A TAXONOMIC REVISION OF *SCHISANDRA* SECTION *SPHAEROSTEMA* (SCHISANDRACEAE)

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The classification of *Schisandra* Michx. sect. *Sphaerostema* (Blume) Nakai is revised, using multivariate statistical analyses as required. Only two species are recognized, viz. *Schisandra plena* A.C. Sm. and *S. propinqua* (Wall.) Baill., following reduction of *S. axillaris* (Blume) Hook.f. & Thoms. to a subspecies of the latter taxon. Four subspecies are recognized in *S. propinqua*, viz.: subsp. *propinqua* (NW India and Nepal); subsp. *intermedia* (A.C. Sm), *stat. nov.* (NE India, Burma and Yunnan); subsp. *sinensis* (Oliv.), *stat. nov.* (central and southern China); and subsp. *axillaris* (Blume), *comb. et stat. nov.* (Java and Bali). The biogeographical origin of the vicariant distribution of *S. propinqua* is discussed. A key is provided for the identification of taxa, with new taxonomic descriptions.

Keywords. Biogeography, classification, Illiciales, Schisandraceae, systematics.

INTRODUCTION

Schisandra Michx. (Schisandraceae) is a genus of c.25 species of scrambling and twining woody vines with an east Asian centre of diversity, although one species is indigenous to eastern North America. Although most species grow in warm and subtropical evergreen forests, some occur in the humid montane forests of Java, and one extends into the cooler deciduous and coniferous forests of NE Asia.

The earliest attempt at creating a supraspecific classification in the genus was undertaken by Nakai (1933), who recognized three sections, viz. sect. *Eu-Schizandra* (a synonym of sect. *Schisandra*), sect. *Maximowiczia* (Rupr.) Nakai, and sect. *Sphaerostema* (Blume) Nakai. Although the sectional descriptions included reference to the important androecial differences, sect. *Sphaerostema* was poorly defined since it indirectly included the two species described by Blume (1825) under the generic name *Sphaerostema*, which possess fundamentally different androecial structures; these species were subsequently transferred to *Schisandra* as *S. axillaris* (Blume) Hook.f. & Thoms. and *S. elongata* (Blume) Baill. Smith (1947) resolved the problem of the delimitation of sect. *Sphaerostema* by transferring *S. elongata* to a newly published section, *Pleiostema* A.C. Sm.; sect. *Sphaerostema* was accordingly redescribed very precisely as consisting only of species with a carnose androecium of fused stamens associated with shallow cavities, with anthers that are either sessile or free terminally.

The first species to be published which is referable to sect. *Sphaerostema sensu* Smith (1947) was *Kadsura propinqua* Wall. (Wallich, 1824), based on collections

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from Nepal. It was subsequently transferred to the genus *Schisandra* by Baillon (1868), and all references to this species in early taxonomic accounts of the Himalayan flora accordingly use either the name *S. propinqua* (Wall.) Baill. or its basionym. Extensive plant collections were subsequently made in Assam and Burma, where a related taxon was recognized as being slightly distinct morphologically. Hooker (1872) referred to these plants under the name *Schisandra axillaris*, which was based on the name *Sphaerostema axillare* Blume (1825) that had previously been applied to Javanese specimens. Botanical explorations of China subsequently revealed a third related taxon, which was named *S. propinqua* var. *sinensis* Oliver (1887).

Prior to the publication of Smith's (1947) monograph, the continental Asian representatives of *Schisandra* sect. *Sphaerostema* were therefore referred to by three names: *S. propinqua* var. *propinqua* (occurring in the Himalayas); *S. propinqua* var. *sinensis* (China); and *S. axillaris* (Assam and Burma). Smith (1947) clarified the taxonomic relationships between the continental Asian and Javanese specimens of *S. axillaris* by elucidating minor but diagnostic morphological differences. He believed the continental Asian taxon was intermediate between vars. *propinqua* and *sinensis* in terms of morphology as well as distribution, and accordingly used a new name, *S. propinqua* var. *intermedia* A.C. Sm. Smith (1947) also described a new species, *S. plena* A.C. Sm., which possesses a very distinct androecial structure, with sessile anthers.

Smith's (1947) monograph was necessarily based on a very limited number of specimens, and is therefore in need of revision. The present publication provides a taxonomic and historical biogeographical reassessment of sect. *Sphaerostema*.

MATERIALS AND METHODS

Herbarium specimens were examined from the following sources: A, C, E, GH, IBSC, K, L, NY, UC and US (herbarium acronyms according to Holmgren et al., 1990). Androecial characters were studied using scanning electron microscopy (SEM). Specimens were attached directly to stubs using colloidal silver liquid or adhesive carbon tabs; the material was then coated with gold, and viewed using a Cambridge Stereoscan 440 SEM at 10kV.

Multivariate statistical analyses of morphological variation in continental Asian specimens of *Schisandra propinqua* were based on the following vegetative characters: (1) petiole length; (2) lamina length; (3) lamina width; (4) ratio of characters 1:2; (5) ratio of characters 2:3; (6) leaf length from base to widest point; (7) ratio of characters 6:2; (8) length from leaf base to first tooth; (9) ratio of characters 8:2; (10) length between teeth at widest point of leaf; (11) ratio of characters 10:2; (12) length from last tooth to leaf apex; (13) ratio of characters 12:2; (14) height of tooth at widest point of leaf; and (15) number of teeth per side of leaf. All measurements were made in mm, and were based on an average of five counts per specimen where possible. Reproductive characters were not included in the multivariate analy-

ses because complete data sets could not be achieved for both androecial and gynoecial characters due to effective dioecy in the genus: studies on *S. chinensis* (Turcz.) Baill. have shown that although the genus is monoecious, sexual expression is flexible and individual plants usually bear flowers of only a single sex (Ueda, 1988).

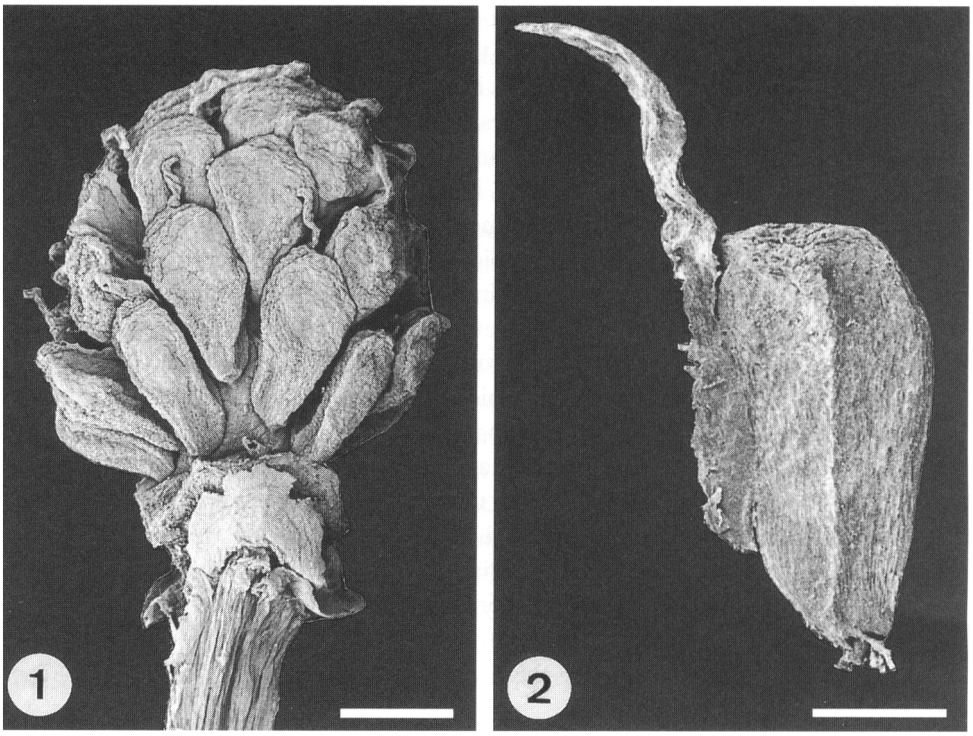
The data were initially investigated using discriminant function analysis (Manly, 1986). Specimens were awarded *a priori* identifications as '*propinqua*', '*intermedia*' or '*sinensis*' either on the basis of specimen determinations made by Smith (1947: 211–218) or by reference to his taxonomic key (1947: 150–151). Stepwise discriminant analysis was used to test these preliminary determinations by the development of jackknifed classification matrices, achieved by the removal of each specimen from the sample in turn and the calculation of its classification probabilities from the remaining sample. The relative taxonomic importance of each character was also assessed by their sequence of use in the analysis and associated partial Wilks' *lambda* value; this is based on their ability to maximize the Mahalanobis' D^2 between the centroids of the taxa. Canonical variables that mathematically maximize the distance between the centroids of the taxa were subsequently derived from the discriminant analysis (Manly, 1986); these derived variables were plotted graphically to illustrate any taxonomic distinctions. The relative involvement of individual characters in the canonical variables is indicated by the standardized coefficient values. All multivariate analyses were conducted using the *Statistica* software package (StatSoft, Inc., 1995).

RESULTS AND DISCUSSION

Delimitation of section Sphaerostema

All species of *Schisandra* show similar gynoecial structures, with a variable number of carpels (12–120 *fide* Smith, 1947: 87) that are free and borne spirally on the receptacle (Fig. 1). Each carpel possesses a stigmatic crest which is extended to form a 'pseudostyle' (Fig. 2); the 'pseudostigma' observed in many species of *Kadsura* is absent. Although differences in carpel number can be an important diagnostic character at the species level, the genus cannot be divided into supraspecific groups on the basis of gynoecial characters.

