A synopsis and a new species of the E Asian genus Pinellia (Araceae)

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Abstract

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The genus *Pinellia* is endemic to E Asia (China, Korea and Japan) with a centre of diversity in E China (Anhui, Zhejiang and Fujiang). Nine species are recognized, among which *P. fujianensis* is described as new to science. A key to the species, synonymies, descriptions, taxonomic notes, data on habitats and distribution are given and all species are illustrated.

Key words: aroids, China, Korea, Japan.

Introduction

Pinellia Ten. is a small genus in the family *Araceae,* which contains 105 genera worldwide (Li 1986, Mayo & al. 1997). The genus is recognized by the present authors as having nine species, distributed in mainland China, Korea and Japan, with two species regionally naturalised in Europa, North America and Australia.

The genus *Pinellia* was established in honour of Giovanni V. Pinelli (1535-1601) by M. Tenore in 1839 based on *P. tuberifera* Ten., which is a superfluous name since *Arum subulatum* Desf. was cited as a synonym in the protologue. That latter name is a taxonomic synonym of *Arum ternatum* Thunb., which is the first known species now recognised as a member of *Pinellia,* namely *P. ternata* (Thunb.) Breitenb., and which was described by Thunberg (1784) from a plant collected in Japan between Iedo and Nagasaki.

Pinellia is characterized by (1) the female zone of the spadix being adnate to the spathe, (2) the male and female zones of the spadix with naked flowers being separated by a sterile zone, (3) the presence of an appendix of the spadix and (4) the presence of a septum at the constriction of the spathe (except in *P. pedatisecta* where a constriction and septum is absent). Engler (1920) placed *Pinellia* in the subfamily *Aroideae,* a placement that has since been accepted. According to a recent chloroplast DNA phylogeny (Renner & al. 2004), *Pinellia* is closely related to *Arisaema* and *Typhonium.*

A few species of the genus, in particular *Pinellia ternata,* are used in Chinese herbal medicine (see, e.g., Hu 1977, 1989, Huang & al. 1986, He & al. 2005), *P. ternata* and *P. tripartita* are also popular for ornamental use.

We present the first synopsis of the entire genus since Engler (1920) and it updates previous taxonomic contributions on the Chinese species (Li & al. 1977, Wu & Li 1979, Li 1995, Li & al. 1997a).

Material and methods

The present study is based on life plants and herbarium specimens from the following herbaria (abbreviations according to Holmgren & Holmgren 1998-): A, AAUB, ANUB, B, FNU, GH, HGAS, HHBG, HIB, HNNU, HUTM, IBK, IBSC, IFP, IMM, K, ICUN, LE, MO, N, NAS, P, PE, SHM, SM, SYS, US, WUH, ZJMA.

It has been attempted in the present synopsis to provide full synonymies, morphological descriptions, line drawings, cytological data so far published, data on habitats, distribution and phenology mainly compiled from the specimen labels, lists of specimens examined, and, were appropriate, taxonomic notes.

Taxonomy

Pinellia Ten. in Atti Reale Accad. Sci. Sez. Soc. Napoli 4: 69. 1839, nom. cons.
Type: *Pinellia tuberifera* Ten., nom. illeg. (≡ *Arum subulatum* Desf., Cat. Pl. Horti Paris: 385. 1829) [= *Pinellia ternata* (Thunb.) Breitenb.].
= *Atherurus* Blume, Rumphia 1: 135. 1837, nom. rej.
= *Hemicarpurus* Nees, Delect. Sem. Horto Bot. Vratisl. l839: 3. late 1839 [& in Linnaea 14 (Litt.-Ber.): 167. 1840].

Perennial herbs, seasonally dormant, with cormlike, subglobose tuber or cylindrical rhizome and tubercles usually formed around the main tuber, on the tuber around the petioles, or at the rhizome ends; with bulbils usually at lower, middle or upper portion of petioles, sometimes at both petiole and the base of the leaf blade. *Leaves* 1-5; *petioles* green, usually unspotted, sometimes spotted, sheath fairly long, very short or nearly absent*;* bulbils present or absent; *leaf blades* simply cordate, ovate, oblong, deeply trifid, or trisect, or pedatisect; *leaflets* oblong-elliptic to ovate-oblong; primary lateral veins of the leaf blade or of each leaflet pinnate, forming a submarginal collective vein, 1-2 distinct marginal veins also present, higher order venation reticulate. *Inflorescence* solitary, appearing with the leaves; *peduncle* green, shorter or slightly longer than petiole; *spathe* persistent, slightly to strongly constricted between tube and blade, except in *Pinellia pedatisecta;* tube convolute, narrowly ellipsoid to ovate, almost closed within by a transverse septum, except in *P. pedatisecta,* gaping at base; limb of spathe oblong-elliptic, boat-shaped, gaping, fornicate, green to purple, twice or more as long as tube; *spadix* much longer than spathe, female zone adnate to spathe, separated from the male zone by the spathe septum, except in *P. pedatisecta,* and by the short, free, naked portion of spadix axis; male zone cylindric, short; terminal sterile appendix smooth, elongate-subulate, often sigmoid, long-exserted from spathe. *Flowers* unisexual, perigone absent. *Male flowers* 1-2(-4)-androus, stamens sometimes united congenitally in pairs or groups of four, short, laterally compressed; anthers sessile, connective slender, thecae ellipsoid, 2-celled, dehiscing by apical slit, rarely each pollen sac opening by a pore; *pollen* extruded in amorphous mass, inaperturate, spherical or subspheroidal, small to medium-sized, exine spinulose. *Female flowers* with ovary ovoid to ovoid-oblong, 1-locular; ovule 1, orthotropous, funicle very short; placentation basal, stylar region attenuate, stigma small, hemispheric to discoid. *Berries* oblong-ovoid, green, yellowish green or whitish; *seeds* obnapiform to ellipsoid, testa irregularly verrucose-rugulose or smooth; embryo axile, elongate, or very small and subglobose, endosperm copious.

Cytology. – Chromosome numbers of six species are reported in the literature (for references see species treatments, below). According to these reports diploid and polyploid cytotypes are known, partly from the same species. *Pinellia yaoluopingensis* and *P. pedatisecta* are diploid (with $2n$ = 26, x = 13), *P. peltata* is hexaploid ($2n$ = 78), *P. tripartita* diploid ($2n$ = 26) or tetraploid ($2n$ = 52).

