

Reduction of Notopterygium to Hansenia (Umbelliferae)

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Reduction of *Notopterygium* to *Hansenia* (*Umbelliferae*)

Abstract

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Morphological analysis, including detailed fruit structure investigation, confirms a hypothesis recently proposed on the basis of a phylogenetic analysis of DNA sequence data, on a close relationship between the mainly Siberian genus *Hansenia* and the endemic Chinese genus *Notopterygium*. Therefore the species of *Notopterygium* are transferred to the previously unispecific *Hansenia* and five new nomenclatural combinations are validated. As a result, *Hansenia* comprises six species, distributed from the mountains of S Siberia across Mongolia and N China to the SW Chinese provinces of Sichuan and Yunnan.

Additional key words: *Apiaceae*, *Apioideae*, China, Siberia, Mongolia, carpology, taxonomy.

Introduction

One of the noteworthy results of our recent molecular phylogenetic analysis of the critical Sino-Himalayan *Umbelliferae* subfamily *Apioideae* (Valiejo-Roman & al. 2002) was the unexpected close affinity between *Hansenia mongolica* Turcz., the only species of that genus, and *Notopterygium forbesii* H. Boissieu and *N. weberbauerianum* (H. Wolff) Pimenov & Kljuykov, the former providing the type of the name *Notopterygium* H. Boissieu. The three species consistently formed a single clade with high statistical support in the ITS sequence analyses. Although all three were determined in the same laboratory in the Moscow State University and the plant material was collected by the authors of the present publication during their Siberian and Chinese expeditions, that affinity, never noted in the taxonomic literature before, became obvious only after molecular analyses. Another ITS sequence referred by Downie & al. (1998) to *N. incisum* C. C. Ting & H. T. Chang (which is a taxonomic synonym of *N. weberbauerianum*) and included in the analyses by Valiejo-Romero & al. (2002), in contrast, grouped consistently far away with *Sphenosciadium*. Most likely this sequence actually comes from misidentified material of some *Angelica* species with a leaf dissection similar to *N. weberbauerianum* and has thus been excluded from our considerations.

Prompted by that molecular phylogenetic analyses, we undertook a comparative morphological investigation of the species of *Hansenia* and *Notopterygium*, which revealed additional evidence for the close relationship of both genera.

In particular fruit morphology, which is of considerable value for the systematics of the *Umbelliferae*, supports the molecular phylogenetic results and strongly indicates that *Hansenia* and *Notopterygium* should be treated as congeneric. In the present contribution the results of the comparative morphological analyses are summarized and the taxonomic consequences are drawn: *Notopterygium* is reduced to a synonym of, and its species are transferred to, *Hansenia*. A taxonomic conspectus of *Hansenia* in its new circumscription is provided.

Material and methods

The present study is based on herbarium specimens collected by the authors in Siberia and China and deposited in the herbarium of the Moscow State University (MW), as well as on material from the herbaria CDBI, E, GB, GH, GOET, K, KUN, LE, M, MW, NAS, P, PE and UPS (abbreviations according to Holmgren & Holmgren 1998-).

Fruit anatomy and petiole anatomy were studied employing standard techniques.

Taxonomic history

Hansenia was described by Turczaninow (1844), a prominent Russian investigator of the Siberian flora, as a genus with the single species *H. mongolica*. The species is thus the type of the name *Hansenia* (Farr & al. 1979; Pimenov & Lavrova 1989; Pimenov & Leonov 1993). The spelling “*mongolica*”, used in the protologue, was later changed incorrectly to “*mongholica*”. *Hansenia* was adopted immediately after its description by Ledebour (1844) and again recently by several authors (Pimenov & Tikhomirov 1981; Revuschkin 1988; Pimenov & Lavrova 1989; Gubanov 1996; Pimenov 1996). Other authors, following Krylov (1935), included it into *Ligusticum* L. s.l. (Schischkin 1950; Popov 1957; Leute 1970; Vodopianova 1979, etc.) under the name *L. mongolicum* (Turcz.) Krylov. However, the considerable difference between *Hansenia* and *Ligusticum* s.str. (i.e. *L. scoticum* L.) were clearly demonstrated for both morphological (Pimenov & Lavrova 1989) and molecular (Valiejo-Roman & al. 2002) characters.

Notopterygium was described by Boissieu (1903) with two species, *N. forbesii* and *N. franchetii* H. Boissieu, which later appeared to be identical. The former was selected as the lectotype of the name *Notopterygium* (Pimenov & Leonov 1993). Koso-Poljansky (1916) validated the replacing name *Drymoscias*, supposing that “*Nothopterigium* De Boissieu” was illegitimate as a later homonym of *Notopterygium* Montagne (= *Gottschea* Nees, *Hepaticae*). The latter name was, however, never published, and thus could not prevent the use of *Notopterygium* H. Boissieu. Later, five other species were described in *Notopterygium*: *N. forrestii* H. Wolff (1930), *N. oviforme* R. H. Shan (1943), *N. incisum* C. C. Tingi & H. T. Chang (Chang 1975), *N. pinnatiin-volucellatum* F. T. Pu & Y. P. Wang (1994) and *N. tenuifolium* M. L. Sheh & F. T. Pu (1997). We showed that *Ligusticum weberbauerianum* H. Wolff is conspecific with and that its name has priority over *N. incisum* (Pimenov & Kljuykov 1999) and validated the new combination *N. weberbauerianum*. As a result, *Notopterygium* comprises six species. There are alternative taxonomic treatments of the species within the genus (Wang & al. 1996; Pu & al. 2000; Sheh & Watson 2005), but the independent status of *Notopterygium* was never questioned: it was always regarded as one of the Chinese endemic genera in the *Umbelliferae* (Sheh & Su 1987). Pu & al. (2000) proposed the division of *Notopterygium* into two sections, *N. sect. Notopterygium* and *sect. Tenuifolium* F. T. Pu, based on the patterns of leaf and bracteole dissection.

Fruit structure of *Hansenia* and *Notopterygium* species

To clarify the relationships in the *Hansenia-Notopterygium* group we compared the fruit structure of *H. mongolica* and the Chinese species of *Notopterygium*. Identification and species delimitation

itation is difficult, especially in the group of *N. weberbauerianum* (= *N. incisum*) and *N. pinnatiinvolucellatum*, due to ambiguities in their description.

Hansenia mongolica (type of *Hansenia*, Fig. 1; see also Pimenov & Lavrova 1989: fig. 2). – Fruits glabrous, with bifid carpophore and two equally developed mericarps, slightly compressed dorsally. *Calyx teeth* small, triangular. *Stylopods* short-conical, styles short, c. 0.5–0.7 mm long, reflexed. *Mericarps* elliptic in outline, 5–7 mm long, 2–3 mm broad, with winged, thin, slightly wavy dorsal and marginal ribs, the latter being slightly broader. *Exocarp* single-layered, of rather large (c. 30 µm) cells with thin walls, interrupting near carpophore. *Commissure* narrow. *Mesocarp* parenchymatous, partly disintegrating at maturity, partly of cells with lignified, pitted walls. *Vascular bundles* situated in the basal and middle parts of the ribs, enlarged in radial direction. *Vittae* per 3–4 in furrows, 4–6 on the commissural side. *Rib secretory ducts* absent. *Endocarp* of one layer of cells, elongate in tangential direction. *Spermoderma* of small cells. *Endosperm* broadly and not deeply concave on the commissural side.