The sectional classification proposed by Smith (1947) is essentially based on androecial morphology, which is highly variable within the genus. Section *Sphaerostema* possesses a fused androecial mass (Figs 3 & 6) which is believed to be derived from the fusion of filaments. The filaments are terminally free in *S. propinqua* and *S. axillaris*, so that the thecae of each anther are almost contiguous and show introrse dehiscence (Figs 3–5). *Schisandra plena* shows an adaptation of this, in which staminal fusion is greater and the anthers are sessile; the thecae of each anther are separated and are located on the opposite sides of the associated cavity (Figs 6–7). Law (1996a, b) proposed the elevation of all Smith's sections to subgeneric level, together with the creation of a new subgenus (*Plena* Y.-W. Law)

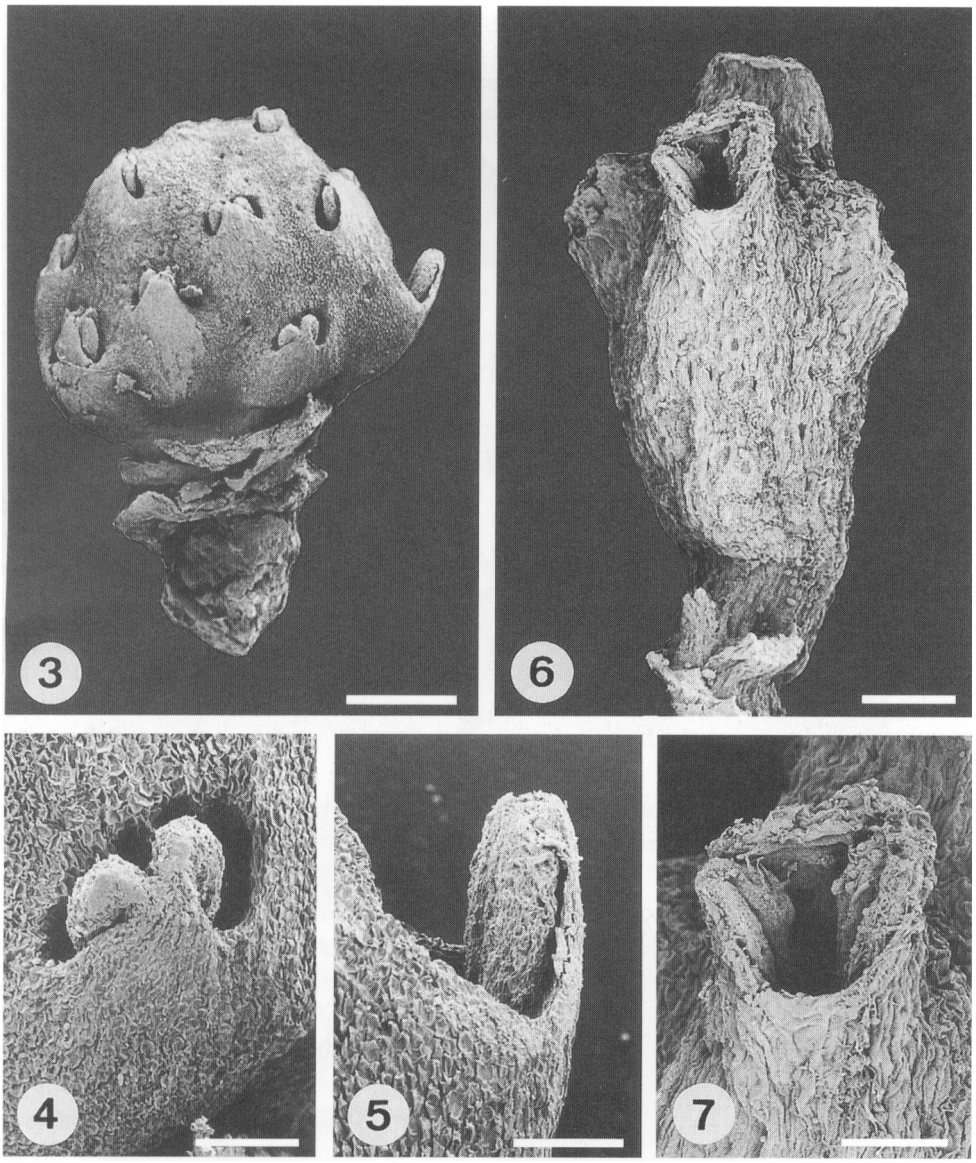


FIGS 1–2. Gynoecial and carpel structure in *Schisandra* sect. *Sphaerostema*. FIG. 1. Gynoecium of *S. propinqua* [*Parkinson* 3133 (K)]. Scale bar = 1mm. FIG. 2. Carpel of *S. propinqua* [*Falconer* 80 (K)]. Scale bar = 500μm.

solely for *S. plena* on the basis of its distinct androecial morphology. These androecial differences would appear to be rather slight, however, and the present author does not accept that recognition above the species level is warranted. A critical phylogenetic study, incorporating molecular as well as morphological data, is needed in order to achieve a satisfactory revision of the supraspecific classification of the genus.

Schisandra propinqua

Preliminary determinations of herbarium specimens of *S. propinqua* (Fig. 8) based on the varietal classification proposed by Smith (1947) were initially tested using discriminant analysis. The jackknifed classification matrix (Table 1) indicates considerable separation between the three *a priori* taxonomic groups although with some degree of overlap, with five specimens (12.5%) suggested as having been misidentified. The order of selection of characters and their partial Wilks' *lambda* values (λ, indicating the contribution of the variable to the discrimination between groups) was as follows: character 10 ($\lambda = 0.70$), 3 ($\lambda = 0.51$), 4 ($\lambda = 0.78$), 2 ($\lambda = 0.63$), 11 ($\lambda = 0.80$), 14 ($\lambda = 0.79$), 1 ($\lambda = 0.92$) and 13 ($\lambda = 0.92$).



FIGS 3–7. Androecial structure in *Schisandra* sect. *Sphaerostema*. FIG. 3. Androecium of *S. propinqua* subsp. *axillaris* (syn. *S. axillaris*) [*Brinkman* 874a (L)]. Scale bar = 1mm. FIG. 4. Abaxial view of anther attachment in *S. propinqua* subsp. *axillaris* (syn. *S. axillaris*) [*Brinkman* 874a (L)]. Scale bar = 250μm. FIG. 5. Lateral view of anther attachment in *S. propinqua* subsp. *axillaris* (syn. *S. axillaris*) [*Brinkman* 874a (L)]. Scale bar = 250μm. FIG. 6. Androecium of *S. plena* [*Henry* 11893 (A)]. Scale bar = 0.5mm. FIG. 7. Anther attachment in *S. plena* [*Henry* 11893 (A)]. Scale bar = 250μm.

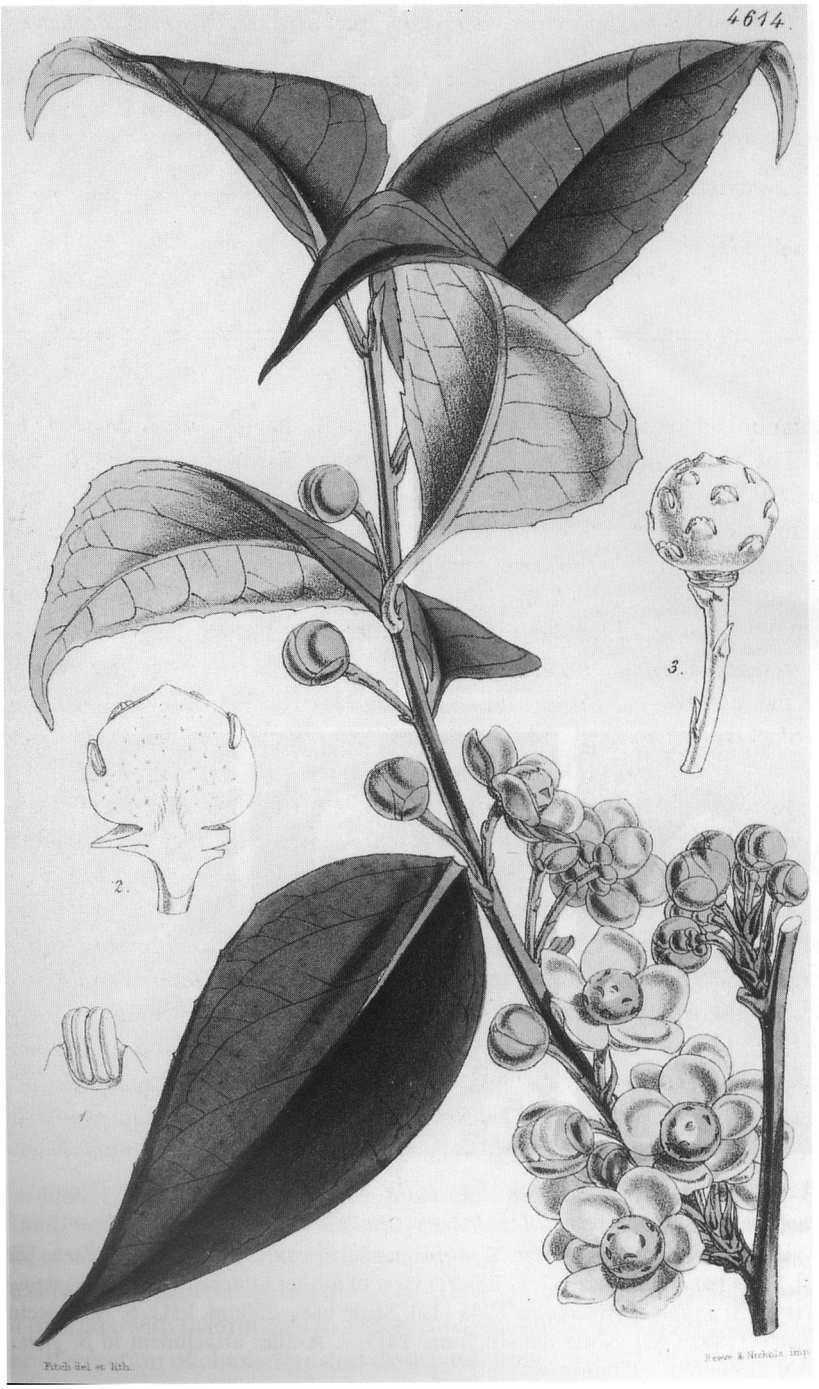


FIG. 8. *Schisandra propinqua* (Wall.) Baill. subsp. *propinqua*. Reproduced from Hooker (1851). Photograph courtesy of Royal Botanic Gardens, Kew.