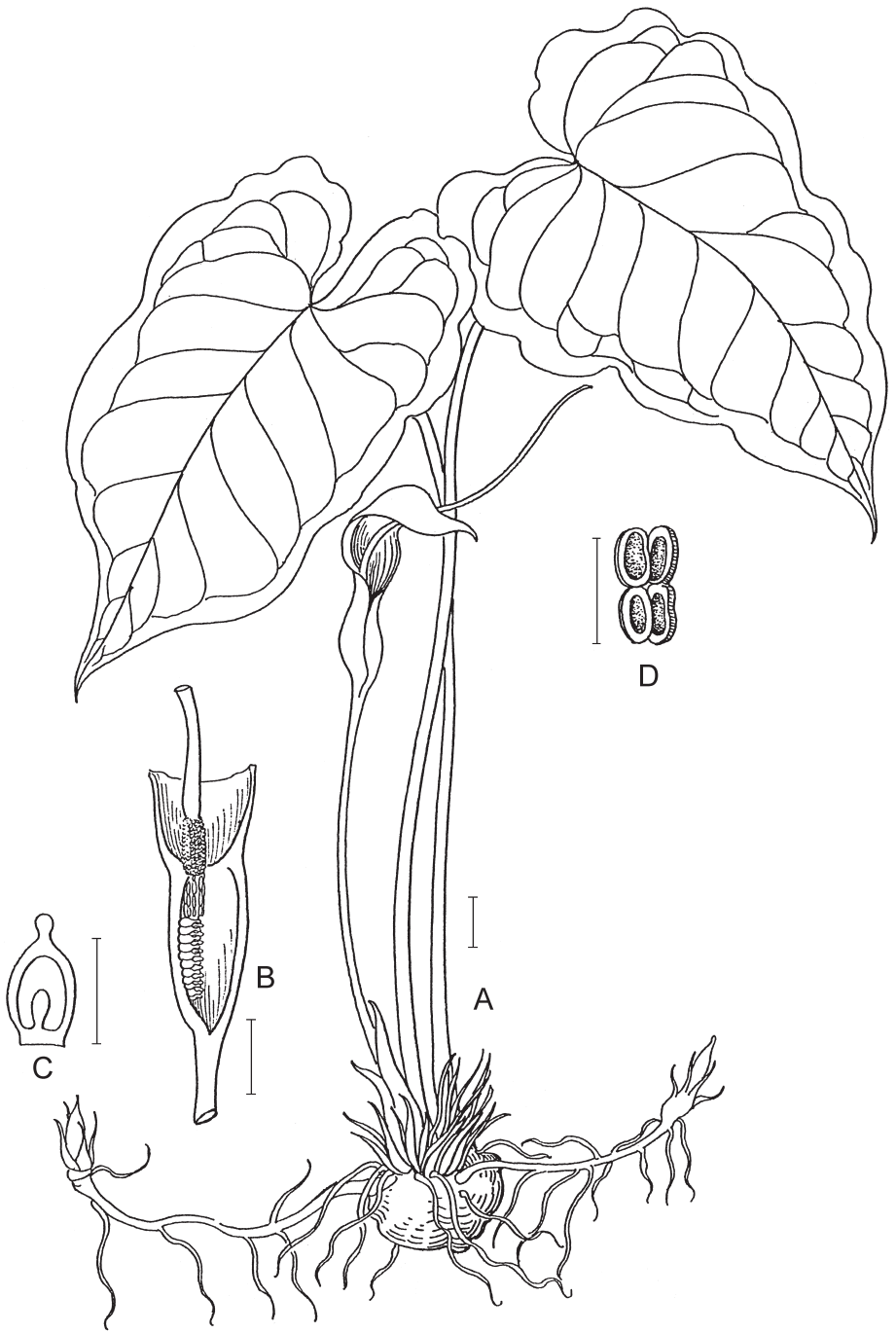

Fig. 1. *Pinellia polyphylla* – A: habit; B: inflorescence, longitudinal section; C: pistil, longitudinal section; D: anther. – Scale bars: A = 10 cm, B = 5 cm, C-D = 2 mm. – Redrawn from Hu (1984: 714, fig. 1).

In *P. cordata* a polyploid cytotype with 2*n* = 72 is known, which can be interpreted as hexaploid with aneuploid reduction from 2*n* = 78. *P. ternata* forms a polyploid complex, which contains various ploidy levels up to decaploids (2*n* = 130) and extensive aneuploid series. All species of *Pinellia* so far seem to have a basic number of x = 13 (for further details see under *P. ternata*).

Distribution. – Eight species of *Pinellia* are present in China, the range of one of these *(P. ternata,* occupying the entire distribution range of the genus) extends to Korea, southern and central Japan. One species *(P. tripartita)* is endemic to southern Japan and the Ryukyu (Nansei-shotō) Islands. *P. ternata* is, moreover, naturalised in Europe, North America and Australia, *P. tripartita* in S Europa and Australia.

Within China the genus is absent from the North and Northwest (not present in the provinces Neimongolia, Helongjiang, Jilin, Qinghai, Xingjiang and Xizang) and confined to the East and Southeast. It has its greatest diversity in the East, where it is represented with four (Anhui, Zhejiang, Hubei) and five (Fujiang) species, respectively.

Key to the species of *Pinellia*

1. Leaf blade entire 2
– Leaf blade compound, trifoliolate or pedate 6
2. Leaf blade not peltate 3
– Leaf blade peltate, ovate or oblong . . . . . 4. *P. peltata*
3. Petiole lacking bulbils 4
– Petiole or base of leaf blade bearing bulbils 5
4. Leaf blade deltoid-ovate or broadly ovate, base deeply cordate, 6-33 × 4-22 cm . . . . . 1. *P. polyphylla*
– Leaf blade ovate or oblong, base obtuse or shallowly cordate, 5-19 × 1.5-6 cm . . . . . 2. *P. integrifolia*
5. Tuber globose; leaf blade sagittate-oblong, cordate-ovate, base deeply cordate; bulbils present at the base of the petiole and at the base of the leaf blade . . . . . 3. *P. cordata*
– Rhizome cylindrical; leaf blade widely sagittate; bulbils at the base of the petiole . . . . . 5. *P. fujianensis*
6. Leaf trifoliolate or pedate with 5 leaflets 7
– Leaf blade always pedate, leaflets 6-11; bulbils absent . . . . . 9. *P. pedatisecta*
7. Leaf blade only deeply tripartite, anterior lobe broadly ovate or ovate-oblong, sessile; bulbils absent . . . . . 6. *P. tripartita*
– Leaf blade trisect, sometimes pedate with only 5 leaflets, leaflets oblong or lanceolate . 8
8. Petiole lacking bulbils, bulbils emerging only from the tuber; lateral leaflets usually bifid . . . . . 7. *P. yaoluopingensis*
– Bulbils present at petiole below middle, or both at lower part of petiole and at the base of the leaf blade . . . . . 8. *P. ternata*

1. *Pinellia polyphylla* S. L. Hu in Acta Pharm. Sin. 19: 713. 1984.
Holotype: China, Sichuan, Hanyuan Xian, Shunhe, rocky slope, sparse forest, in field, 800 m, *S. L. Hu & Y. L. Hou 829060* (IMM).

Tuber depressed globose, irregularly depressed, to 6 cm in diam., with 1-4 stolons, 4-7 cm long, stolon often bearing globose tubercles of 5-10 mm diam. at the end. *Leaves* 1-4; petiole 10-60(-70) cm long, greenish or flesh-red; leaf blade deltoid-ovate to broadly ovate, 6-33 × 4-22 cm, acuminate at apex, base deeply cordate, chartaceous, primary lateral veins 5-15 per side. *Inflorescence* with peduncle shorter than petioles; *spathe* erect, 5-8 cm long, greenish or yellowish green, tube funnelform, 1-2.5 × 0.5 cm, throat constricted, limb broadly lanceolate, 3.5-5 × 0.8-1.2 cm; *spadix* longer than spathe; female zone adnate to spathe tube, 1.5-2 cm long; male zone free, 1-1.5 cm long; sterile zone between female and male flowers 1-1.5 cm long; appendix 6-11.5 cm