Notopterygium forbesii (type of *Notopterygium*, Fig. 2A). – Fruits glabrous, slightly compressed laterally, with bifid carpophore and two equally developed mericarps, slightly compressed dorsally. *Calyx teeth* small, lanceolate. *Stylopods* conical, styles 0.5–1 mm long, reflexed. *Mericarps* ovate in outline, 4.5–6 mm long, 2.5–2.8 mm broad, with winged, thin, approximately equal dorsal and marginal ribs. *Exocarp* single-layered, of comparatively large cells with slightly thickened outer walls, sometimes separating from the mesocarp and interrupting near the carpophore. *Commissure* narrow. *Mesocarp* parenchymatous, partly disintegrating at maturity. *Vascular bundles* situated in the basal and middle parts of ribs, enlarged in radial direction. *Vittae* per 2–4 in furrows, 4–5 on the commissural side. *Rib secretory ducts* absent. *Endocarp* of one layer of cells with thin, slightly lignified cells, elongate in tangential direction. *Spermoderma* of small cells. *Endosperm* broadly and not deeply concave on the commissural side.

Notopterygium forrestii (Fig. 2B). – Fruits glabrous, slightly compressed laterally, with bifid carpophore and two equally developed mericarps. *Calyx teeth* small, triangular or lanceolate, sometimes hardly observed. *Stylopods* flat, with elevated margin, styles c. 0.8 mm long, reflexed. *Mericarps* elliptic or ovate in outline, 3–3.5 mm long, 1.4–1.6 mm broad, with winged, thin, approximately equal dorsal and marginal ribs. *Exocarp* single-layered, of considerably large cells with thin walls, interrupting near the carpophore. *Commissure* narrow. *Mesocarp* parenchymatous of cells with thin walls. *Rib vascular bundles* thin. *Vittae* per 3 in furrows, 4–6 on the commissural side. *Rib secretory ducts* absent. *Endocarp* of one layer of small cells, elongate in tangential direction. *Spermoderma* of comparatively large cells. *Endosperm* not deeply concave on the commissural side.

Notopterygium oviforme (Fig. 2C). – Fruits elliptic or ovate, glabrous, with bifid carpophore and two equally developed mericarps. *Calyx teeth* short, triangular. *Stylopods* depressed-conical, styles 0.5–1 mm long, reflexed. *Mericarps* ovate in outline, 5–6 mm long, 2.5–3 mm broad, with winged, thin, approximately equal dorsal and marginal ribs. *Exocarp* single-layered, of middle-sized cells with thin walls, frequently separating from mesocarp and interrupting near the carpophore. *Commissure* narrow. *Mesocarp* parenchymatous, partly disintegrating at maturity. *Vascular bundles* slightly enlarged in radial direction. *Vittae* per 1–2 in furrows, 4 on the commissural side. *Rib secretory ducts* absent. *Endocarp* of one layer of cells with thin, slightly lignified walls. *Spermoderma* of small cells. *Endosperm* slightly concave on the commissural side.

Notopterygium weberbauerianum (= *N. incisum*) (Fig. 2D). – Fruits glabrous, with bifid carpophore and two equally developed mericarps, slightly compressed dorsally. *Calyx teeth* short, triangular. *Stylopods* flat, styles short, up to 1 mm long, reflexed. *Mericarps* ovate in outline, 3.5–4 mm long, 2–3 mm broad, with winged, thin, approximately equal dorsal and marginal ribs. *Exocarp* single-layered, of rather large cells with thin walls, interrupting near carpophore. *Commissure* narrow. *Mesocarp* parenchymatous, partly disintegrating at maturity. *Vascular bundles* situated in the basal and middle parts of the ribs, enlarged in radial direction. *Vittae* per 2–3 in

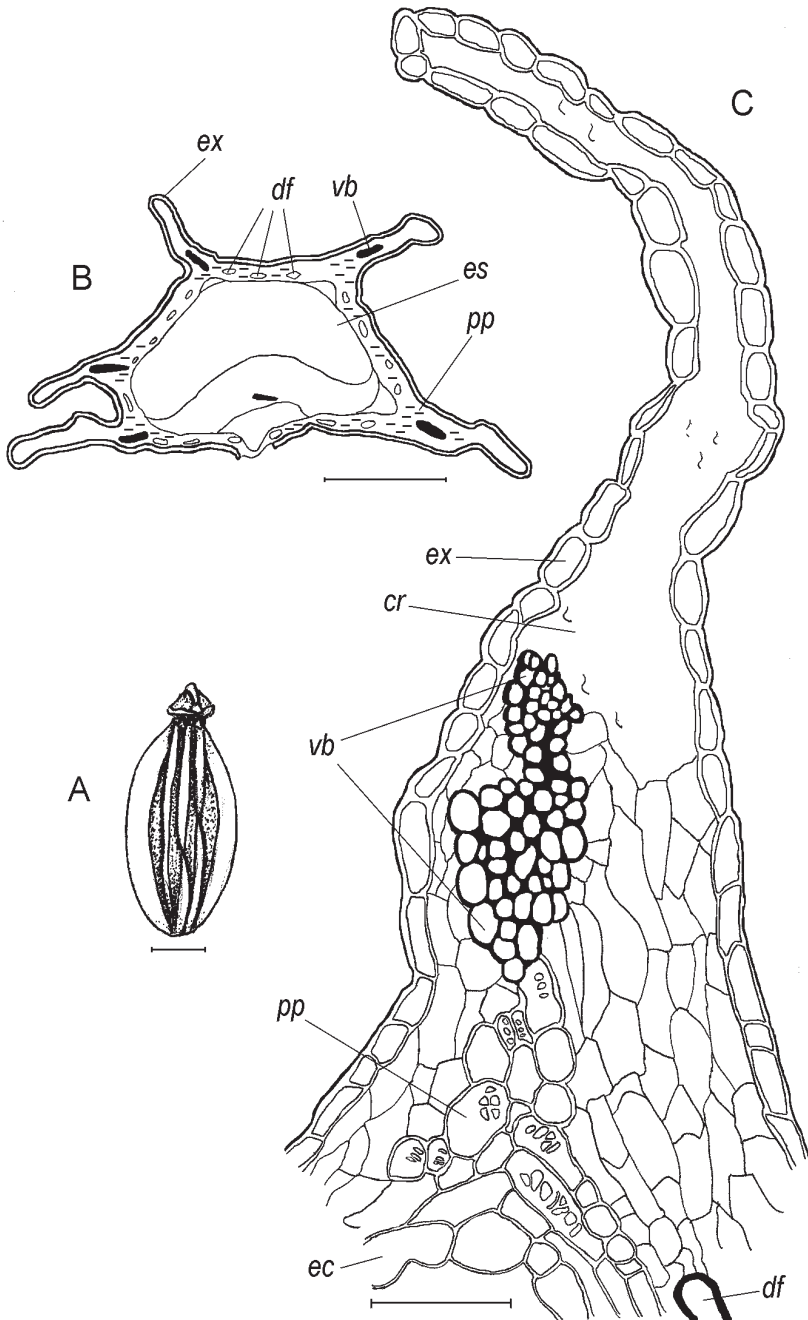


Fig. 1. *Hansenia mongolica* (Pimenov & Kljuykov 33, MW), mericarp – A: dorsal view; B: transect; C: dorsal rib in transect. – Scale bars: A-B = 1 mm, C = 0.1 mm. – Abbreviations: cav = cavity; col = collenchyma; cr = crushed cells; dc = commissural secretory ducts; df = secretory ducts in furrows; ec = endocarp; es = endosperm; ex = exocarp; pp = parenchyma cells with lignified pitted walls.