TABLE 1. Classification matrix for continental specimens of *Schisandra propinqua*, derived by stepwise discriminant analysis.

Preliminary classification	Percent correct	Suggested classification (number of specimens)		
		'propinqua'	*'intermedia'*	*'sinensis'*
'propinqua'	90.9	10	0	1
'intermedia'	85.7	1	12	1
'sinensis'	87.0	1	2	20
Total	87.5	12	14	22

Two canonical variables were derived from the discriminant analysis (plotted as Fig. 9). The first canonical variable is most useful for distinguishing between var. *propinqua* and var. *sinensis*; this is largely effected by characters 2, 3, 4 and 1 (with standardized coefficient values of 1.83, −1.59, 1.08 and −0.99 respectively). The second canonical variable separates var. *intermedia* from the other two, and is largely effected by characters 10, 11, 2, 4 and 1 (with standardized coefficient values of 2.89, −2.07, −2.02, −1.87 and 1.00 respectively). Although there is very little overlap between var. *propinqua* and var. *sinensis* in Fig. 9, var. *intermedia* overlaps with both of them; this is consistent with Smith's (1947: 150) observations that populations of *S. propinqua* var. *intermedia* are intermediate between vars. *propinqua* and *sinensis*.

There are several taxonomic characters that are useful in distinguishing between *S. propinqua* var. *propinqua* and var. *sinensis*, including leaf length:width ratio (2.15–*3.72*–5.21 in var. *sinensis*, compared to 2.32–*2.77*–3.09 in var. *propinqua*), and the size of the leaf margin teeth (larger, often serrate or dentate, in var. *sinensis*). The vegetative differences indicated in Fig. 9 are also reflected in many reproductive characters. *Schisandra propinqua* var. *sinensis* typically has smaller male flowers, as indicated by the diameter of the androecium (1.8–*2.1*–2.4mm in var. *sinensis*, compared to 3.2–*3.7*–4.3mm in var. *propinqua*); this is largely the product of the number of stamens (reduced to only 4–11 in var. *sinensis*, whereas there are 10–18 in var. *propinqua*). Contrary to remarks by Smith (1947: 150), no differences are apparent in the number of perianth parts in male flowers, although female flowers typically have 14–17 parts in var. *propinqua* but only 8–15 in var. *sinensis*.

Although there are therefore few taxonomic problems regarding the separation of vars. *propinqua* and *sinensis*, the classification of var. *intermedia* is more complex. The varietal name was applied by Smith (1947) as an indication of its intermediate morphology between vars. *propinqua* and *sinensis*. This is reflected in all the diagnostic characters cited above: var. *intermedia* has a leaf length:width ratio of 1.25–*2.96*–4.63, androecia with diameters of 2.6–*2.7*–2.8mm and 10–12(–16) stamens, and female flowers with 9–12 perianth parts.

The infraspecific classification of *S. propinqua* proposed by Smith (1947) and the

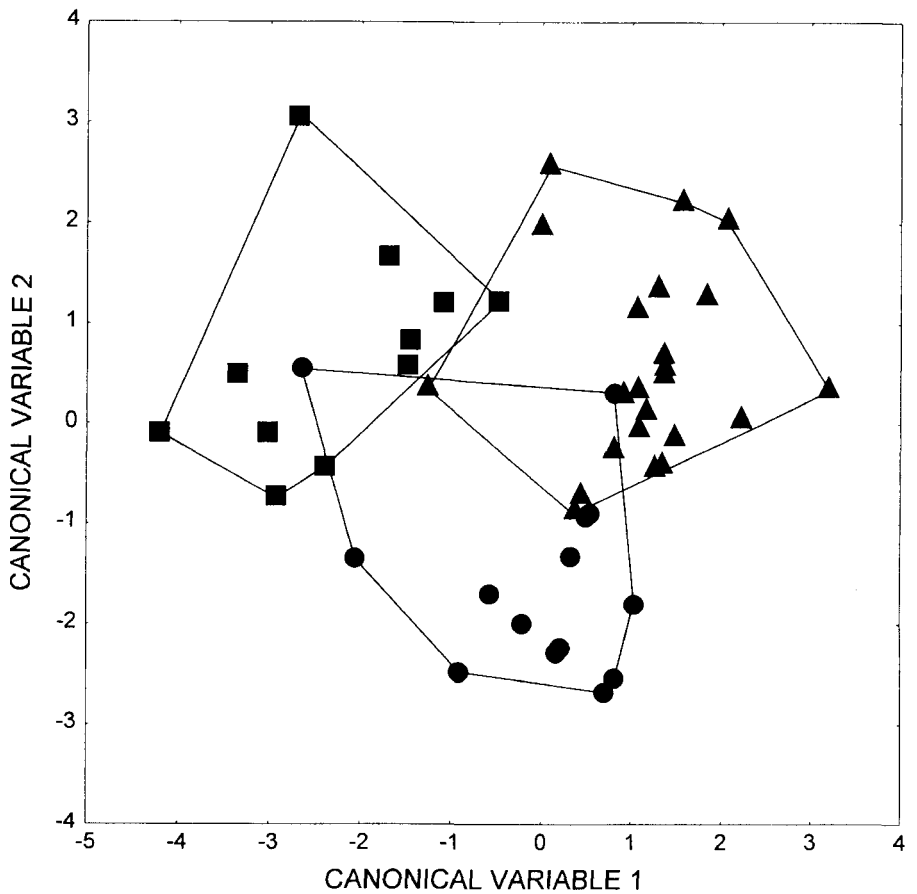


FIG. 9. Canonical variables analysis of leaf variation in continental Asian specimens of *S. propinqua*. Tentative determinations indicated by the following symbols: var. *propinqua sensu* A.C. Sm. (■); var. *intermedia* A.C. Sm. (●); and var. *sinensis* (Oliv.) A.C. Sm. (▲).

intermediate nature of var. *intermedia* is therefore corroborated, although the three infraspecific taxa are recognized as subspecies rather than varieties in the present treatment. This is in accordance with current usage of infraspecific ranks (following proposals by Du Rietz, 1930), in which subspecies are regarded as the *regional* facies and varieties as the *local* facies of a species.

Schisandra axillaris

Historically, there has been considerable taxonomic confusion regarding the delimitation of *Schisandra axillaris* (Fig. 10). Although Blume (1825, 1830) used the basionym *Sphaerostema axillare* solely for Javanese specimens, Hooker (1872) subsequently applied the name (following transfer of the specific epithet to *Schisandra*)

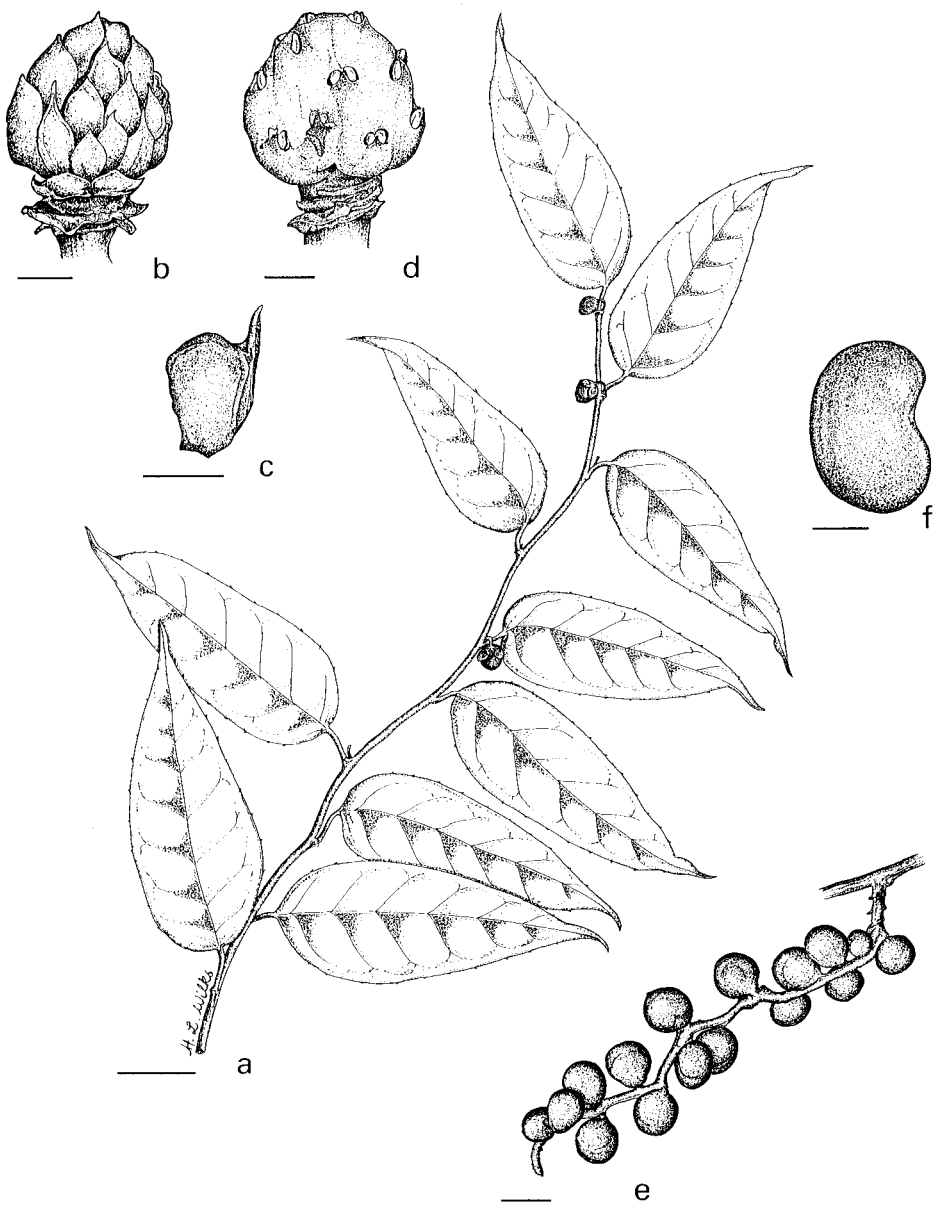


FIG. 10. *Schisandra propinqua* (Wall.) Baill. subsp. *axillaris* (Blume) R.M.K. Saunders. a, flowering branch; b, gynoecium; c, isolated carpel (lateral view); d, androecium; e, fruit; f, seed. Scale bars: a, 2cm; b–d, 1mm; e, 5mm; f, 2mm. [a, *Blume* s.n., s.a. (L); b–c, *Coert* 944 (L); d, *Brinkman* 874a (L); e–f, *Backer* 3656 (L)]. Del. H.L. Wilks. Reproduced with permission from *Flora Malesiana*.