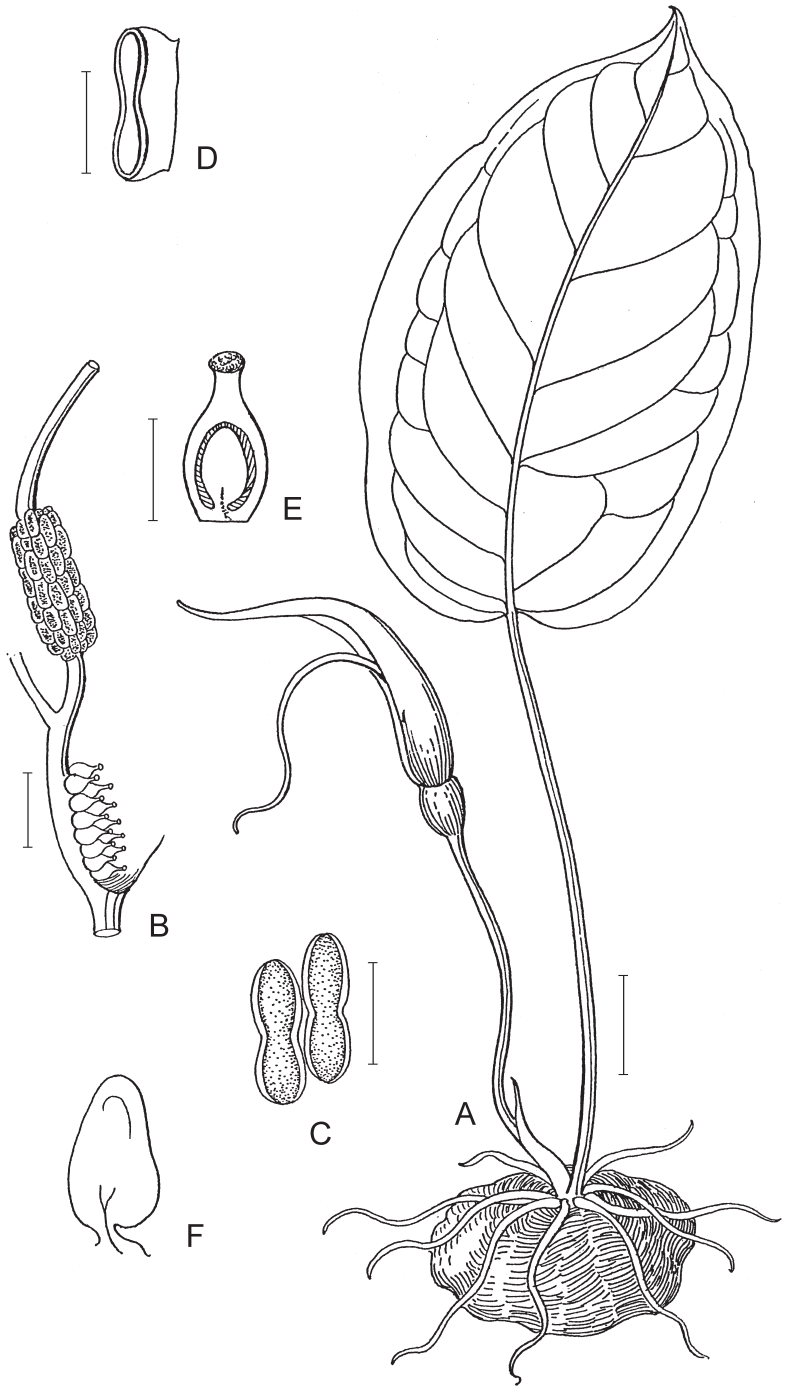

Fig. 2. *Pinellia integrifolia* – A: habit; B: spadix; C: male flower; D: theca, lateral view; E: pistil, longitudinal section; F: ovule. – Scale bars: A = 2 cm, B = 1 cm, C-E = 0.5 mm. – Redrawn from A. Engler (1920: 222, fig. 54).

long, tortuous, greenish to yellowish green. *Female flowers* densely arranged; pistil c. 2.4 mm long, ovary ovoid, c. 2 mm long and 1.3 mm in diam., stigma subsessile, small, c. 0.4 mm in diam., style very short. *Male flowers* with ellipsoid thecae, opening by a slit. *Berries* ovoid, green to whitish; seed 1, globose, c. 1.5 mm in diam. – Fig. 1.

Note. – *Pinellia polyphylla* differs from *P. cordata* in having a larger tuber, to 6 cm in diam., with 1-4 stolons and petioles without bulbils.

Habitat and distribution. – Endemic to China: Sichuan. Growing in secondary forests, rock slopes and in fields, up to 800 m. Flowering from May to June, fruiting from July to September.

Additional specimens examined. – China: Sichuan: Ebian Xian, Yongluo, *T. H. Jiang 829164* (IMM); Ganluo Xian, Haima, *H. F. Hao 829155* (IMM).

2. *Pinellia integrifolia* N. E. Br. in Hooker's Icon. Pl. 19: ad t. 1875. 1889.
Type: China, Hubei, Yichang, 5.1888, *A. Henry 4323* (K).

Tuber depressed globose, 1-1.3 cm in diam. *Leaves* 1-3; petiole slender, 5-15 cm long, base sheathing; leaf blade entire, ovate, oblong, oblong-lanceolate, 5-19 × 1.5-6 cm, short-acuminate to acute at apex, base obtuse, rarely shallowly cordate; primary lateral veins 6-7 per side. *Inflorescence* with peduncle shorter than petioles; peduncle 6-10 cm long; *spathe* (6-)7-9 cm long, tube 0.8-1.2 cm long, limb lanceolate, 7-8 cm long, long-acuminate, curved; *spadix* 8-12 cm long; female zone 5-10 mm long; male zone 5-10 mm long; sterile zone between female and male flowers 5-10 mm long; appendix filiform, 4-9 cm long, incurved, pendulous. *Female flowers* densely arranged; pistil 0.8-0.9 mm long, ovary ovoid, c. 0.6 mm long and 0.4 mm in diam., style distinct, c. 0.3 mm long, stigma subhemispheric, c. 0.18 mm in diam., broader than style. *Male flower*s with thecae elongate, c. 0.7 mm long, opening by a long slit. *Berries* pale green to whitish. – Fig. 2.

Note. – *Pinellia integrifolia* is characterized by its ovate or oblong leaf blades, its obtuse or shallowly cordate leaf bases and by petioles lacking bulbils.

Habitat and distribution. – Endemic to Central China: western Hubei (Yichang) and eastern Sichuan (Xuyong, Chongqing). Growing on slopes, in moist areas by streams, lower than 1000 m. Flowering in September.

Additional specimens examined. – China: Hubei: Yangzhi River. 3.11.1905, *E. H. Wilson 4568* (K). – Sichuan: Chongqing Xiang, Shiziyan, *Li Bin-quan 6573* (SM); Xuyong, *Zhong Mingfan 1098* (KUN, NAS, SM).

3. *Pinellia cordata* N. E. Br. in J. Linn. Soc. Bot. 36: 173. 1903.
Type: China, Zhejiang, Tien Tai Mt foot, 1889, *Faber 82* (K).
= *Pinellia browniana* Dunn in J. Linn. Soc. Bot. 38: 370. 1908. – Holotype: China, Fujian, Central Fukian, Shaowu xian, *Dunn 3717* (HK?, n.v.; isotype: IBSC).

Tuber depressed globose, 1-1.5 cm in diam. *Leaves* 1-3; petiole 12-25 cm long, green or purple; leaf blade cordate-oblong, cordate-ovate or cordate to sagittate, 4-25 × 2-7.5 cm, green above, greenish or purple below, long-acuminate at apex, base deeply cordate, primary lateral veins 9-10 per side; bulbils present at basal portion of petiole and at base of leaf blade (apex of petiole), ovoid. *Inflorescence* with peduncle shorter than petioles, 3.7-18 cm long; *spathe* green, purplish yellow or violet, 4-7 cm long, tube 1-1.3 cm long and wide, limb elliptic, 3-4.5 × 1.2-3 cm, apex obtuse or acute, erect or slightly incurved; *spadix* 9-23 cm long; female zone (0.8-)1-1.2 cm long; male zone 5-7 mm long; sterile zone between female and male flowers 7-8 mm long; appendix violet-green, 6.5-20 cm long, tortuous. *Female flowers* densely arranged; pistil c. 2.5 mm long, ovary ellipsoid-oblong, c. 2 mm long and 1 mm in diam., style short, c. 0.3 mm long and 0.5 mm in diam., stigma discoid, 0.6-0.7 mm in diam. *Male flowers* with thecae elongate, c. 1.8 mm long, opening by a slit. *Berries* ovoid. – Fig. 3.