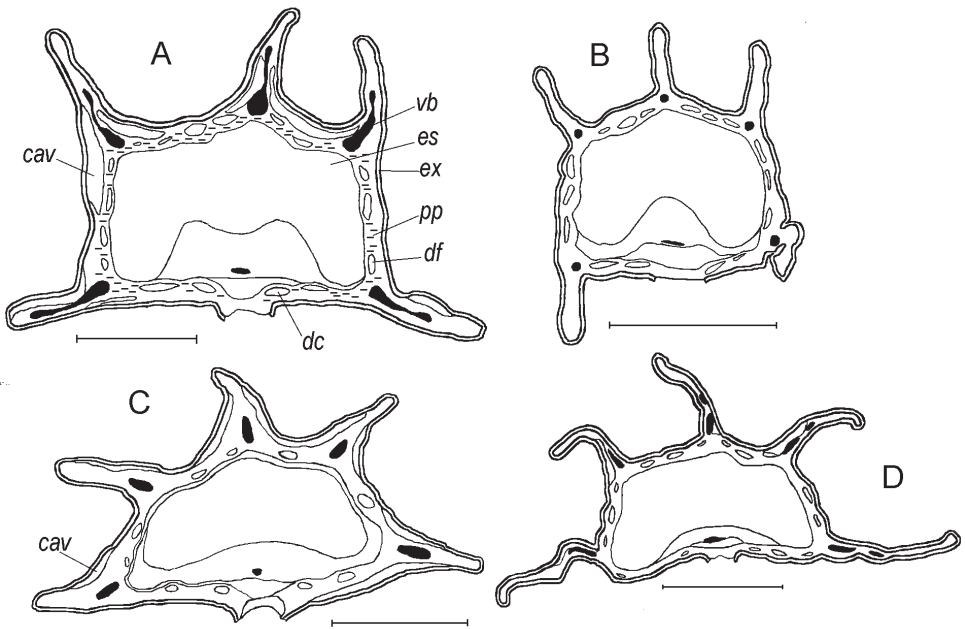


Fig. 2. Transect of mericarps – A: *Notopterygium forbesii* (Pimenov & al. 166, MW); B: *N. forrestii* (isotype, PE); C: *N. oviforme* (Pimenov & al. 290, MW); D: *N. weberbauerianum* (Pimenov & al. 292, MW). – Scale bars: 1 mm; for the abbreviations see caption of Fig. 1.

furrows, 5-6 on the commissural side. *Rib secretory ducts* absent. *Endocarp* of one layer of cells, elongate in tangential direction. *Spermoderma* of small cells. *Endosperm* broadly and not deeply concave on the commissural side.

Notopterygium pinnatiinvolutellatum. – There are some problems in distinguishing this and the previous species, with similarly dissected leaves. *N. pinnatiinvolutellatum* was described (Pu & Wang 1994) as closely related to *N. incisum*. Pu & al. (2000) distinguished two species mainly on the basis of bracteole dissection (pinnate/entire), although *N. pinnatiinvolutellatum* has, after their description, both types of bracteoles. As one of the differences, an unusual mericarp rib structure was noted in protologue: “mericarpia ... jugis brevialatis, sed nonnunquam jugis intermediis modo projectis approximatis filiformibus ...”. The mericarp with two winged marginal ribs and one winged dorsal rib was pictured in the protologue. Later, Wang & al. (1996) reproduced the same figure along with one of a mericarp of *N. incisum*, with two dorsal ribs. In the protologue of *N. incisum* (Chang 1975), however, the mericarp is pictured with three dorsal ribs, approximately equally developed. We collected near Kangding (Sichuan) *N. weberbauerianum* with a fruit structure corresponding to the protologue (see previous paragraph). However, some specimens from Sichuan cited in the protologue of *N. incisum* (5642 and 64061) have fruits with usually three winged ribs only. Supposing that these specimens actually belong to the then unknown *N. pinnatiinvolutellatum*, the variability in the number of similar ribs would be a diagnostic character of this species, and the mericarp of “*N. incisum*” with four aliform ribs illustrated by Wang & al. (1996) would also represent *N. pinnatiinvolutellatum*. *N. pinnatiinvolutellatum* and *N. weberbauerianum* (= *N. incisum*) could then be distinguished even without bracteoles, which are usually deciduous. This is, however, only a hypothesis to be tested by further studies. The fruit description of our own collection from Sichuan, which we refer to *N. pinnatiinvolutellatum*, is as follows.

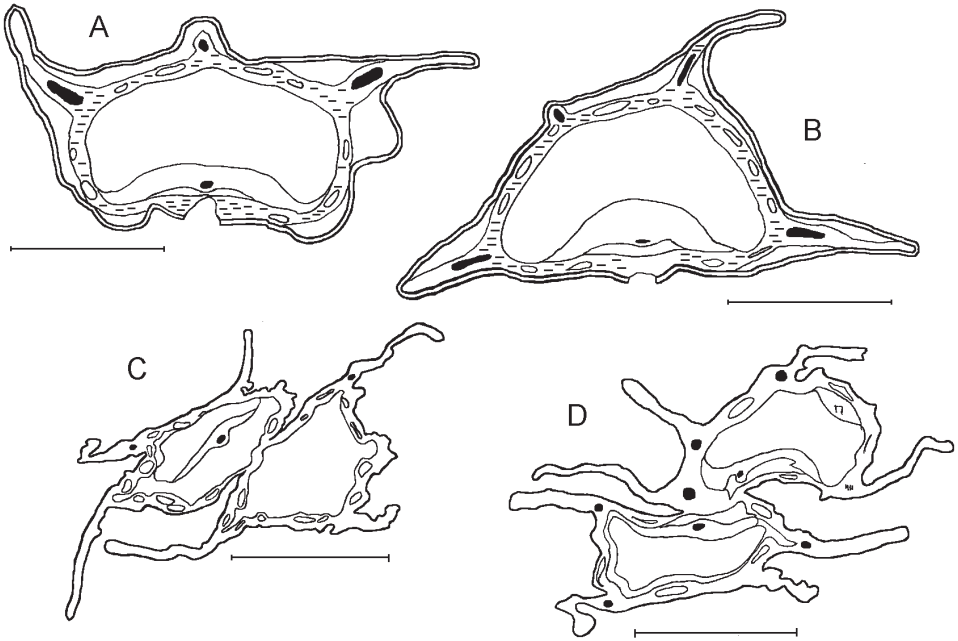


Fig. 3. *Notopterygium pinnatiinvolutellatum* – A & B: transect of mericarps (Pimenov & al. 152, MW); C & D: transect of fruits (C = N 5642, NAS; D = N 64061, NAS). – Scale bars: 1 mm; for the abbreviations see caption of Fig. 1.

Notopterygium pinnatiinvolutellatum (Fig. 3A-D). – Fruits glabrous, ovate, with bifid carpophore and two strikingly different mericarps. *Calyx teeth* short, triangular. *Stylopods* flat, styles 0.8-1 mm long, reflexed. *Mericarps* ovate in outline, 3.6-4 mm long, 2.5-3 mm broad, with very variable, winged, thin ribs; usually the two mericarps of a fruit differ in the number of developed ribs: one mericarp has four winged ribs (sometimes they are also unequal, but all have vascular bundles), and the second mericarp has three winged ribs (sometimes only two of them are developed normally while the third is reduced, although equally having a vascular bundle); rarely both mericarps have four winged ribs. *Exocarp* single-layered, of rather large, equal or slightly unequal cells with thin walls, interrupting near the carpophore. *Commissure* narrow. *Mesocarp* parenchymatous, partly disintegrating at maturity, partly of cells with lignified pitted walls. *Vascular bundles* 3 or 4 in each mericarp, situated in the basal and middle parts of the ribs, enlarged in radial direction. *Vittae* 3-4 in furrows, 4-5 on the commissural side. *Rib secretory ducts* absent. *Endocarp* of one layer of cells, elongate in tangential direction. *Spermoderma* of small cells. *Endosperm* broadly and not deeply concave on the commissural side.