to collections from Assam and Burma. Smith (1947) regarded specimens from the two geographical regions as representing distinct taxa; although he recognized the continental Asian collections as a variety of *S. propinqua* (var. *intermedia*, elevated to the subspecific rank in the present revision), he maintained *S. axillaris* as a distinct species. He noted, however, that there were difficulties in distinguishing the taxa, and that the differentiating characters were 'rather unsatisfactory' (Smith, 1947: 149).

The only characters that can be used to distinguish the two taxa are: (1) leaf margin (generally entire, although occasionally denticulate in *S. axillaris*, with 0–*1.8*–6.6 teeth per margin, whereas *S. propinqua* subsp. *intermedia* is variably entire to denticulate or serrulate, occasionally serrate, with 0–*4.5*–9.5 teeth per margin); (2) leaf thickness (generally coriaceous in *S. axillaris*, but generally papyraceous in *S. propinqua* subsp. *intermedia*); (3) pedicel length (0–*4.0*–10.7mm in *S. axillaris*, 4.0–*7.9*–12.0mm in *S. propinqua* subsp. *intermedia*); and (4) number of perianth parts in male flowers (9–*10*–12 in *S. axillaris*, 7–*8.5*–10 in *S. propinqua* subsp. *intermedia*). These minor differences do not warrant taxonomic acceptance as distinct species, and recognition at an infraspecific level is more appropriate. As with *S. propinqua* (discussed above) and in accordance with the proposals of Du Rietz (1930), the differences in geographical distributions suggest the use of the subspecific rather than varietal rank.

It should be noted that although Smith (1947: 148) included Sumatra within the distributional range of '*S. axillaris*', this was due to the misidentification of the specimen *Beccari* 367 (K!) (=*Kadsura heteroclita* (Roxb.) Craib). Although the distributional range is very restricted, *S. propinqua* subsp. *axillaris* is shown in the present revision to occur in Bali as well as Java.

Schisandra plena

Schisandra plena is the most distinctive of the species assigned to sect. *Sphaerostema*. The leaves are large ([8–]8.5–13.5[–14] × 3.5–5cm) compared with *S. propinqua* s.l. ([5–]7–11.5[–20] × [1–]2–4[–8.5]), and possess a highly diagnostic venation pattern consisting of small reticulate tertiary veins that are prominent on the adaxial surface.

Differences are also apparent in the number of perianth parts in male flowers, with 12–15(–17) in *S. plena* but only (7–)8–10(–12) in *S. propinqua*, although this difference is not reflected in the number of perianth parts in the female flowers. The most important diagnostic feature of *S. plena*, however, is the structure of the androecium. Smith (1947) applied the sectional name *Sphaerostema* to species which possess an androecial mass, derived from the fusion of filaments (Figs 3 & 6). The filaments are essentially free apically in *S. propinqua*, so that the thecae of each anther are contiguous and show introrse dehiscence (Figs 3–5). *Schisandra plena* shows an adaptation of this in which staminal fusion is greater and the anthers are sessile; the thecae of each anther are separated and are positioned on opposing sides of the associated cavity (Figs 6–7). The androecial morphology exhibited by *S. plena* is presumably derived from the *S. propinqua* type by increased fusion of stamens.

Schisandra plena has a very restricted geographical distribution in Yunnan, with one collection from NE India (Arunchal Pradesh province). Although it is 50 years since Smith (1947) published his monograph, very few additional collections of this species have been made, and the present author was able to examine only two collections not studied by Smith.

Historical biogeography

Schisandra propinqua shows a vicariant distribution pattern, with three subspecies (subspp. *propinqua*, *intermedia* and *sinensis*) occurring in continental Asia, and one (subsp. *axillaris*) restricted to Java and Bali. Steenis (1979: 125–131, figs 15–17) has shown that this disjunction is relatively common, listing over 100 Indo-Malesian widespread species that are absent from Sumatra, the Malay Peninsula, Borneo, northern Sulawesi and the southern Philippines. Steenis (1979: 125) comments that these disjunctions are the result of climatic differences: NW and eastern Java (together with the Lesser Sunda Islands and parts of southern Sulawesi) have seasonal droughts (Oldeman, 1975), and therefore form a distinctly different climatic-vegetational region from more northern areas of Malesia such as Sumatra, the Malay Peninsula, Borneo, northern Sulawesi and the Philippines, which are generally tropical and perennially wet.

During the Pleistocene, western Malesia was emerged as the 'Sunda shelf' due to lowered sea levels, estimated at between 100m (Biswas, 1973; Verstappen, 1975) and 150m (Chappell & Thom, 1977) below the current level. Climatic conditions at the time were substantially cooler than present, with lower precipitation levels and consonant periods of drought. Migration of Laurasian genera such as *Schisandra* south across the Sunda shelf therefore presumably occurred during this period, with subsequent extinction in northern Malesia following climatic change.

TAXONOMIC PROPOSALS

Schisandra sect. **Sphaerostema** (Blume) Nakai, Fl. Sylv. Koreana 20: 101 (1933) [as '*Schizandra*']; A.C. Sm. in Sargentia 7: 95–96 (1947). – *Sphaerostema* Blume, Bijdr. Fl. Ned. Ind.: 22 (1825), *pro gen.* – *Schisandra* subgen. *Sphaerostema* (Blume) Y.-W. Law, Fl. Reipubl. Pop. Sin. 30(1): 264 (1996); Y.-W. Law, Rep. Abstr. Meeting 50th Anniv. Bot. Soc. China: 155 (1983), *nom. nud.* – *Schisandra* subgen. *Plena* Y.-W. Law, Fl. Reipubl. Pop. Sin. 30(1): 265–267 ['subgen. *Plenischisandra*', sphalm.], 272 (1996); Y.-W. Law, Rep. Abstr. Meeting 50th Anniv. Bot. Soc. China: 155 (1983), *nom. nud.* TYPE: *Sphaerostema axillare* Blume, Bijdr. Fl. Ned. Ind.: 22 (1825) (=*Schisandra propinqua* (Wall.) Baill. subsp. *axillaris* (Blume) R.M.K. Saunders).

Woody vines; monoecious. *Leaves* alternate on long shoots or clustered on short shoots, exstipulate; lamina papyraceous to coriaceous, elliptic to ovate, base obtuse to truncate (acute in younger leaves), apex acuminate, margins entire to denticulate-

serrulate, rarely serrate. *Flowers* borne axillary to leaves on young growth; solitary, occasionally with secondary flower in axil of prophyll, or in clusters. *Male flowers* with (7–)8–15(–17) perianth parts; androecium of 4–18 stamens, fused into carnose mass; anthers either sessile (*Schisandra plena*) or on short free connectives (*S. propinqua*). *Female flowers* with (8–)11–15(–17) perianth parts; gynoecium of 18–52 free carpels; pseudostyles narrow and subulate. *Seeds* 1–2 per berry, testa ± smooth.

Key to taxa

1a. Leaf venation finely reticulate and prominent on adaxial surface; male flowers with 12–15(–17) perianth parts; anthers sessile on carnose androecial mass (cf. Figs 6–7) ——— **2. S. plena**

1b. Leaf venation lacking finely reticulate pattern, not prominent on adaxial surface; male flowers with (7–)8–10(–12) perianth parts; anthers borne on short free connectives attached to carnose androecial mass (cf. Figs 3–5) ——— **1. S. propinqua** (2)

2a. Flowers solitary or in clusters; male flowers comparatively small, with androecium c.1.8–2.4mm diam., consisting of 4–11 stamens ——— **1c. S. propinqua** subsp. **sinensis**

2b. Flowers solitary, rarely with secondary flower in axil of prophyll; male flowers comparatively large, with androecium c.2.6–4.3mm diam., consisting of 10–18 stamens ——— 3

3a. Female flowers with 14–17 perianth parts — **1a. S. propinqua** subsp. **propinqua**

3b. Female flowers with 9–14 perianth parts ——— 4

4a. Leaves papyraceous; pedicels comparatively long, 4–12mm ——— **1b. S. propinqua** subsp. **intermedia**

4b. Leaves generally coriaceous; pedicels comparatively short, (2–)3–5(–12)mm ——— **1d. S. propinqua** subsp. **axillaris**

1. Schisandra propinqua (Wall.) Baill., Hist. Pl. 1: 148 (1868) [as '*Schizandra*']; Hook.f. & Thoms. in Hook.f., Fl. Brit. Ind. 1: 45 (1872) [as '*Schizandra*']; King in Ann. Bot. Gard. Calcutta 3: 220 (1891) [as '*Schizandra*']; Parment. in Bull. Sci. Fr. Belg. 27: 236, 310 (1896) [as '*Schizandra*']; A.C. Sm. in Sargentia 7: 149 (1947); Rehder, Man. Cult. Trees Shrubs, ed. 2: 255 (1951); Y.-W. Law, Sylva Sin. 1: 538 (1983); G. Krüssmann, Man. Cult. Broad-Leaved Trees Shrubs 3: 311 (1986); J. Cullen & J. Howe, Eur. Gard. Fl. 3: 318 (1989). – *Kadsura propinqua* Wall., Tent. Fl. Napal.: 11 (1824); G. Don, Gen. Syst. 1: 102 (1831); Walp., Rep. Bot. Syst. 2: 16 (1845). – *Sphaerostema propinqua* (Wall.) Blume, Fl. Javae [Schizandr.]: 15 (1830) [as '*S. propinquo*']; Hook.f. & Thoms., Fl. Ind. 1: 85 (1855); Walp. in Ann. Bot. 4: 79 (1857). TYPES: Nepal, Sankoo [Sanku], Mt. Sheopore, s.a., *N. Wallich* 4986 (lecto. K-W [designated here]; isolecto. C!, K [×2]!).