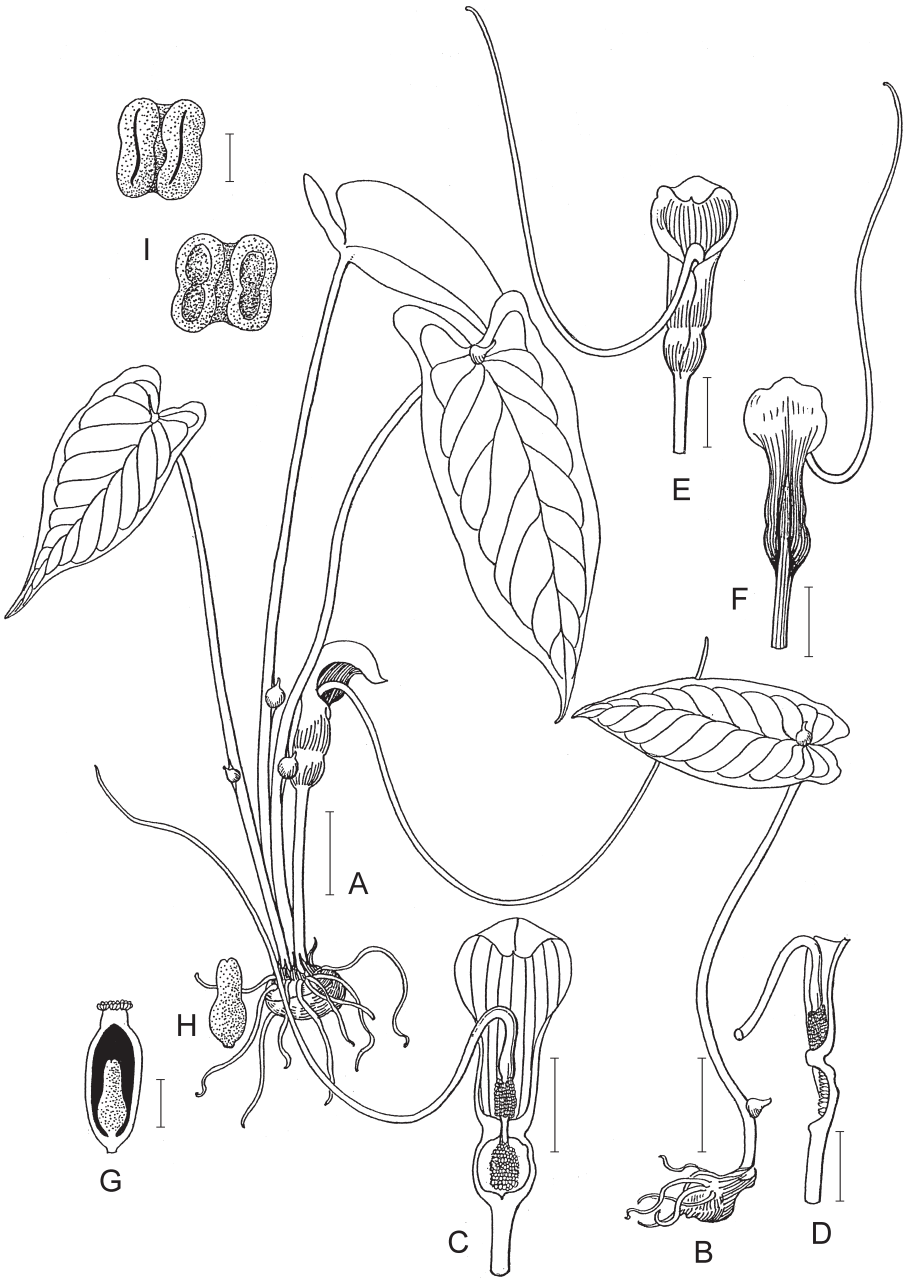

Fig. 3. *Pinellia cordata* – A: habit; B: juvenile plant; C: inflorescence, longitudinal section in front view; D: inflorescence, longitudinal section in side view; E: inflorescence, frontal view; F: inflorescence, back view; G: pistil, longitudinal section; H: ovule; I: anthers. – Scale bars: A = 4 cm, B-F = 2 cm, G-I = 1 mm. – Drawing after life plants from Anhui province.

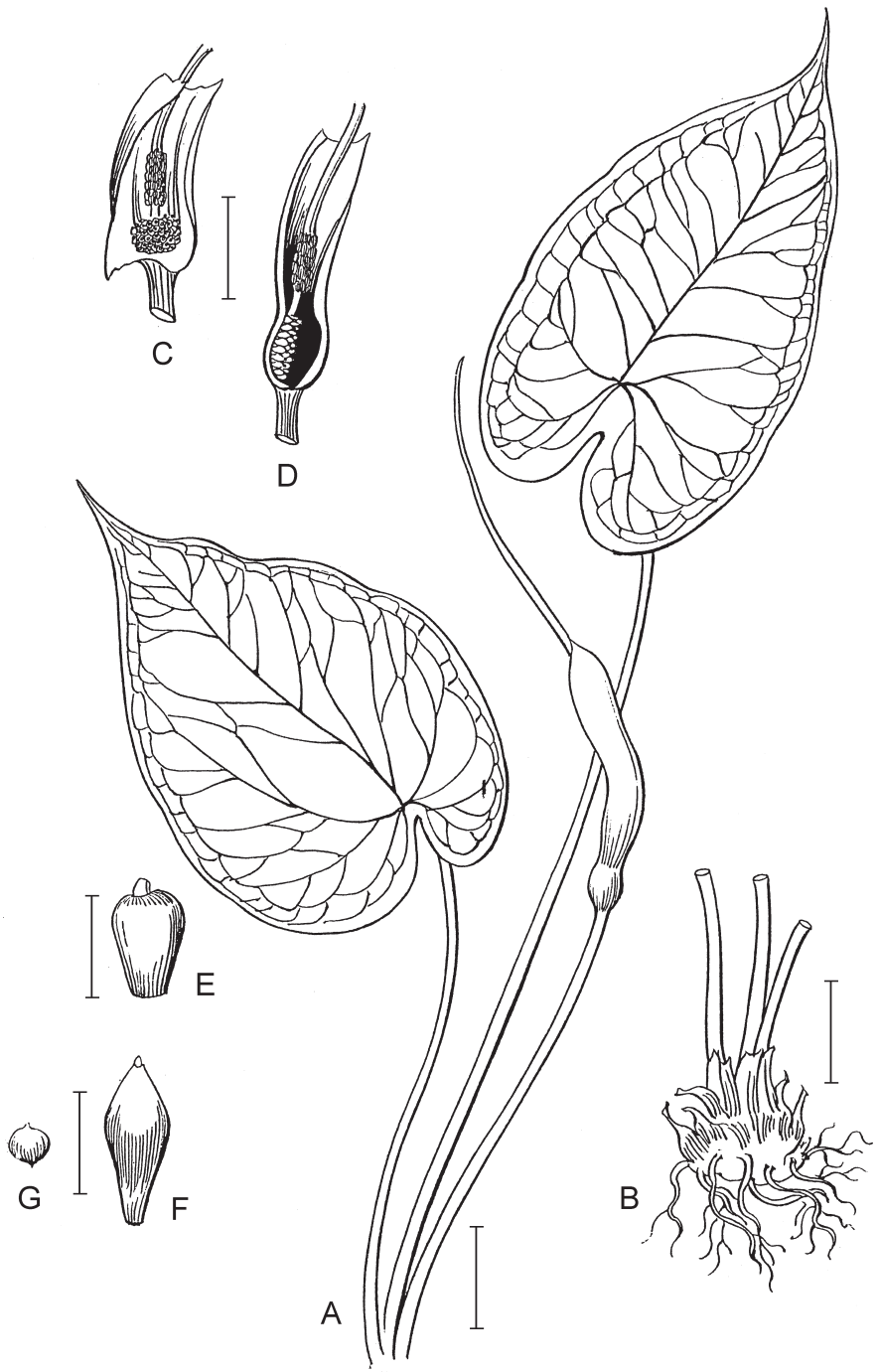

Fig. 4. *Pinellia peltata* – A-B: habit; C-D: inflorescence, spathe opened to show the spadix, front view (C), side view (D); E: pistil; F: fruit; G: seed. – Scale bars: A-B = 2 cm, C-D = 1 cm, E-G = 0.2 mm. – Redrawn from P'ei (1935: fig. 1).