Notopterygium tenuifolium. – We had no authentic material of this recently described species. According to the original description by Sheh & Pu (1997: 41, “Fructus elliptic-oblongi, dorsaliter compressi, circa 4 mm longi, 2.5 mm lati, jugis 5 omnino evolutis, late alatis; vittae ad valleculeas 2, ad commissural 5-6. Albumen facie planum”) and their picture it is difficult to conclude whether the species belongs to *Notopterygium* or not. Its deeply dissected leaves do not correspond to leaf character of the other *Notopterygium* species and *Hansenia*, all having broad (“*Angelica*-like”) terminal leaf lobes. The fruit structure pictured without some essential details matches *Notopterygium*, but also some other local genera. Therefore, it seems premature to make any conclusion about this poorly known species and it is excluded from the present analysis.

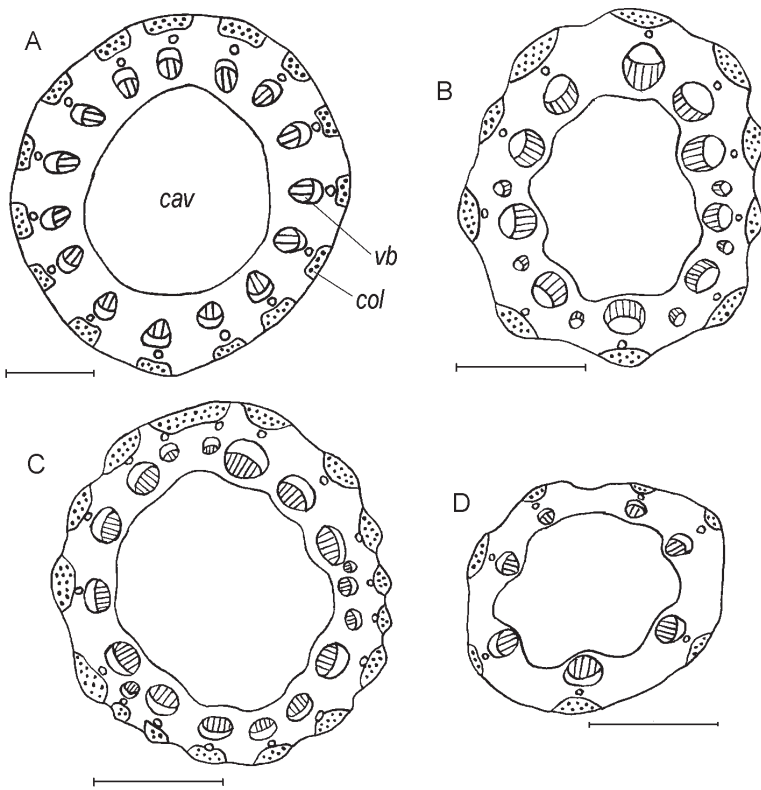


Fig. 4. Transect of petioles – A: *Hansenia mongolica* (Pimenov & Kljuykov 33, MW); B: *Notopterygium forbesii* (Pimenov & Kljuykov 206, MW); C: *N. weberbauerianum* (Pimenov & al. 259, MW); D: *N. oviforme* (Pimenov & al. 290, MW). – Scale bars: 1 mm; for the abbreviations see caption of Fig. 1.

Petiole anatomy

Petiole anatomy is used in the *Umbelliferae* taxonomy mainly as a diagnostic character to distinguish closely related species. Sometimes it helps to circumscribe some minor infrageneric taxa. Petioles of *Hansenia mongolica* were described earlier (Pimenov & Lavrova 1989: fig. 2). Additional petiole anatomical studies in three species of *Notopterygium* (Fig. 4) revealed that the petiole cross sections are almost similar (round, without furrow on the adaxial side, hollow, with circular peripheral vascular bundles). *H. mongolica* and *N. oviforme* have petioles similar even in all details of the structure. The petioles of *N. weberbauerianum* and *N. forbesii* have some additional small, irregular vascular bundles, situated amongst bigger regular ones.

Conclusion

Although there is some variation in the fruit structure of *Notopterygium* (homomericarpic and heteromericarpic fruits), *N. forbesii*, providing the type of the generic name, and *Hansenia mongolica* are very similar carpologically. Also the petiole anatomy is very similar between *Hansenia* and *Notopterygium*. Together with the similarity in other characters, such as stem, leaf and synflorescence structure, this confirms the close affinity of the two genera indicated by the DNA sequence analyses. Therefore both should be considered as congeners and *Notopterygium* has to be sunk into the synonymy of *Hansenia*.

Taxonomy

Hansenia Turcz. in Bull. Soc. Imp. Naturalistes Moscou 17(4): 754. 1844. – Type: *Hansenia mongolica* Turcz.

= *Notopterygium* H. Boissieu in Bull. Herb. Boissier, ser. 2, 3: 838. 1903 ≡ *Drymoscias* Koso-Pol. in Bull. Soc. Imp. Naturalistes Moscou, ser. 2, 29: 118. 1916, in adnota, nom. illeg. – Lectotype (Pimenov & Leonov 1993): *Notopterygium forbesii* H. Boissieu.

Emended description. – Perennial polycarpic or, more rarely, monocarpic herbs with thick vertical branching roots. *Stems* 30–100 cm high, fistulose, glabrous or sparsely pubescent, branching in the upper part. *Leaves* 2–3(–4)-pinnate or -ternate, glabrous; petioles fistulose, with peripheral vascular bundles. *Umbels* several, with equal or very unequal glabrous rays. *Bracts* absent or few, deciduous. *Bracteoles* usually entire or rarely pinnatisect, deciduous. *Petals* glabrous, white or yellowish, rarely brownish or dark brown, obovate, with short inflexed tip and short claw. *Stylopods* conical, low-conical or flat. *Styles* short, reflexed. *Fruits* glabrous, ovate to elliptic, with bifid carpophore. *Mericarps* homomorphic or rarely heteromorphic, with thinly winged, rarely carinate ribs. *Exocarp* of small cells, interrupting near carpophore; commissure narrow. *Mesocarp* parenchymatous, partly of cells with thin, lignified, pitted walls. *Rib vascular bundles* elongated in radial direction. *Vittae* in valliculae 2–4, on the commissural side 4–8. *Rib secretory ducts* usually absent. *Endocarp* of cells elongated in tangential direction. *Endosperm* broadly and not deeply concave on the commissural side.

A synopsis of diagnostic characters of the *Hansenia* species is presented in Table 1.

Distribution. – Russia (W Siberia: Altai; Central Siberia: Krasnoyarsk Terr., Tuva; E Siberia: Irkutsk d., Buryatia, Chita d.), Mongolia, China (NW: Gansu; Tibet: Xizang A. R., Qinghai; N: Neimenggu A. R., Ningxia Huizu A. R., Shaanxi, Shanxi; Central: Henan, Hubei; SW: Sichuan, Yunnan).