Woody vines, monoecious. *Leaves* variably papyraceous to coriaceous, (5–)9–15(–20)μm thick; lamina elliptic to ovate, (5–)7–11.5(–20)×(1–)2–4(–8.5)cm, length:width ratio (1.8–)2.5–4.0(–5.7); primary vein plane to slightly impressed above, slightly to very prominent below; secondary veins (4–)4.5–6.5(–9) pairs, variably straight or arcuate; base obtuse to truncate (acute in younger leaves); apex short acuminate; margin (sub-)entire to denticulate-serrulate, rarely serrate, 0–7(–13) teeth; petiole (4–)8–16.5(–27)mm long, (0.6–)0.9–1.4(–2.0)mm diameter. *Flowers* borne axillary to leaves on young growth; solitary, occasionally with secondary flower in axil of prophyll, or in clusters; pedicel (0–)4.5–12.5(–17)mm long, (0.3–)0.4–1.1(–1.7)mm diam.; perianth parts cream, yellow, orange, pink, or flushed purplish. *Male flowers* with (7–)8–10(–12) perianth parts; outermost perianth part ovate, (0.8–)1.0–2.4(–2.7)×(0.9–)1.1–2.4(–3.0)mm, length:width ratio (0.5–)0.7–1.5(–1.7); innermost perianth part ovate (rarely elliptic or obovate), (1.4–)2.6–4.0(–5.6)×(0.9–)1.7–2.5(–2.7)mm, length:width ratio (0.7–)1.3–2.4(–3.6); largest perianth part ovate or obovate, (3.1–)5.0–6.2(–7.5)×(2.4–)3.0–5.0(–7.0)mm, length:width ratio 0.9–1.5(–1.9); outermost perianth part highly reduced, 0.2–0.4(–0.7) of length of largest; innermost perianth part (slightly) reduced, (0.4–)0.5–0.9 of length of largest; androecium of (4–)8–18 stamens, fused into carnose mass (1.8–)2.4–3.5(–4.3)mm diam., with anthers borne on free connectives, arising from cavities; pollen hexacolpate. *Female flowers* with (8–)11–15(–17) perianth parts; outermost perianth part ovate, (0.6–)1.0–1.4(–2.2)×(0.8–)1.3–2.1(–2.3)mm, length:width ratio 0.6–1.1(–1.8); innermost perianth part elliptic to ovate (rarely obovate), (2.9–)3.5–5.7(–6.4)×2.0–3.5(–4.0)mm, length:width ratio 1.1–1.7(–2.5); largest perianth part ovate, (4.6–)6.0–9.0(–12.5)×(3.6–)5.0–7.0(–10.0)mm, length:width ratio 1.0–1.3(–1.7); outermost perianth part highly reduced, 0.1–0.3 of length of largest; innermost perianth part reduced, 0.5–0.8(–0.9) of length of largest; gynoecium of 18–52 free carpels, gynoecium 2.8–3.8mm diam.; ovaries 1.1–2.0×0.6–1.2mm, length:width ratio (1.2–)1.4–2.2(–2.8); pseudostyle flat-subulate, without pseudostigma. *Fruit* pedicel length variable, 5–30mm long, 0.5–1.5mm wide; torus 22–65mm long, 0.8–1.7mm wide; berries red to purple, 4.3–9.0×4.1–8.3mm, length:width ratio 0.8–1.2(–1.4). *Seeds* 1–2 per berry, discoid, (3.5–)4.2–4.9(–5.5)×(3.2–)3.7–4.5(–5.4), length:width ratio (0.9–)1.1–1.2(–1.4); testa ± smooth.

Notes. The stomatal anatomy of *S. propinqua* is described by Rao (1939), including subspp. *propinqua* and *intermedia*. Pollen structure has been described and illustrated by Mitriou (1970), Walker (1974: figs 43–44) and Praglowski (1976). References to '*S. axillaris*' in these publications presumably refer to *S. propinqua* subsp. *intermedia* rather than subsp. *axillaris* since continental Asian specimens were studied, although it should be noted that voucher specimens were not cited by Mitriou (1970).

1a. subsp. **propinqua.** – *S. propinqua* var. *typica* A.C. Sm. in Sargentia 7: 151 (1947). – *S. propinqua* var. *propinqua*; Y.-W. Law, Fl. Reipubl. Pop. Sin. 30(1): 264–265 (1996).

Illustrations: Wallich (1824: fig. 15); Lindley (1834: fig. 1688); Hooker (1851: fig. 4614) (reproduced here as Fig. 8); Baillon (1868: figs 183–184); King (1891: pl. 41A); Parmentier (1896: fig. 8.8).

Leaves generally papyraceous, (6.0–)8.5–10.5(–13.0) × (2.0–)2.5–4.0(–4.5)cm, length : width ratio (2.1–)2.5–2.9(–3.3); margin denticulate to serrulate, rarely (sub-)entire, (0–)1–8(–13) teeth. *Flowers* borne solitary in axil of leaf, rarely with secondary flower in axil of prophyll; pedicel 4.5–12.5mm long. *Male flowers* comparatively large, largest perianth parts 3.5–7.2 × 3.7–6.7mm; androecium of 10–18 stamens, fused into carnose mass 3.2–4.3mm diameter. *Female flowers* comparatively large, 14–17 perianth parts, largest perianth parts 7.2–12.5 × 5.5–10.0mm. *Fruit* pedicel short, up to c.10mm long; berries c.7–8 × 7–8mm.

Distribution. NW India (northern Uttar Pradesh) and western Nepal, with isolated collections from central and eastern Nepal (Fig. 11).

Habitat. Open situations in scrubland or in mixed woodland, 1220–1830m altitude.

Notes. Flowering between May and July, with fruits ripe in October and November.

Specimens examined. INDIA. UTTAR PRADESH: *B.C. Datta* 2 (A); *H. Falconer* 80 (A, C, GH, K, L); *U. Kanjilal* 750 (K); *M.L. Punj* 4 (NY); *C.S. Rawat* 4 (A); *R. Strachey & J.E. Winterbottom* 2 (GH); *N.K. Tripathi* 4 (E).

NEPAL. *C.E. Chardon* s.n., 1862 (P); *H. Kanai, G. Murata & M. Togashi* 6303834 (A, K); *B. Ram* 423 (A, NY); *A.D. Schilling & C.D. Sayers* 558 (K), 561 (K [×2]); *J.D.A. Stainton, W.R. Sykes & L.H.J. Williams* 5933 (E, L); *N. Wallich* 1897 (C), 4986 (C, K [×2]), s.n., s.a. (GH, K, L).

1b. subsp. **intermedia** (A.C. Sm.) R.M.K. Saunders, **stat. nov.** – *S. propinqua* var. *intermedia* A.C. Sm. in Sargentia 7: 152 (1947). TYPE: China, Yunnan, outskirts of lava bed west of T'eng-yüeh, v 1912, *G. Forrest* 7692 (holo. A!, iso. K!).

Schisandra propinqua var. *propinqua*; Y.-W. Law, Fl. Reipubl. Pop. Sin. 30(1): 264–265, *pro parte.*

Sphaerostema axillare auctt. non Blume; Hook.f. & Thoms., Fl. Ind. 1: 86 (1855); Drury, Hand-book Ind. Fl. 1: 649 (1864); Walp. in Ann. Bot. 4: 79 (1857).

Schisandra axillaris sensu Hook.f. & Thoms., *quoad specim. et descript., excl. basionym*; Hook.f. & Thoms., Fl. Brit. Ind. 1: 45 (1872); King in Ann. Bot. Gard., Calcutta 3: 220 (1891); Kanjilal, Kanjilal & Das, Fl. Assam 1(1): 28 (1934).

Schizandra propinqua sensu Kanjilal, Kanjilal & Das, Fl. Assam 1(1): 28 (1934), *non* Baill.

Illustrations: King (1891: pl. 74A [as '*Schizandra axillaris*']); Smith (1947: fig. 29a–c [as '*Schisandra propinqua* var. *intermedia*']; Law (1983: fig. 189).