Chromosome number. – 2*n* = 72 (Li & al. 1997b).

Note. – *Pinellia cordata* is characterized by its small size and by having bulbils at both the petioles and leaf blade bases. Its tuber is poisonous and used for the treatment of detoxification of viper bites, lumbago and in case of allergic reactions, furthermore externally to treat traumatic injury, abscesses, neck lymphosarcoma, breast mastitis and draining of pus.

Habitat and distribution. – Endemic to China: Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi and Zhejiang provinces. Growing in forests, along streams, moist meadows, cliffs, rock debris, below 800 m altitude. Flowering from March to June, fruiting from May to September.

Selected additional specimens examined. – China: Anhui: De Xian, *Yue Junshan 5059* (NAS); Huang Shan, *Yue Junshan 1844* (NAS), *He Xianyu 2377* (NAS), *T. N. Liou & P. C. Tsoong 3162* (PE), *P.C. Tsoong* (PE), *Qui Liangqing 7359* (SHM), *7360* (SHM); Jinzhai, Long jing He, *K. Yao 8911* (K); *Shan Ren-Hwa 60829* (NAS), *Shen Xiansheng 504* (AAUB); Jiuhuashan, *Yue Junshan 5447* (NAS); She Xian, *Shan Ren-Hwa 60821* (NAS), *Ye Peizhong 204* (NAS); Xuning Xian, *Yue Junshan 2326* (NAS). – Fujian: Chong-an xian, *Wamingjin 3083* (PE); Nanping, *C. Y. Chou 77* (FNU), *He Jing 2187* (FNU, PE), *Lin Ying 100* (FNU, IBSC, PE); Yenping Xian, *Hong Kong Herb. Team 3716* (K); Yongan Xian, *Wang Dashun 1359* (FNU). – Guangdong: Conghua xian, *W. T. Tsang 20549* (IBSC, IMMS, SYS); Ruyuan Xian, *Gao Xipeng 52767* (IBSC). – Guangxi: Guilin, *Deng Kezhen 13465* (IBSC); Longzhou, *Zhong Jixing 808845* (IBK, IBSC). – Guizhou: Kaili, *S Guizhou Group 1937* (HGAS). – Hubei: Yongshu Xian, *Ji Zongshan 23* (NAS). – Hunan: Jianghua, *Cheng Pengju 716* (HNNU, HUTM), *Wen & Wang 734* (HNNU, HUTM); Quanyang Xian, *Anjiang Agriculture School 1316* (PE); Yunfeng Shan, *Li Zhetang 2143* (PE). – Jiangxi: Fuchao, *Wang Mingjing 547* (NAS), *701* (NAS); Lu Shan, 23.9.1941, *H. Migo* (NAS), *A. N. Steward & al. 402* (N); Shangyou, *Nie Minxiang 8261* (LBG); Quannan Xian, *Julian Shan Xiong Je 1375* (NAS). – Zhejiang: Changhua Xian, *He Xiaoyu 23625, 22635, 22973* (HHBG, NAS, PE), *Liu Maobin 4772* (PE); Chunan Xian, *She Menlan 27732* (NAS); Kaihua Xian, *Wang Jingxiang 2075* (PE), *Chang Shaoyao 26254* (NAS); Linan Xian (ZJMA 3918); Longquan Xian (ZJMA 1327); Tianmu Shan, *He Xiao-yu 21886, 22291* (HHBG, NAS, PE), *Yue Jun-shan 1514, 1709* (NAS); Xiaofeng Xian, *He Xiao-yu 24181, 24387* (HHBG, NAS); Tiantai, *Wang Shui 1261* (NAS).

4. *Pinellia peltata* C. P'ei in Contr. Biol. Lab. Sci. Soc. China 10: 1, fig. 1. 1935.
Holotype: China, Zhejiang, Qingyuan Xian, Mt Shilong, 5.1931, *S. Chen 3278* (PE).

Tuber subglobose, 1-2.5 cm in diam. *Leaves* 2-3; petiole 27-33 cm long; leaf blades peltate, 10-17 × 5.5-12 cm, deep green, ovate or oblong, short-acuminate at apex, deeply cordate at base, primary lateral veins (5-)6-8 per side. *Inflorescence* with peduncle 7-15 cm long, shorter than petioles; peduncle 5-8 cm long; *spathe* 4-5 cm long, yellowish green, tube obovoid, c. 8 mm long; limb opening, 3-4 × 0.5-0.8 cm, apex obtuse to acute; *spadix* 11-13 cm long; female zone c. 0.8 cm long; male zone c. 0.6 cm long; sterile zone between female and male flowers c. 0.35 cm long; appendix c. 10 cm long. *Female flowers* densely arranged; pistil obovoid, 0.25-0.3 mm long and 0.12-0.15 mm in diam., stigma sessile, very small. *Male flowers* with thecae elongate, opening by a slit. *Berries* ovoid, pale green to whitish, acute at apex; seed globose. – Fig. 4.

Chromosome number. – 2*n* = 78 (Li & al. 1997).

Note. – *Pinellia peltata* differs from all other species of the genus by its subglobose tuber and its peltate leaves, which are ovate to oblong-ovate and shortly acuminate at apex.

Habitat and distribution. – Endemic to China: Fujian and Zhejiang. Growing in forests, on grassy slopes, on or between rocks. Flowering from May to June, fruiting from August to September.

Additional specimens examined. – Fujian: Songzheng Xian, *Xu Hann-lin 4049* (IMM). – Zhejiang: Leqing Xian, *Fruit Group 650* (NAS).

5. *Pinellia fujianensis* H. Li & G. Zhu, **sp. nov.**
Holotype: China, Fujian, Gutian Xian, Fudaoling, forest margin, rocky wetland, 17.4.l946, *Ling Lai-kuan 1027* (FNU).

Pinellia cordata N. E. Br. similis sed rhizomate obovato, 3.5 cm longo, folio sagittato, folii basi sine bulbilo differt.

Perennial with an obovoid rhizome, to 3.5 cm long and 1.4 cm in diam., with more than 5 nodes, swollen, internodes very short, 2-3 mm long, present year's part rooting; cataphylls 2-3, long-acuminate, c. 1.5 cm long. *Leaves* 2-3; petiole 10-45 cm long, bearing bulbils at base; leaf blade widely sagittate, anterior lobe deltoid-ovate, 7-13.5 × 4.5-10 cm, long-acuminate at apex, basal lobes subtriangular, 4-7 × 2.5-3.5 cm, divaricate; primary lateral veins 6-7(-8) per side. *Inflorescence* with peduncle 8-20(-25) cm long; peduncle shorter than petioles, to 14(-15) cm long; *spathe* reddish to yellowish violet, c. 5.5 cm long, tube 1.5 × 0.1 cm, limb lanceolate, 3.5-4 × 1.4 cm, navicular, erect; *spadix* c. 11 cm long; female zone 1.3 cm long with 9-10 pistils; male zone free from spathe, 7 × 3 mm; sterile zone between female and male flowers 5-7 mm long; appendix slender, 8 cm long, outcurved. *Female flowers* adnate to the spathe, densely arranged; pistil c. 1.2 mm long, ovary ellipsoid, 0.7-0.8 mm in diam., style slender, c. 0.25 mm long and 0.15 mm in diam., stigma discoid, c. 0.3 mm in diam. *Berries* ovoid; seed 1, ovoid, c. 0.4 mm in diam. – Fig. 5.