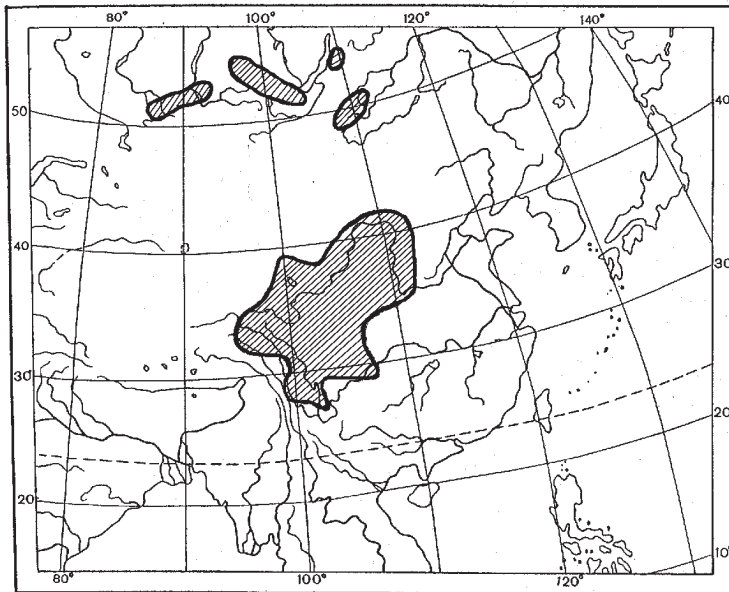


Fig. 5. – Distribution of *Hansenia*. – The map is based on Pu & al. (2000), on the other references cited for the species and on the herbarium material studied; the area of *H. mongolica* is reproduced from Busik & Pimenov (1974) and Pimenov (1996).

The species of *Hansenia* are distributed from the mountains of S Siberia (Altai, W & E Sayan, Yablonovyi Ridge in Transbaikalia) and NE Mongolia across N China to the SW Chinese provinces of Sichuan and Yunnan (Fig. 5). The distribution area has some disjunction; the main disjunction is between *H. mongolica* and the Chinese species, which are separated from each other by the Gobi desert and other Mongolian and N Chinese deserts. *H. mongolica* itself occurs in four disjunct subareas. Being not unique, disjunctive areas of this type are of interest for the investigation of the genesis of the S Siberian flora.

Key to the species of *Hansenia*

1. Pedicels 10-15 mm long; stylopods conical 1. *H. forbesii*
- Pedicels shorter, usually no more than 5 mm long; stylopods flat or shortly conical 2
2. Umbels 5-9-rayed 3
- Umbels 11-25-rayed 4
3. Umbel rays \pm of the same length; terminal leaf lobes slightly acute towards the tip; upper cauline leaves with narrowly linear, up to 3-4 cm long terminal lobes; calyx teeth longer than the stylopods 2. *H. forrestii*
- Umbel rays strongly unequal; terminal leaf lobes broadly ovate to almost round in outline, obtuse; upper cauline leaves with short terminal lobes; calyx teeth shorter than stylopods 4. *H. oviformis*
4. Fruits heteromericarpic, having one mericarp with four winged ribs and another with three winged ribs 5. *H. pinnatiinvolucellata*
- Both mericarps of a fruits with five approximately equal ribs 5
5. Terminal leaf lobes broadly ovate to oblong, at the margin toothed, teeth obtuse; pedicels up to 3 mm long; mericarps elliptic in outline, 5-7 mm long, 2-3 mm broad 3. *H. mongolica*
- Terminal leaf lobes narrowly ovate to linear-lanceolate, at the margin irregularly sinuate; pedicels up to 5 mm long; mericarps ovate in outline, 3.5-4 mm long, 2-3 mm broad 6. *H. weberbaueriana*

1. *Hansenia forbesii* (H. Boissieu) Pimenov & Kljuykov, **comb. nov.**

\equiv *Notopterygium forbesii* H. Boissieu in Bull. Herb. Boissier, ser. 2, 3: 840. 1903 \equiv *Drymoscias forbesii* (H. Boissieu) Koso-Pol. in Bull. Soc. Imp. Naturalistes Moscou, ser. 2, 29: 118. 1916. – Holotype: China, “Prov. Hupeh, 5.1889”, A. Henry 6629 (P; isotypes: K!, LE!).

$=$ *Notopterygium franchetii* H. Boissieu in Bull. Herb. Boissier, ser. 2, 3: 839. 1903 \equiv *Drymoscias franchetii* (H. Boissieu) Koso-Pol. in Bull. Soc. Imp. Naturalistes Moscou, ser. 2, 29: 118. 1916. – Syntypes: China, “Tan-Ken-Cheou, sous-prefecture de Ta-Lin-Hoen, alt. 2500 m”, 7.1893, P. R. Farges 1268 (P); China, “Touan-Chen, sous-prefecture Ta-Li-Hoen, alt. 2200 m”, 7.1898, P. R. Farges 1421 (P).

$=$ *Angelica rubrivaginata* H. Wolff in Acta Horti Gothob. 2: 318. 1926. – Holotype: China, “Sze-ch’uan bor.: Ch’un-ch’e, Nadelwald, 3200 m. In silva abietina”, 1.8.1922, H. Smith 4124 (UPS!).

$=$ *Angelica tsinlingensis* K. T. Fu in Fl. Tsinling. 1(3): 420, 461, fig. 358. 1981. – Holotype: China, “Shenxi, Hwa-in Hsien, Hwa-shan, Ta-pai-yang-cha, alt. 1500 m”, 22.9.1974, Fu KunTsun 17242 (WUK).

Distribution. – China (NW: Gansu; Tibet: Qinghai; N, Neimenggu A. R., Ningxia Huizu A. R., Shaanxi, Shanxi; Central: Henan, Hubei; SW: Sichuan, Yunnan).

Additional specimens (excluding those cited in Pu & al. 2000). – CHINA: Qinghai, Kokonor, K. M. Liou (NAS); Kansu occid., Ha Si Fan, 12.8.1918, R. P. Licent 4590 (P); Szetschuan septentrionalis, ad fl. Nerevu, 26.7.1885, G. N. Potanin (LE); Hupeh, 1889, A. Henry (LE); Sichuan, valley of Suomehe river, above Maerkang, near Zhuokeji, moist forest, 31°51'N, 102°21'E, 2200-2500 m, 17.9.1998, Pimenov & Kljuykov 206 (MW); Sichuan, Songpan Co., route Songpan-Hongyuan, 38 km from Songpan, river Dobaihe, Huangshenguan, 34°54'N, 103°31'E,

Table 1. Synopsis of the diagnostic characters of the species of *Hansenia*.

Characters	<i>H. mongolica</i>	<i>H. forrestii</i>	<i>H. forbesii</i>	<i>H. oviformis</i>	<i>H. weberbaueriana</i>	<i>H. pinnati- involutellata</i>
Life form	polycarpic	monocarpic (?)	polycarpic	polycarpic	polycarpic	polycarpic
Underground part	thickened horizontally branching roots	thickened roots	thickened roots	thickened horizontally branching roots	thickened rhizome with rope-like roots	thickened vertical roots
Radical leaves						
blade in outline	oviform	—	oviform	broadly triangular	broadly triangular	broadly triangular
size [cm]	12-20 × 12-15	—	20-35 × 18-25	5-7 × 4-9	28-35 × 25-28	20-30 × 15-25
dissection	2-3-pinnatisect	2-3-pinnatisect	3-pinnatisect	2-pinnatisect	3-pinnatisect	3-4-pinnatisect
terminal leaf lobe [mm]	elliptic to broadly lanceolate, with round teeth, 15-30 × 5-15	oviform to lanceolate, dentate, 20-35 × 15-25	broadly lanceolate to oviform-lanceolate, serrate, cuneate at the base, 15-30 × 5-15	(broadly) oviform to almost round, with round or obtuse teeth 10-20 × 15-20	oviform-lanceolate to lanceolate, irregularly lobed, 30-60 × 15-25	oviform-lanceolate, irregularly lobed, 20-25 × 8-15
Upper stem leaves						
dissection	2-3-pinnatisect	pinnate,	pinnate,	pinnate,	bipinnatisect,	bipinnatisect,
terminal lobe shape, length [cm]	—	narrow, linear, 3-4	lanceolate-linear	narrow, linear, short	narrow, linear, up to 0.5	lanceolate, dentate, 0.5-1
Umbels	11-20-rayed, rays ± equal	6-9-rayed, rays ± equal	11-20-rayed, rays ± equal	5-9-rayed, rays very unequal	11-18-rayed, rays ± equal	11-20-rayed, rays ± equal
Pedicels [length mm]	2.5-3	up to 4	10-14	up to 2	up to 5	up to 5
Calyx teeth	short, triangular	short, triangular or lanceolate, equal or longer than stylopods	short, lanceolate	short, triangular, shorter than stylopods	short, triangular, acute	short, triangular
Petals	white or greenish white, with inflexed tip	whitish-yellowish, with long claw	dark brown, small, up to 0.3 mm long	white, up to 0.6 mm long, with short claw and secretory duct	yellowish-whitish, 0.9-1.2 mm long, oblanceolate, with inflexed tip, short claw and secretory duct	unknown
Stylopods	short-conical	flat, with elevated margin	conical	flat	depressed-conical	flat