Leaves generally papyraceous, (5.0–)7.0–11.0(–20.0) × (1.0–)2.0–4.5(–8.5)cm, length : width ratio (1.8–)2.4–4.0(–5.4); margin entire to denticulate or serrulate, rarely serrate, 0–7(–11) teeth. *Flowers* borne solitary in axil of leaf, rarely with secondary flower in axil of prophyll; pedicel 4–12mm long. *Male flowers* compara-

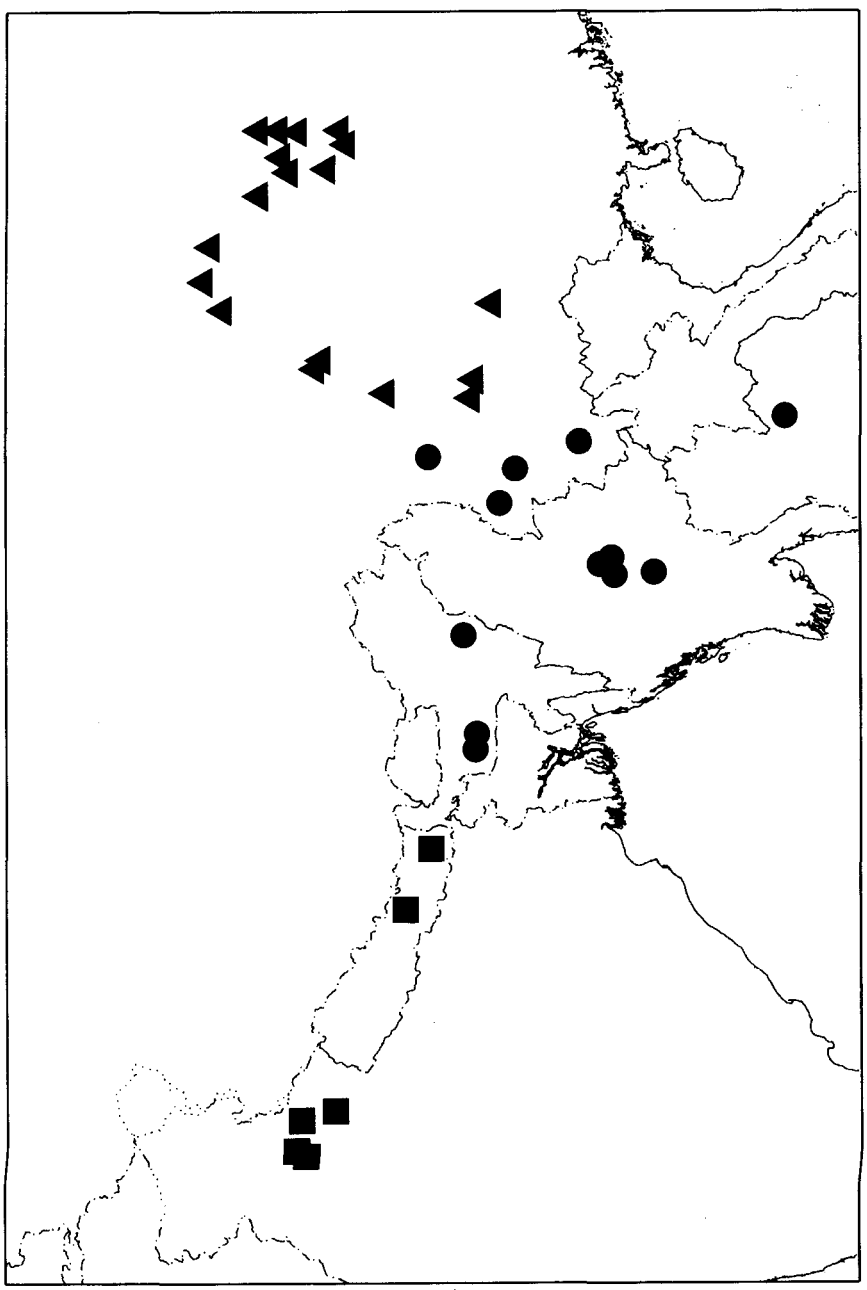


FIG. 11. Geographical distributions of *Schisandra propinqua* subspp. *propinqua* (■), *intermedia* (●) and *sinensis* (▲) in Asia. Symbols represent origins of individual or multiple herbarium collections for which precise locality details are available.

tively large, largest perianth parts 4.0–7.4 × 2.4–5.2mm; androecium of 10–12(–16) stamens, fused into carnose mass c.2.6–2.8mm diameter. *Female flowers* with 9–12 perianth parts, largest perianth parts 6.3–10.9 × 5.6–6.6mm. *Fruit* pedicel short, 7–12mm long; berries 5.9–9.0 × 5.5–8.3mm.

Distribution. NE India (Meghalaya and Nagaland), eastern Burma, northern Thailand, and China (Yunnan) (Fig. 11). Keng (1972) did not list any *Schisandra* species in his account of the family for the *Flora of Thailand*, although he noted that the genus was to be expected there. Two species of *Schisandra* are now known in Thailand: *S. propinqua* subsp. *intermedia* (reported here) and *S. perulata* Gagnep. (Maxwell, 1993).

Habitat. Growing in mixed woodland or in open scrubland, often near rocky areas; (820–)1070–2130m altitude.

Notes. Flowering between May and July, with fruits ripe by September.

Specimens examined. BURMA. *F.G. Dickason* 5076 (A); *J.H. Lace* 5432 (E, K), 5875 (E [×3], K), 5919 (E [×2]), s.n., 11 vii 1913 (E); *C.G. Parkinson* 3133 (K), 12176 (K); *A. Rodger* 610 (E).

CHINA. YUNNAN: *Y.P. Chang* 869 (IBSC); *F. Ducloux* 468 (UC); *K.M. Feng* 9303 (IBSC); *G. Forrest* 7686 (A), 7692 (A, K), 11845 (A, UC), 15860 (A), 19125 (A), 21523 (A), 22245 (A); *H.F. von Handel-Mazzetti* 10017 (A); *A. Henry* 10719 (A), 13023 (A); *E.E. Maire* 196 (UC); *S. Ten* 296 (A), 391 (A), 540 (A); *H.T. Tsai* 54643 (A), 57088 (A); *T.T. Yü* 16315 (A), 22054 (A).

INDIA. MEGHALAYA: *J.D. Hooker & J.J. Thomson* s.n., s.a., 'Khasia' (E, GH, K [×3], NY), s.n., s.a., 'temperate' (L [×2]). NAGALAND: *F. Kingdon Ward* 17495 (A), 19035 (NY).

THAILAND. *N. Fukuoka* T-63689 (=508) (A); *H. Takahashi* T-63507 (=1314) (A).

1c. subsp. **sinensis** (Oliv.) R.M.K. Saunders, **stat. nov.** – *S. propinqua* var. *sinensis* Oliv. in Hook. Ic. Pl. 18: pl. 1715 (1887) [as '*Schizandra*']; Maxim. in Acta Hort. Petrop. 11: 39 (1889) [as '*Schizandra*']; Diels in Bot. Jahrb. 29: 322 (1900) [as '*Schizandra*']; Diels in Bot. Jahrb. 36 beibl. 82: 39 (1905) [as '*Schizandra*']; Rehder & Wilson in Sargent, Pl. Wils. 1: 416 (1913); Rehder in Bailey, Stand. Cycl. Hort. 6: 3110 (1917) [as '*Schizandra*']; Rehder in J. Arn. Arb. 5: 147–148 (1924); Rehder in J. Arn. Arb. 10: 191 (1929) [as '*Schizandra*']; Rehder, Man. Cult. Trees Shrubs, 260 (1927), ed. 2: 255 (1940); A.C. Sm. in Sargentia 7: 153–154 (1947); W.-T. Wang, Icongr. Corm. Sin. 1: 801 (1980); Y.-W. Law, Fl. Reipubl. Pop. Sin. 30(1): 265 (1996). TYPES: China, Hupeh [Hubei], vicinity of I-ch'ang, 1885–88, *A. Henry* 1544 (lecto. GH! [designated here]; isolecto. GH!, K!); ibid., 1885–88, *A. Henry* 1693 (para. K!, US!); ibid., s.a., *A. Henry* 2028 (para. K!); ibid., 1885–88, *A. Henry* 3243 (para. K!, US!).

Schisandra propinqua var. *linearis* Finet & Gagnep. in Bull. Soc. Bot. Fr. 52, Mém. 4: 51 (1905) [as '*Schizandra*'], [reprinted as Contr. Fl. As. Or. 2: 51 (1907)]. TYPES: China, Hupeh [Hubei], vicinity of I-ch'ang, 1885–88, *A. Henry* 1544 (lecto. GH! [designated here]; isolecto. GH!, K!); ibid., s.a., *A. Henry* 2028 (para. K!); ibid., s.a.,

A. Henry 3424 (para., not located); ibid., s.a., *A. Henry* 3961 (para. GH [×2]!, K!, NY!); ibid., 1885–88, *A. Henry* 6219 (=62119?) (para. GH, K!); China, western Hupeh [Hubei], viii 1900, *E.H. Wilson* 1304 (para. A!, IBSC!, K!, NY!). NOMENCLATURAL NOTE: Finet & Gagnepain (1905) cited *A. Henry* 62119 as one of the type specimens; this cannot be located and has been interpreted by Smith (1947) and the present author as a typographical error for collection 6219.

Embelia valbrayi H. Lév., Cat. Pl. Yun-Nan: 177 (1916). TYPES: China, Yunnan, La-kou, vii [1912], *E.E. Maire* s.n. (lecto. E!, isolecto. A [×2]); ibid., ix [1912], *E.E. Maire* s.n. (para. E!); ibid., ix 1910, *E.E. Maire* 2923 (possible para. NY, UC!) [As noted by A.C. Smith on an annotation note on the UC sheet, this specimen 'agrees perfectly with duplicates of the actual type from the Léveillé herbarium' and 'the difference in date may result from confusion in the labels, or it may imply that Maire collected from the same plant (or at least the same locality) at different times'].

Illustrations: Oliver (1887: pl. 1715); Smith (1947: fig. 29, j–l); Wang (1980: fig. 1602); Law (1996a: fig. 77, 1–10).