Note. – *Pinellia fujianensis* is similar to *P. cordata* but differs in having an acute rhizome, to 3.5 cm long, widely sagittate leaf blades and petioles bearing bulbils at base.

Habitat and distribution. – Endemic to Fujian, China. Growing in forests, on rocky sites in moist areas. Flowering in April, fruiting in September.

Paratypes. – China: Fujian: Minghou Xian, Nanyu, *Ling Laikuan 73024* (FNU); Minhou Xian, Beisha, *Ling Laikuan 139* (FNU).

6. *Pinellia tripartita* (Blume) Schott, Syn. Aroid.: 5. 1856 ≡ *Atherurus tripartitus* Blume in Rumphia 1: 137, t. 31, 37. 1835 ≡ *Arisaema tripartitum* (Blume) Engl. in Candolle, Monogr. Phan. 2: 538. 1879. – Holotype: Japan, Loo-Choo, *C. Wright 319* (P).
= *Pinellia tripartita* var. *atropurpurea* Makino in Bot. Mag. Tokyo 15: 135. 1901.

Perennial with subglobose tuber c. 2.5 cm in diam; cataphylls lanceolate, to 10 cm long. *Leaves* 2-5; petiole 30-35 cm long, green; leaf blade tripartite, green, leaflets broadly ovate to ovate-oblong, anterior leaflet 15 × 4-7 cm, apex 1.5 cm long; lateral leaflets smaller; primary lateral veins 8-12 per side, forming a distinct marginal collective vein, also with two thinner collective veins along margin. *Inflorescence* solitary; peduncle thin, to 25 cm long, shorter than petioles; *spathe* 7-9(-10) cm long, whitish green, tube oblong to subcylindrical, 3.5 × 1-1.25 cm, almost closed within by a transverse septum, gaping at base, blade oblong, boat-shaped, gaping, 4 × 2.5 cm; *spadix* 20-25 cm long; female zone c. 3 cm long; male zone 1.8-2 cm long; sterile zone between female and male flowers 0.6-0.7 cm long; appendix smooth, sigmoid, long-exserted from spathe, 15-20 cm long, base 3 mm in diam. *Female flowers* densely arranged; pistil 1-1.2 mm long, ovary ovoid, 0.9-1 mm long and wide, style distinct, attenuate, 0.2-0.3 mm long, stigma subhemispheric. *Male flowers* with thecae elongate, opening by a slit. *Berries* ovoid, 1-seeded, pale green to whitish. – Fig. 6.

Chromosome numbers. – $2n = 26, 52$ (Li & al. 1997b).

Note. – *Pinellia tripartita* differs from *P. yaoluopingensis* in having broadly ovate or ovate-oblong, sessile leaflets and a tuber lacking tubercles. It is also easily distinguishable from *P. ternata* by its petioles lacking bulbils.

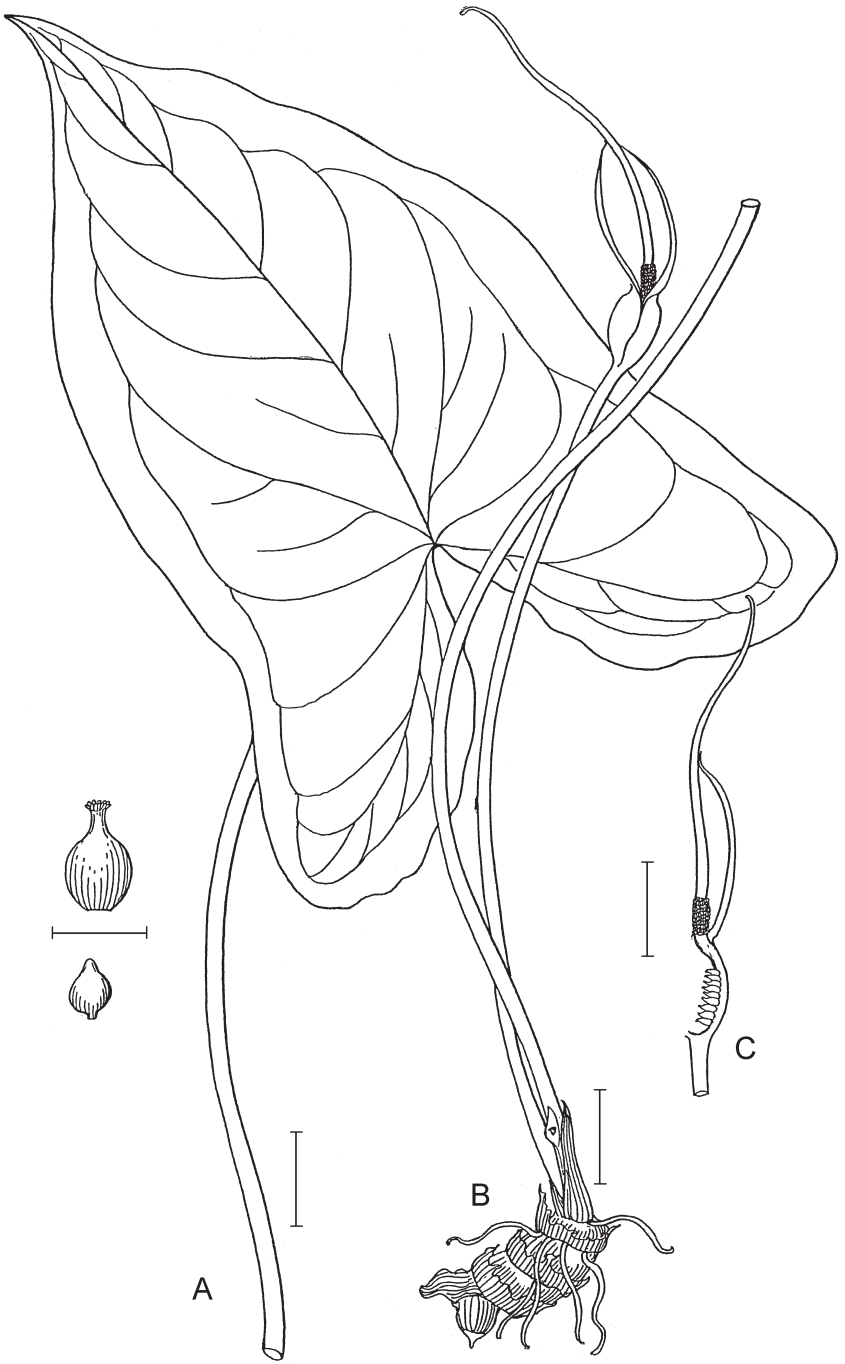

Fig. 5. *Pinellia fujianensis* – A: leaf; B: inflorescence and rhizome; C: spadix, spathe opened, in side view; D: pistil; E: seed. – Scale bars: A-B = 2 cm, C = 1 cm, D-E = 1 mm. – Drawn after the holotype.