continued on next page

continued from previous page		<i>H. mongolica</i>	<i>H. forrestii</i>	<i>H. forbesii</i>	<i>H. oviformis</i>	<i>H. weberbaueriana</i>	<i>H. pinnati-uvulcellata</i>
Characters							
Styles [length mm]	0.5-0.7	up to 0.8	0.5-1	0.5-1	0.5-1	up to 1	0.8-1
Mericarps [mm]	equal, elliptic, 5-7 × 2-3	equal, elliptic or oviform, 3-3.5 × 1.4 × 1.6	equal, oviform, 4.5-6 × 2.5-2.8	equal, oviform, 5-6 × 2.5-3	equal, oviform, 3.5-4 × 2-2.5	equal, oviform, 3.5-4 × 2-2.5	inequal, broadly oviform, 3.6-4 × 2.5-3
Mericarp ribs	5, equal, winged, thin, slightly wavy	5, equal, winged, thin,	5, ± equal, winged, thin	5, ± equal, winged, thin	5, ± equal, winged, thin	5, ± equal, winged, thin	2, 3 or 4, winged, thin, equal or unequal
Exocarp	rather large cells with thin walls	large cells with thin walls	large cells with slightly thickened outer walls	middle-sized cells with thin walls, frequently separating from mesocarp	rather large cells with thin walls	rather large cells with thin walls	rather large cells with thin walls
Vitae per vallicula	3-4	3	2-4	1-2	2-3	2-3	3-4
Commissural vitae	4-6	4-6	4-5	4	5-6	5-6	4-5
Vascular bundles	in basal and middle rib parts, enlarged in radial direction	thin	in basal and middle rib parts, enlarged in radial direction	in basal rib part, slightly enlarged in radial direction	in basal and middle rib parts, enlarged in radial direction	in basal and middle rib parts, enlarged in radial direction	in basal and middle rib parts, enlarged in radial direction
Endocarp	of small cells	of small cells	of small cells with slightly lignified walls	of cells with slightly lignified walls	of small cells	of small cells	of small cells
Endosperm, commissural face	broadly and not deeply concave	not deeply concave	broadly and not deeply concave	slightly concave	broadly and not deeply concave	broadly and not deeply concave	broadly and not deeply concave

3350 m, 15.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 166* (E, KUN, MO, MW, NAS, PE); Sichuan, Danba Co., basin of Dadu he river, upper part of Jiangxigua river valley, 30°35'N, 101°39'E, 3200 m, 18.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 239* (MW).

Fruit structure. – See Fig. 2A.

Ref. – Under *Notopterygium forbesii*: Chang (1975: 85, fig. 1), Ma (1979: 154, t. 71), Fu (1981: 381), Ma & Liu (1998: 56), Pu (1993: 1298), Vinogradova (1994: 59), Sheh (1997: 448, t. 129, fig. 1-4), Ding & Wang (1997: 143, fig. 1687), Pan (1999: 418), Pu & al. (2000: 432), Chen & Jin (2000: 370, fig. 205), Fu & al. (2001: 576, fig. 914), Pimenov & Kljuykov (2003: 133). – Under *Notopterygium franchetii*: Sheh & Watson (2005: 54). – Under *Angelica rubrivaginata*: Vinogradova (1994: 24). – Under *Angelica tsinlingensis*: Yuan & Shan (1985: 5), Yuan (1992: 18, t. 6, fig. 1-5), Pan & Watson (2005: 164).

2. *Hansenia forrestii* (H. Wolff) Pimenov & Kljuykov, **comb. nov.**

≡ *Notopterygium forrestii* H. Wolff in Repert. Spec. Nov. Regni Veg. 27: 325. 1930. – Holotype: China, “Yunnan, Mekong-Salwin divide. Lat. 28°10', 10000', open stony pasture on the margins of the thickets and streams” 9.1914. *G. Forrest 13342* (E!; isotypes: BM!, PE!). – Fig. 6.

Distribution. – China (SW: Sichuan, Yunnan).

Additional specimens. – CHINA: Kari pass, Mekong-Yangtze divide, 10000 ft., 27°40'N, open thickets, 8.1914, *G. Forrest 131333* (PE).

Fruit structure. – See Fig. 2B.

Ref. – Wu (1984: 917), Pu & al. (1992: 233, t. 103, fig. 6-9), Pu (1993: 1298), Sheh (1997: 450, t. 129, fig. 5-8), Pu & al. (2000: 434), Sheh & Watson (2005: 54).

3. *Hansenia mongolica* Turcz. in Bull. Soc. Imp. Naturalistes Moscou 17: 754. 1844

≡ *Ligusticum mongolicum* (Turcz.) Krylov in Fl. Sib. Occid. 8: 2014. 1935. – Lectotype (designated by Vinogradova 2005): Russia, “In lateribus sylvarum alpis Nuchu-Daban et ulterius in sylvio subalpinis ad fluvium Oka, nec non in sylvis Dahuriae subalpiniae”, *N. S. Turczaninov* (LE!; isotypes: K!, M!). – Fig. 7.

Distribution. – Russia (W Siberia: Altai; Central Siberia: Krasnoyarsk Terr., Tuva; E Siberia: Irkutsk d., Buryatia, Chita d.), Mongolia.

Additional specimens. – RUSSIA: Buriatia, Tunka Alps, above Nilova Pustyn, Chubuty vall., 1310 m, 10.8.1992, *Pimenov & Kljuykov 33* (MW).

Fruit structure. – See Fig. 1.

Ref. – Under *Hansenia mongolica*: Ledebour (1844: 362), Revuschkin (1988: 102), Pimenov (1996: 163, map 121), Gubanov (1996: 79), Annenkhonov & al. (2001: 432). – Under *Ligusticum mongolicum*: Schischkin (1950: 573), Popov (1957: 465), Hiroe (1958: 110), Czerepnin (1963: 259), Malyshev (1965: 187), Leute (1970: 489, t. 14, fig. 1), Busik & Pimenov (1974: 66, map 146), Schischkin & Vinogradova (1975: 747, fig. 352), Krasnoborov (1977: 55), Vodopjanova (1979: 684, map 970), Krasnoborov (1984: 170), Shauro (2006: 171).

4. *Hansenia oviformis* (R. H. Shan) Pimenov & Kljuykov, **comb. nov.**

≡ *Notopterygium oviforme* R. H. Shan in Sinensia 14: 112, fig. 1. 1943 ≡ *Notopterygium forbesii* var. *oviforme* (R. H. Shan) H. T. Chang in Acta Phytotax. Sin. 13(3): 85. 1975 ≡ *Notopterygium forbesii* subsp. *oviforme* (R. H. Shan) F. T. Pu in Acta Phytotax. Sin. 38(5): 433. 2000. – Type: China, “Szechuan. Western China Sci. Inst. 1382” (n.v.).