Leaves papyraceous to subcoriaceous, (5.5–)7.0–11.0(–12.5)×(1.0–)1.5–3.5(–4.5)cm, length:width ratio (2.2–)2.5–5.0(–5.7); margin serrulate, occasionally denticulate, rarely (sub-)entire or serrate, (0–)2–7(–10) teeth. *Flowers* borne solitary or in clusters in axil of leaf; pedicel 3–16mm long. *Male flowers* comparatively small, largest perianth parts 3.1–5.8×2.4–3.5mm; androecium of 4–11 stamens, fused into carnose mass c.1.8–2.4mm diameter. *Female flowers* with 8–15 perianth parts, largest perianth parts 4.6–6.2×3.6–5.1mm. *Fruit* pedicel long, 14–30mm long; berries 4.3–8.7× 4.1–8.3mm.

Distribution. China (Yunnan, Guizhou, Sichuan, Gansu, Shanxi, Hubei and Hunan); a small number of specimens also collected in Xizang (Tibet) (Fig. 11).

Habitat. Growing in woods (generally broad-leaved), often near ridges, slopes, and ravines; 400–2600(–3100)m altitude.

Notes. Flowering between May and September, with fruits ripe between August and December.

Specimens examined. CHINA. GANSU: *J.-X. Yang* 3643 (IBSC); *J.-X. Yang & Z.X. Hu* 3570 (IBSC). GUIZHOU: *Guizhou Expedition* 3960 (IBSC), 4336 (IBSC); *H.F. von Handel-Mazzetti* 119 (A). HUBEI: *H.-C. Chow* 567 (A), 898 (A), 1439 (A); *A. Henry* 1544 (GH [×2]), 1693 (K, US), 3243 (K, US), 3699 (GH), 3961 (GH [×2], NY), 6219 (GH); *H.C. Li* 2945 (IBSC); *M.H. Nieh & Q.-H. Li* 264 (IBSC); *E.H. Wilson* 485 (A [×2], GH), 1304 (A, IBSC, NY); *S.-X. Yang* 537 (IBSC). HUNAN: *K.S. Chow* et al. 120 (A); *Hunan Expedition* 524 (IBSC); *S.C. Lee* 204722 (IBSC), 204799 (IBSC). SHANXI: *C.Y. Chang* 17810 (IBSC), 17994 (IBSC), 18169 (IBSC); *T.P. Wang* 16535 (IBSC). SICHUAN: *Anon.* 1893 (IBSC); *D.E. Boufford & B. Bartholomew* 24908 (A); *C.Y. Chiao* 1163 (A); *H.C. Chow & H.-Y. Li* 110710 (IBSC); *K.L. Chu* 4003 (IBSC); *T.L. Dai* 103218 (IBSC); *H.F. von Handel-Mazzetti* 1943 (A); *T.N. Liou & C. Wang* 264 (IBSC); *M.-G. Liu & J.-L. Liu* 122 (IBSC); *D.Y. Peng* 45343 (IBSC); *Sichuan University* 108563 (IBSC), 109051 (IBSC); *H. Smith* 2366 (A); *T.P. Soong* 39439 (IBSC); *F.C. Tai & C.M. Teng* 5307 (IBSC); *T.H. Tsang* 1.306 (IBSC); *H.L.*

Tsiang 35048 (IBSC); *F.T. Wang* 22166 (A); *E.H. Wilson* 1070 (A), 1268b (A); *K.H. Yang* 58216 (IBSC). XIZANG (TIBET): *Qingzang Expedition* 4609 (IBSC). YUNNAN: *E.E. Maire* 91 (A), 237 (IBSC), 2923 (UC), 3650 (UC); *P.I. Mao* 1934 (IBSC).

1d. subsp. **axillaris** (Blume) R.M.K. Saunders, **comb. et stat. nov.**; R.M.K. Saunders, Fl. Males., ser. 2, 13: 204–206 (1997). – *S. axillaris* (Blume) Hook.f. & Thoms. in Hook.f., Fl. Brit. Ind. 1: 45 (1872) [as '*Schizandra*'] *quoad basionym*; Backer, Schoolfl. Java: 16 (1911); A.C. Sm. in Sargentia 7: 147–148 (1947); Backer & Bakh.f., Fl. Java 1: 99–100 (1963). – *Sphaerostema axillare* Blume, Bijdr. Fl. Ned. Ind.: 22 (1825) [as '*Sphaerostema axillaris*']; Blume, Fl. Javae [Schizandreae]: 14 (1830); G. Don, Gen. Hist. Dichlam. Pl. 1: 101 (1831) [as '*Sphaerostemma axillaris*']; Miq., Fl. Ned. Ind. 1(2): 19 (1858), *pro parte* [as '*Sphaerostemma axillare*']. TYPES: West Java, Goenoeng Tjareme, ['in sylvis altis montis Tjerimai Provinciae Cheribon'], s.a., *C.L. Blume* 66 (lecto. BO [photograph]!); ibid., s.a., *C.L. Blume* s.n. (para. K!, NY!).

Sphaerostema pyrifolium Blume, Fl. Javae [Schizandreae]: 16 (1830); Walp., Rep. Bot. Syst. 1: 92 (1842) [as '*Sphaerostemma*']; Miq., Fl. Ned. Ind. 1(2): 19–20 (1858) [as '*Sphaerostemma*']; Koorders, Exkursionsfl. Java 2: 243 (1912), *pro syn.* [as '*Sphaerostemma pirifolium*']. – *Uvaria pyrifolia* Reinw. ex Blume, Fl. Javae [Schizandreae]: 16 (1830), *pro syn.* TYPE: West Java, Tjiandjoer, s.a., *C.G.C. Reinwardt* s.n. (lecto. L!, isolecto. L [×3]!).

Sphaerostema pyrifolium var. *denticulatum* Blume ex Koorders, Exkursionsfl. Java 2: 243 (1912), *pro syn.* [as '*Sphaerostemma pirifolium*'].

Schizostigma axillare Hook.f. & Thoms. ex Merr., Enum. Phil. Fl. Pl. 2: 153 (1923), *sphalm.*

Illustrations: Fig. 10 (reproduced from Saunders, 1997: fig. 1); Blume (1830: figs 3–4, latter as '*Sphaerostema pyrifolium*'); Koorders (1912: fig. 52, as '*S. axillaris*', redrawn from Blume, 1830: fig. 4); Steenis (1972: fig. 29.4, as '*S. axillaris*').

Leaves generally coriaceous, 6–11.5 × 2.0–4.5(–5.0)cm, length : width ratio (2.0–)2.3–3.2(–3.5); margin entire, occasionally denticulate, 0–6(–8) teeth. *Flowers* borne solitary in axil of leaf; pedicel (2–)3–5(–12)mm long. *Male flowers* comparatively large, largest perianth parts 4.3–7.5 × 4.1–7.0mm; androecium of 10–13(–17) stamens, fused into carnose mass 2.8–3.9mm diameter. *Female flowers* with 10–14 perianth parts, largest perianth parts c.4.8–7.8 × 5.0–6.0mm. *Fruit* pedicel short, 3–8mm long; berries 6.7–8.5 × 6.6–8.2mm.

Distribution. Java and Bali (Fig. 12).

Habitat. Submontane to montane forests, 1200–2200m altitude, although Koorders (1912) reports '*S. axillaris*' growing at altitudes of only 400m.

Notes. Flowering between March and October (Backer & Bakhuizen van den Brink, 1963: 100).

Specimens examined. BALI. *Sarip* 368 (L).

JAVA. *J.J. Afriastini* 1484 (L); *C.A. Backer* 3656 (L); *C.L. von Blume* s.n., s.a. (K, L, NY),

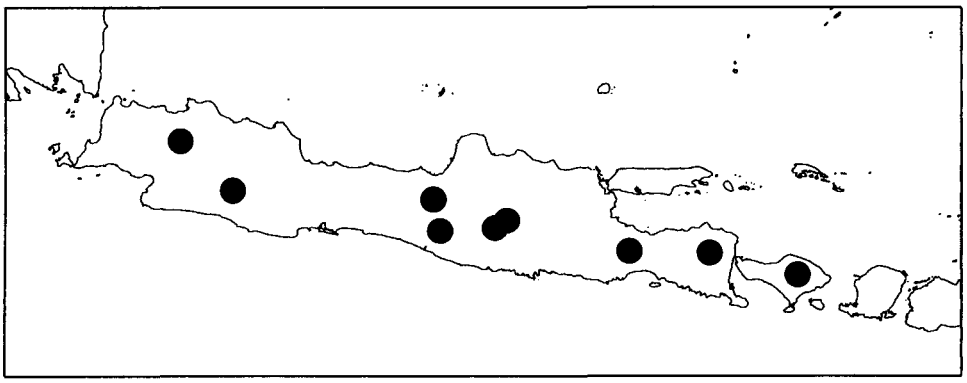


FIG. 12. Geographical distribution of *Schisandra propinqua* subsp. *axillaris* (●) in Java and Bali. Symbols represent origins of individual or multiple herbarium collections for which precise locality details are available.

750 (L), 1601 (L); *R. Brinkman* 874a (L); *J.H. Coert* 746 (L), 944 (L); *F.W. Junghuhn* s.n., s.a. (L); *S.H. Koorders* 25982b (L), 28047b (L), 37670b (L), 37671b (L), 37673b (L); *C.G.C. Reinwardt* s.n., s.a. (L); *Soegandiredjo* 128 (L); *G.H. de Vriese & J.E. Teijsmann* s.n., 1859–60 (L); *F.A.C. Waitz* s.n., s.a. (L).

2. Schisandra plena A.C. Sm. in Sargentia 7: 154 (1947); Y.-W. Law, Fl. Reipubl. Pop. Sin. 30(1): 267 (1996). TYPE: China, Yunnan, Ssu-mao/Sze-mao, 14 v [without year], *A. Henry* 10854 (holo. A!; iso. MO!, NY!, US [×2]!).

Schisandra propinqua sensu Rehder & Wilson *non* Baill. in Sargent, Pl. Wils. 1: 416 (1913).

Illustrations: Smith (1947: fig. 29, d–i); Law (1996a: fig. 77, 11–15).