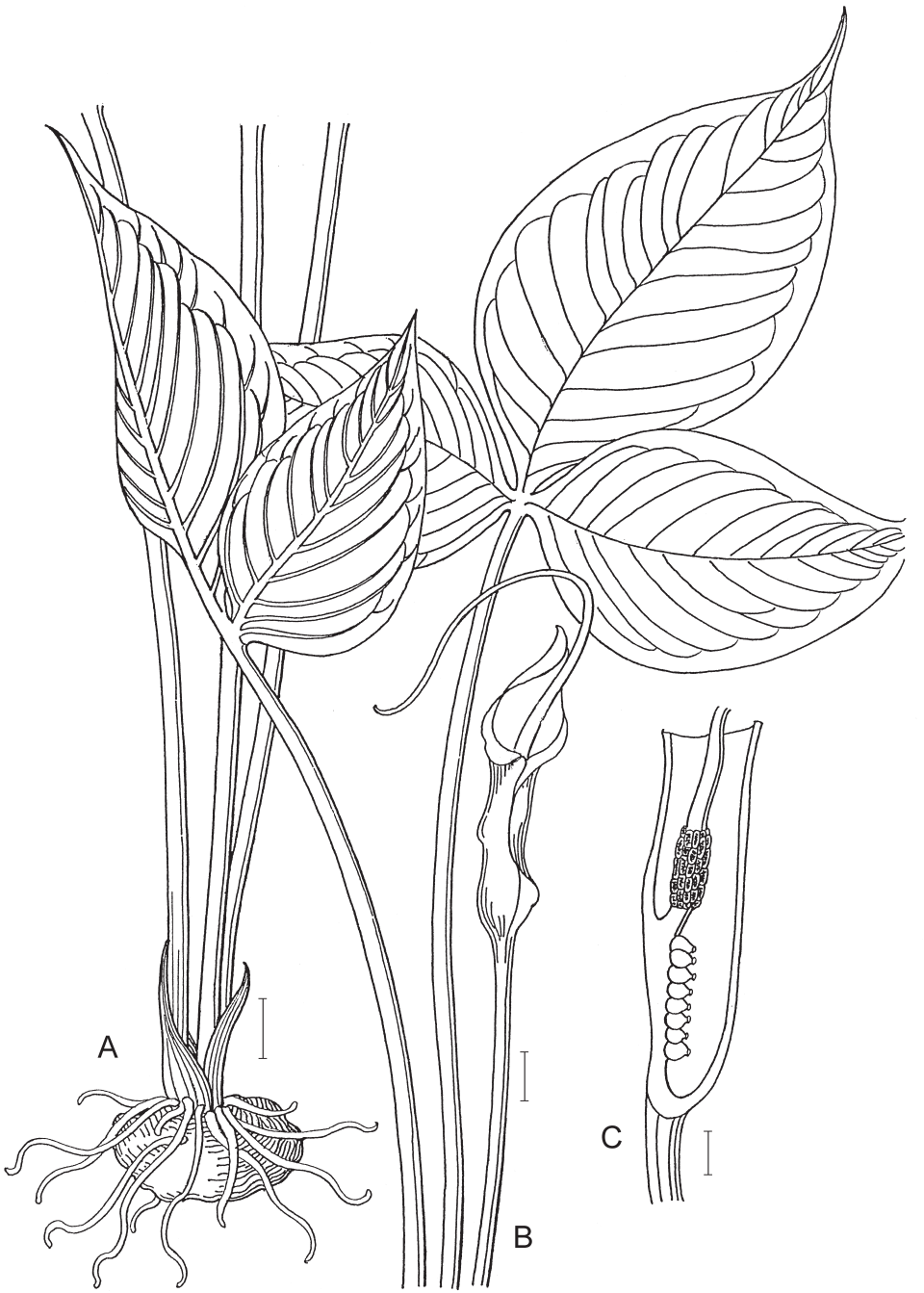

Fig. 6. *Pinellia tripartita* – A: basal part of plant; B: upper part of plant; C: inflorescence, longitudinal section and spathe partly removed, side view. – Scale bars: A = 1 cm, B-C = 1.2 cm. – Drawn after a life plant in cultivation.

Habitat and distribution. – Japan (Honshu, Shikoku, Kyushu and Ryukyu (Nansei-shotō) Islands; Ohwi 1984, Walker 1976). The species is also cultivated as an ornamental plant and widely naturalized in Australia and S Europe. A specimen collected by Charles Wright, who also collected the type of the name *P. tripartia,* is labelled as to come from Hong-Kong (*C. Wright 508,* P); besides, there is, however, no indication for the presence of this species in China. Found in dense broad-leaved forests, at forest margins and on roadsides. Flowering from May to July, fruiting from June to September.

Additional specimens examined. – JAPAN: Nagasaki, Mt Hiko-san, *N. Narohashi 1401* (E, K, P); Nagasaki, *R. Oldham 819* (K, P); Hiuga, *Yokohama* (E).

7. *Pinellia yaoluopingensis* X. H. Guo & X. L. Liu in Acta Bot. Yunnan. 8: 223, fig. 1. 1986. Holotype: China, Anhui, Yuxi Xian, Yaoluoping, in forest, c. 1000 m, *X. Guo 850233* (ANUB); paratypes: *X. L. Liu 695, 698* (WUH).

Tuber subglobose, 1.3-3 cm in diam., bearing bulbils at its top. *Leaves* 1-4; petiole 12-25 cm long, deep green with purple spots; leaf blade trifoliolate, sometimes also pedate, leaflets 3-5, central leaflet oblong-elliptic or obovate elliptic, 5-10 × 3-4.5 cm, acuminate or acute at apex, cuneate at base, lateral leaflets sessile, smaller, 5.5-7.3 × 4 cm; 4-5 primary lateral vein per side, forming a collective vein along margin. *Inflorescences* 1-2; peduncle usually longer than petioles, 22-36 cm long; *spathe* 7-8 cm long, constricted, green, tube 2-3.5 × 6-8 mm, limb oblong, 3-4 × 2-3 cm, obtuse at apex; *spadix* 16-20 cm long; female zone 2-2.5 cm long and 3-5 mm wide; male zone 5-7 × 3-4 mm; sterile zone between female and male flowers 5-6 mm long; appendix 13-18 cm long, green, sigmoid, recurved. *Female flowers* densely arranged; pistil 1-1.1 mm long, ovary broadly ovoid, 0.9 mm long and in diam., style distinct, stigma discoid, c. 0.25 mm in diam. *Male flowers* with thecae elongate, c. 1.4 mm long, each pollen sac opening by a pore. *Berries* conic, obtuse, seed 1. – Fig. 7.

Chromosome number. – $2n = 26$ (Li & al. 1997b).

Note. – The species differs from *Pinellia ternata* in having a tuber with tubercles around the petiole bases and by lacking bulbils elsewhere.

Habitat and distribution. – Endemic to Anhui (Yuxi Xian, Jingde Xian) and Jiangsu (Nanjing), China. Growing in broad-leaved forests, c. 1000 m. Flowering in May, fruiting from July to September.

8. *Pinellia ternata* (Thunb.) Breitenb. in Bot. Zeitung (Berlin) 37: 687. 1879 ≡ *Arum ternatum* Thunb., Fl. Jap.: 233. 1784 ≡ *Arisaema ternatum* (Thunb.) Schott in Schott & Endlicher, Melet. Bot.: 60. 1860. – Lectotype (designated here): *Thunberg 21638* (UPS).

= *Arum triphyllum* Houtt., Nat. Hist. 2(2): 183. 1774, nom. illeg., non L. (1753).
= *Arum bulbiferum* Salisb., Prodr.: 260. 1796.
= *Arum fornicatum* Roth, Nov. Pl. Ind. Or.: 362. 1821 ≡ *Hemicarpurus fornicatus* Nees, Del. Sem. Hort. Bot. Vratisl.: 4. 1839.
= *Arum atrorubens* Spreng., Syst. Veg. 2: 769. 1826.
= *Arum subulatum* Desf., Cat. Hort. Paris, ed. 3, 7 & 385. 1829 ≡ *Pinellia tuberifera* Ten. in Atti Accad. Sci. Fis. Mat. Napoli 4: 57. 1839, nom. illeg.
= *Arum macrourum* Bunge, Enum. Pl. Chin. Bor.: 67. 1831 ≡ *Arisaema macrourum* (Bunge) Kunth, Enum. 3: 644. 1841.
= *Arum bulbosum* Blume, Rumphia 1: 136. 1835.
= *Arisaema loureiri* Blume, Rumphia 1: 108. 1835.
= *Pinellia angustata* Schott in Miquel, Ann. Mus. Ludg. Bat. 1: 123. 1863 ≡ *Pinellia ternata* var. *angustata* (Schott) Engl. in Candolle, Monogr. Phan. 2: 256. 1879.
= *Typhonium ?tuberculigerum* Schott in Miquel, Ann. Mus. Ludg. Bat. 1: 123. 1863.