= *Ligusticum litangense* F. T. Pu in Acta Phytotax. Sin. 29(6): 534. 1991. – Holotype: China, “Sichuan: Litang, Kalatz Mountain, alt. 4300 m, in the alpine bush meadow”, 20.9.1984, *Pu FaTing 374* (CDBI!; isotype: NAS!).

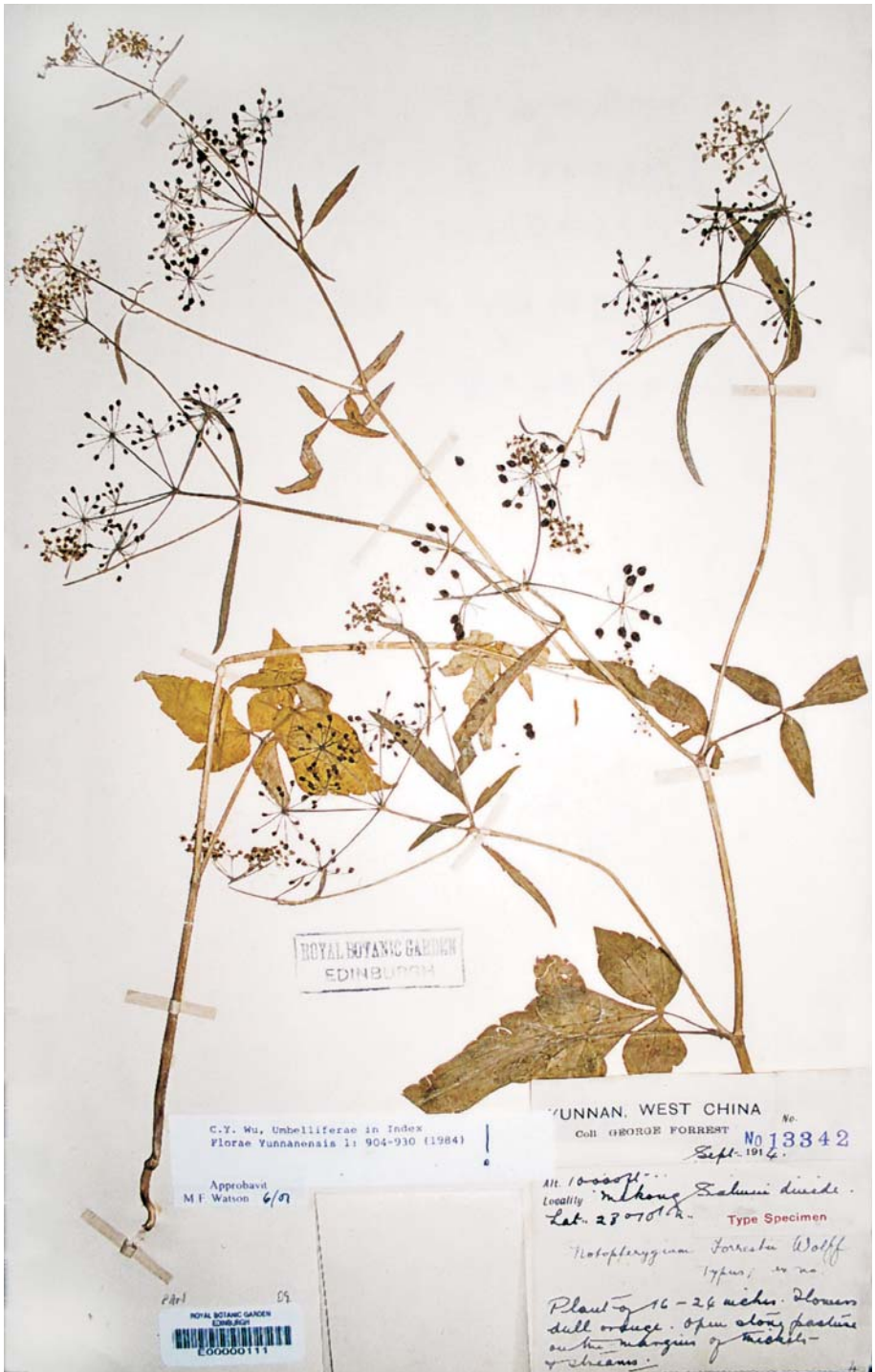


Fig. 6. *Hansenia forrestii* – holotype at E.

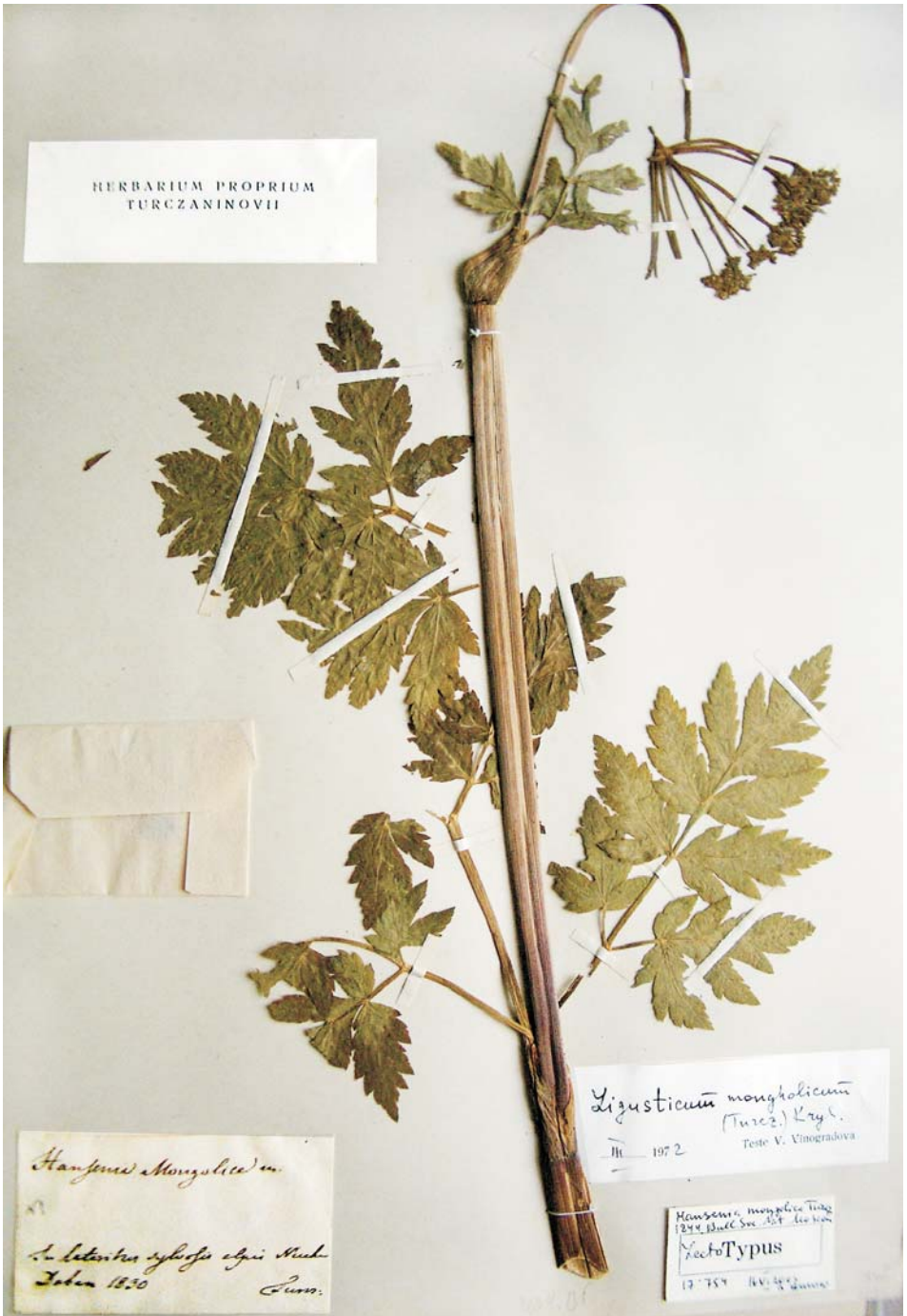


Fig. 7. *Hansenia mongolica* – holotype at LE.

