (Guttiferae)

	Mesua	Kayea
① Vessels	In oblique pattern (similar to Calophyllum)	Almost evenly distributed
② Vascentric tracheids	thick around vessels	sparse
③ Fibres	Libriform wood fibre	Fibre tracheid
④ Rays	uniseriate only	1-2 or 1-3 seriate

Table 6-2 Some characteristics of wood of Abelia and Zabelia (Caprifoliaceae)

	Abelia	Zabelia
① Stem (twig)	Smooth	With 6 regular furrows
② Porosity	Diffuse-porous	Ring-porous
③ Perforation of vessels	Scalariform with many bars	Mostly simple, smt. scalariform with a few bars
④ Aggregate rays	Absent	Present in the part of furrows found in stem (twig)

Table 6-3 Some characteristics of wood of Terminalia (Combretaceae)

	Group A	Group B
① Rays	Exclusively uniseriate	1-2 to 1-4 seriate
② Crystals	Styloid	Druse

Table 6-4 Some characteristics of wood of Canarium (Burseraceae)

	Group A	Group B
① Horizontal resin canal	Present	Absent
② Silica grains	Absent	Present