Woody vines, monoecious. *Leaves* papyraceous to slightly coriaceous; lamina (ovate-)elliptic, (8–)8.5–13.5(–14) × 3.5–5cm, length : width ratio 1.8–3.0(–3.3); primary vein (slightly) impressed above, prominent below; secondary veins 5–7 pairs, (slightly) arcuate; tertiary and quaternary venation very intricate and prominent above; base obtuse (acute in younger leaves); apex (short) acuminate; margin entire; petiole 13–16(–19)mm long, 1.1–1.6(–2.0)mm diameter. *Flowers* borne axillary to leaves on young growth; solitary or in clusters; pedicel 7–12(–15)mm long, 0.6–0.7mm diam.; perianth parts white or pale yellow, red at base. *Male flowers* with 12–15(–17) perianth parts; outermost perianth part ovate, 0.8–1.0 × 1.3–1.4mm, length : width ratio 0.6–0.8; largest perianth part ovate or obovate, 8.6–9.7 × 4.0–4.2mm, length : width ratio 2.1–2.4; outermost perianth part highly reduced, c.0.1 of length of largest; innermost perianth part often slightly reduced; androecium of c.8 stamens, fused into carnose mass, 4.5–6 × 3–4mm, with sessile anthers, narrowing towards base; pollen hexacolpate. *Female flowers* with c.13 perianth parts; perianth parts ± similar to those of male flowers; gynoecium of c.31 free carpels, gynoecium c.4 × 4mm; ovaries c.1.2 × 0.9mm, length : width ratio c.1.3; pseudostyle

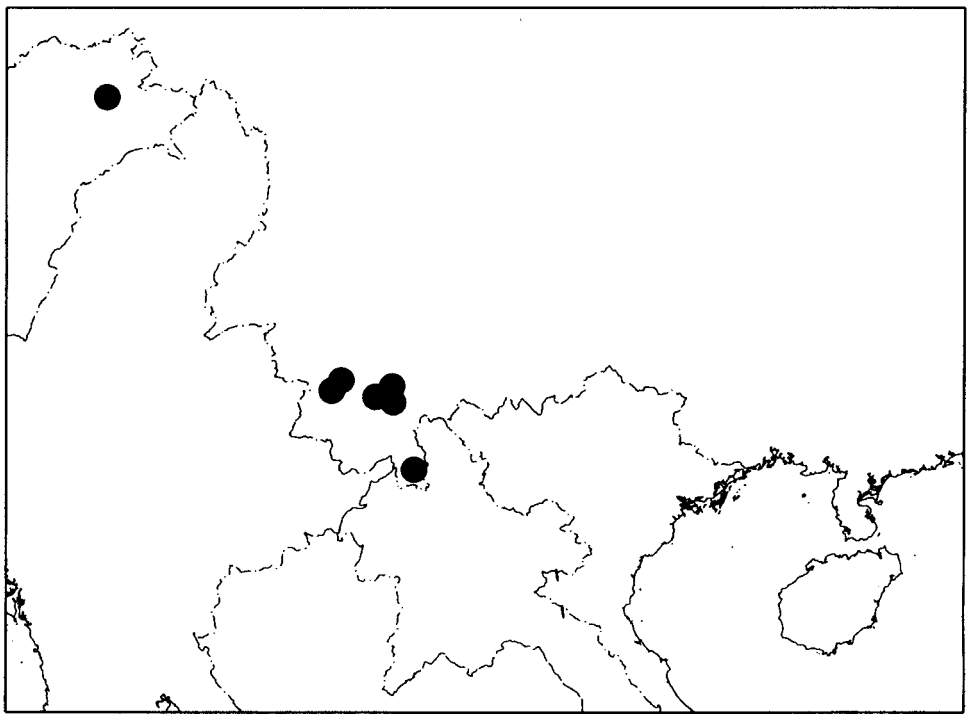


FIG. 13. Geographical distribution of *Schisandra plena* (●) in Asia. Symbols represent origins of individual or multiple herbarium collections for which precise locality details are available.

subulate, without pseudostigma. *Fruit* pedicel not significantly elongated, 11–15mm long; torus 5–17cm long (*fide* Smith, 1947: 156); berries (orange-)red, c.10 × 12mm, length : width ratio c.0.9. *Seeds* 1–2 per berry, flattened-elliptical, 7–7.5 × 5.5–6mm (*fide* Smith, 1947: 156), testa ± smooth.

Distribution. NE India (Arunchal Pradesh) and China (Yunnan) (Fig. 13).

Habitat. Dense woodland, 600–1520m altitude.

Notes. Flowering between April and May, with fruits ripe between August and September. The pollen morphology of *S. plena* is described by Praglowski (1976).

Specimens examined. CHINA. YUNNAN: *Anon.* s.n., s.a. (IBSC 174186); *A. Henry* 10854 (A, MO, NY, US), 11749 (A), 11893 (A), 12192 (A, K, NY); *C.-J. Liao* s.n., 12 xii 1983 (IBSC); *C. W. Wang* 76340 (A), 78784 (A).

INDIA. ARUNCHAL PRADESH: *F. Kingdon Ward* 8009 (K).

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APPENDIX

List of exsiccatae

Species determinations are indicated by the following abbreviations: AXI (*Schisandra propinqua* subsp. *axillaris*), INT (*S. propinqua* subsp. *intermedia*), PLE (*S. plena*), PRO (*S. propinqua* subsp. *propinqua*), and SIN (*S. propinqua* subsp. *sinensis*). Only sheets with specific collection numbers are listed.

Afriastini, J.J. 1484 (AXI).
Backer, C.A. 3656 (AXI); *Blume, C.L. von* 750 (AXI), 1601 (AXI); *Boufford, D.E. & B. Bartholomew* 24908 (SIN); *Brinkman, R.* 874a (AXI).
Chang, C.Y. 17810 (SIN), 17994 (SIN), 18169 (SIN); *Chang, Y.P.* 869 (INT); *Chiao, C.Y.* 1163 (SIN); *Chow, H.-C.* 567 (SIN), 898 (SIN), 1439 (SIN); *Chow, H.-C. & H.-Y. Li* 110710 (SIN); *Chow, K.S.* et al. 120 (SIN); *Chu, K.L.* 4003 (SIN); *Coert, J.H.* 746 (AXI), 944 (AXI).
Dai, T.L. 103218 (SIN); *Datta, B.C.* 2 (PRO); *Dickason, F.G.* 5076 (INT); *Ducloux, F.* 468 (INT).
Falconer, H. 80 (PRO); *Feng, K.M.* 9303 (INT); *Forrest, G.* 7686 (INT), 7692 (INT), 11845 (INT), 15860 (INT), 19125 (INT), 21523 (INT), 22245 (INT).
Guizhou Expedition 3960 (SIN), 4336 (SIN).

Handel-Mazzetti, H.F. von 119 (SIN), 1943 (SIN), 10017 (INT); *Henry, A.* 10719 (INT), 10854 (PLE), 11749 (PLE), 11893 (PLE), 12192 (PLE), 13023 (INT), 1544 (SIN), 3699 (SIN), 3961 (SIN), 6219 (SIN); *Hunan Expedition* 524 (SIN).

Kanai, H., G. Murata & M. Togashi 6303834 (PRO); *Kanjilal, U.* 750 (PRO); *Kingdon Ward, F.* 8009 (PLE), 17495 (INT), 19035 (INT); *Koorders, S.H.* 25982b (AXI), 28047b (AXI), 37670b (AXI), 37671b (AXI), 37673b (AXI).

Lace, J.H. 5432 (INT), 5875 (INT), 5919 (INT); *Lee, S.C.* 204722 (SIN), 204799 (SIN); *Li, H.C.* 2945 (SIN); *Liou, T.N. & C. Wang* 264 (SIN); *Liu, M.-G. & J.-L. Liu* 122 (SIN).

Maire, E.E. 91 (SIN), 196 (INT), 237 (SIN), 2923 (SIN), 3650 (SIN); *Mao, P.I.* 1934 (SIN).

Nieh, M.H. & Q.-H. Li 264 (SIN).

Parkinson, C.G. 3133 (INT), 12176 (INT); *Peng, D.Y.* 45343 (SIN); *Punj, M.L.* 4 (PRO).

Qingzang Expedition 4609 (SIN).

Ram, B. 423 (PRO); *Rawat, C.S.* 4 (PRO); *Rodger, A.* 610 (INT).

Sarip 368 (AXI); *Schilling, A.D. & C.D. Sayers* 558 (PRO), 561 (PRO); *Sichuan University* 108563 (SIN), 109051 (SIN); *Smith, H.* 2366 (SIN); *Soegandiredjo* 128 (AXI); *Soong, T.P.* 39439 (SIN); *Stainton, J.D.A., W.R. Sykes & L.H.J. Williams* 5933 (PRO); *Strachey, R. & J.E. Winterbottom* 2 (PRO).

Tai, F.C. & C.M. Teng 5307 (SIN); *Ten, S.* 296 (INT), 391 (INT), 540 (INT); *Tripathi, N.K.J.* 4 (PRO); *Tsai, H.T.* 54643 (INT), 57088 (INT); *Tsang, T.H.* 1.306 (SIN); *Tsiang, H.L.* 35048 (SIN).

Wallich, N. 1897 (PRO), 4986 (PRO); *Wang, C.W.* 76340 (PLE), 78784 (PLE); *Wang, F.T.* 22166 (SIN); *Wang, T.P.* 16535 (SIN); *Wilson, E.H.* 485 (SIN), 1070 (SIN), 1268b (SIN), 1304 (SIN).

Yang, J.-X. 3643 (SIN); *Yang, J.-X. & Z.X. Hu* 3570 (SIN); *Yang, K.H.* 58216 (SIN); *Yang, S.-X.* 537 (SIN); *Yü, T.T.* 16315 (INT), 22054 (INT).