Distribution. – China (N: Shaanxi; SW: Sichuan).

Additional specimens. – CHINA: Sikang, Taofu, Donglo-La, in prato herboso-fruticosa, 4200 m, 24.9.1934, *H. Smith 12428* (PE); Sikang, Kangting (Tachienlu), Cheto-La, in prato herboso-fruticosa, 3600 m, 4.8.1934, *H. Smith* (PE); Sichuan, Kanding Co., pass across Daxue Shan, between Xinduqiao and Kanding, E of Shuizheotzi, 30°04'N, 101°46'E, 4340 m, 21.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 290* (MW); Tongolo, Setchuen, 1891, *J. A. Soulie 119* (P); Thibet oriental, Ta-tsien-lou (principalité de Kiala), 21.6.1893, *J. A. Soulie* (P); Thibet oriental, Tongolo, *J. A. Soulie 2609* (P); Sichuan, near Tongolo (Dongolou), 30°03'N, 101°29'E, 3700 m, 21.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 303* (MW); Sichuan, between Yajiang and Litang, 90 km road station, 29°59'N, 100°52'E, 4100 m, 23.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 338* (MW).

Fruit structure. – See Fig. 2C.

Ref. – Under *Notopterygium oviforme*: Sheh & Watson (2005: 54). – Under *Notopterygium forbesii* var. *oviforme*: Chang (1979: 190). – Under *Ligusticum litangense*: Pu & Watson (2005: 144).

5. *Hansenia pinnatiinvolutellata* (F. T. Pu & Y. P. Wang) Pimenov & Kljuykov, **comb. nov.**

≡ *Notopterygium pinnatiinvolutellatum* F. T. Pu & Y. P. Wang, in *J. Sichuan Univ., Nat. Sci. Ed.* 31(3): 386. 1994. – Holotype: China, “Sichuan: Xiaoling, Balang Mountain, alt. c. 3400 m, among shrubs in grassland at the edge of mountain coniferous forests”, 26.9.1990, *Pu FaTing, Wang YouPing & al. 90061* (CDBI).

Distribution. – China (SW: Sichuan).

Additional gathering. – CHINA: Sichuan, Songpan Co., route to Hunglong, pass across Min Shan ridge, 32°44'N, 103°42'E, 4200 m, 19.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 152* (E, KUN, MO, MW); Sichuan, 25.7.1958, *N5642* (NAS); *ibid.*, 31.8.1964, *N64061* (NAS).

Fruit structure. – See Fig. 3A-D.

Note. – As was noted above, we are not completely sure whether this species is actually distinct from *Hansenia weberbaueriana*. Apart from our poor knowledge of authentic material of the species, its recognition as a separate species depends on the taxonomic value heteromerocarpy is given in *Umbelliferae* systematics. In our opinion heteromerocarpy can both be purely infra-specific variation or characterisation of species and even species groups, so that this question can be decided only as the case arises, sufficient material provided.

Ref. – Under *Notopterygium pinnatiinvolutellatum*: Pu & al. (2000: 436), Sheh & Watson (2005: 55).

6. *Hansenia weberbaueriana* (Fedde ex H. Wolff) Pimenov & Kljuykov, **comb. nov.**

≡ *Ligusticum weberbauerianum* Fedde ex H. Wolff in *Repert. Spec. Nov. Regni Veg.* 27: 312. 1929 ≡ *Notopterygium weberbauerianum* (Fedde ex H. Wolff) Pimenov & Kljuykov in *Feddes Repert.* 110(7-8): 485. 1999. – Holotype: China, “Central-Kansu: Lien hoa shan, forests, 10000 ft”, 14.-20.7.1925, *J. F. Rock 12727* (GH; isotypes: BM!, E!, K!, NAS!).

= *Ligusticum pilgerianum* H. Wolff in *Repert. Spec. Nov. Regni Veg.* 27: 307. 1929. – Holotype: China, “Sze-chuan, reg. bor.: Dongrergo, in prato fruticoso-herboso, c. 4200 m”, 8.8.1922, *H. Smith 3544* (UPS!; isotype: PE!).

= *Notopterygium incisum* C. C. Ting & H. T. Chang in *Acta Phytotax. Sin.* 13(3): 86, fig. 2. 1975. – Holotype: China, “Qinghai, Qumarleb”, *Qu MaLai & Liu ShangWu 863* (HNWP).

Distribution. – China (NW: Gansu; Tibet: Xizang A. R., Qinghai; N: Shaanxi; Central: Henan; SW: Sichuan).

Additional specimens. – CHINA: Qinghai, E of Anyemaqen, grazed *Salix* thickets, 3800 m, 34°45'N, 99°41'E, 30.7.1998, *G. Miehe & J. Q. Liu Sonamco 98-32419* (GOET); Prov. Kam, pars

orientalis, trajectum Hun-cheo, 10.8.1893, *G. N. Potanin* (LE); Kam (Tibet), systema fluminis Yantze, in cursu superiore, fl. I-chu, 13000', 29.6.1900, *V. F. Ladygin 431* (LE); NW Sichuan, upper Yalong basin, Chola Shan, Dege-Garze, Manigango, 31°52'N, 99°7'E, 4180 m, fir forest on boulder slope, 27.9.1994, *U. Wundisch 94-453-16* (GOET); Sichuan, Kanding Co., pass across Duxue Shan, between Xinduqiao and Kanding, E of Shuizheotzi, 30°04'N, 101°46'E, 4340 m, 19.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 259* (MW); *ibid.* 21.9.1998, *id.* 292 (MW); Sichuan, between Yajiang and Litang, 90 km road station, 29°59'N, 100°52'E, 4100 m, 23.9.1998, *Pimenov, Kljuykov, Hu ZhiHao & Liu QiXing 330* (MO, MW, NAS).

Fruit structure. – See Fig. 2D.

Note. – Among the Chinese species, *Hansenia weberbaueriana* is the most similar to *H. mongolica*. – Under *Ligusticum weberbauerianum*: Pu & Watson (2005: 145)

Ref. – Under *Ligusticum weberbauerianum*: Pu & Watson (2005: 145). – Under *Ligusticum pilgerianum*: Rehder & Kobuski (1933: 25), Walker (1941: 647). – Under *Notopterygium incisum*: Chang (1979: 190, t. 100, fig. 1-5), Fu (1981: 382, fig. 333), Chang (1986: 441, t. 174), Pu (1993: 1298), Vinogradova (1994: 59), Ding & Wang (1997: 144, fig. 1688), Pan (1999: 418, t. 70, fig. 1-6), Pu & al. (2000: 434), Fu & al. (2001: 576, fig. 913), Sheh & Watson (2005: 54).

Incertae sedis

Notopterygium tenuifolium Sheh, M. L. & Pu, F. T. (1997), see note on p. <6>

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