Fig. 7. *Pinellia yaoluopingensis* – A: habit; B: spadix, longitudinal section; C: pistil; D: pistil, longitudinal section; E: anther, view from above. – Scale bars: A = 2 cm, B = 1 cm, D-E = 1 mm. – Redrawn from Liu & Guo (1986: 224, fig. 1).

= *Pinellia tuberifera* var. *subpandurata* Engl. in Bot. Jahrb. Syst. 1: 488. 1881 ≡ *Pinellia ternata* var. *subpandurata* (Engl.) Engl., Pflanzenr. 73: 224. 1920.
= *Pinellia ternata* var. *giraldiana* Engl., Pflanzenr. 73: 224. l920.
= *Pinellia ternata* var. *vulgaris* Engl., Pflanzenr. 73: 224. 1920.
= *Pinellia koreana* K.-H. Tae & J.-H. Kim in Novon 15: 484. 2005.
[– *Pinellia zinguiensis* H. Li, nom. nud., in Proceedings of VI International Aroid Conference, Kunming (Abstracts): 44. 1995]

Perennial with globose tuber 1-2 cm in diam. *Leaves* 2-5; petiole 15-20 cm long, base sheathing, bulbils present in sheath, at lower or middle portion of petiole as well as at base of leaf blade; leaf blade trifoliolate, sometimes pedate with 5 leaflets; leaflets oblong-elliptic or lanceolate, green above, greenish below, acuminate at apex, cuneate at base, anterior leaflet 3-10 × 1-3 cm; lateral leaflets (3-)4-7.5 × 1.8-2.3 cm; 7-9(-10) primary lateral veins per side, forming a collective vein along margin. *Inflorescence* with peduncle longer than petioles, 25-35 cm long; peduncle 15-25 cm long; *spathe* 6-7 cm long, greenish or whitish green, rarely purplish, tube narrowly cylindric, 1.5-2 cm long, limb oblong, green and usually violet at margin, 4-5 × 1.5 cm, obtuse or acute at apex; *spadix* 9-10 cm long; female zone c. 2 cm long; male zone 5-7 mm long; sterile zone between female and male flowers 3 mm long; appendix 6-7(-8) cm long, green to violet, erect or sigmoid. *Female flowers* densely arranged; pistil 2.1-2.2 mm long, ovary ovoid, c. 1.8 mm long and 1-1.1 mm in diam., style distinct, attenuate, stigma very small, c. 0.2 mm in diam., not broader than style. *Male flowers* with thecae elongate, c. 1.2 mm long, opening by a slit. *Berries* ovoid, yellow green to whitish, with persistent stigma and style, 1-seeded. – Fig. 8.

Chromosome numbers. – A compilation of the chromosome numbers reported in the literature and further own counts for *Pinellia ternata* are given by Li & al. (1997b). A recent comprehensive cytological study of *P. ternata* by Chen & al. (2006) revealed the existence of septuploid ($2n$ = 91), octoploid ($2n$ = 104; see also Tae & Kim 2005 under *P. koreana*), nonuploid ($2n$ = 117) and decaploid ($2n$ = 130) cytotypes, thus all based on x = 13, as well as further indications for extensive series of aneuploid reduction. Assumptions about basic numbers of *P. ternata* (and thus for *Pinellia*) different from x = 13 (i.e. x = 7, 9, see Li & al. 1997b, Tae & Kim 2005) should be taken with great caution in the light of these new data; early counts for *P. ternata* of, e.g., $2n$ = 28 (for references see Li & al. 1997b) would need confirmation and counts of higher ploidy levels deviating from x = 13 are apparently due to aneuploid reduction.

Note. – *Pinellia ternata* is a highly variable species both with respect to morphology and cytology. It differs from other species of the genus by having bulbils at different parts of the petiole. After having examined the variation in the position of the bulbils at the petiole, it became evident that this feature is of no taxonomic value in contrast to the view expressed by Li (1995).

Pinellia koreana has been described recently from Korea, having pedate leaf blades with five leaflets otherwise not differing from *P. ternata.* Pedate leaf blades, however, are occasionally produced by vigorous individuals of *P. ternata* and this new taxon can therefore safely be sunk in the synonymy of *P. ternata*.

Tubers of the species are used in traditional Chinese medicine for treatment of coughs, for reducing phlegm, stopping vomit, and externally for treatment of breast mastitis and otitis media.

Habitat and distribution. – Growing in grassy land, secondary forests, wasteland and cultivated land; below 2500 m, widely distributed over China excluding Nei Mongolia, Qinghai, Xinjiang and Xizang, further in central and southern Japan and Korea. Naturalized in Europe, North America and Australia. Flowering from May to July, fruiting from July to September.

Selected additional specimens examined. – China: Anhui: Lanya Mountains, *Wang Xing-wu* (E, K); Huangshan District, *Pei Jian 3856* (PE). – Fujian: Changding Xian, *Ling Lai-kuan 5092* (PE); Fushen Xian, *Ling Lai-kuan 1345* (PE). – Gansu: Tian Xian, *Huanghe Group 4063* (PE); Huatingyuan (Huating Garden), *Wang Zuo-bin 16944* (PE). – Guangdong: Guangxi, Yangsou Xian, *Shan Ren-Hwa 847* (PE); Lingui Xian, *Guangxi Expedition 3997* (PE). – Guizhou: Anlong Xian,

Fig. 8. *Pinellia ternata* – A: habit; B: juvenile plant; C: leaf with bulbil; D: inflorescence, side view; E: inflorescence, back view; F: inflorescence, front view; G: inflorescence, longitudinal section, front view; H: inflorescence, longitudinal section, side view; I: pistil, longitudinal section; J: ovule; K: anthers. – Scale bars: A-H = 2 cm, I-K = 1 mm. – Drawing after life plants cultivated in Kunming Botanical Garden.

Guizhou Expedition 3106 (PE); Kaidong Xian, *S. Guizhou Group 1229* (PE). – HAINAN: Luochan Xian, *S.H. Chun 1485* (PE). – HEBEI: Beijing, *T. P. Wang 191* (PE); Fangshan Xian, *K. M. Liou 846* (PE). – HEILONGJIANG: Henan, Gongjishan, *Chang Xiang-qin 20071* (PE); Xinyang Xian, *Guan Dai 245* (PE). – HUBEI: Batung, *E. H. Wilson 378* (K, E). – HUNAN: Longshan Xian, *Liu Lin-han 9372* (PE); Nanyue Xian, *Liu Lin-han 1589* (PE). – JIANGSU: *K. Ling 2388* (N). – JIANGXI: Nanfeng Xian, *Yang Xiang-xue & al. 65019* (PE); Lushan, *Sheng Qi-jing 393* (PE). – JILIN: Liaoning, Shengyang, *Zhu You-chang 1082* (IFP); Zhuanghe Xian, *Zhu You-chang & al. 785* (IFP). – NINGXIA: Shaanxi, Zhongnanshan, *T.P. Wang 2181* (PE); Foping Xian, *Fu Kulnstitutengjun 4970* (PE). – SHANDONG: Tsinanfu, *C. Y. Chiao 3095* (E); Laoshan xian, *Pucha Group 1038* (PE); Taishan, *Sino-Germany Expedition 593A* (PE). – SHANXI: Taihanshan, *K. M. Liou 7321* (PE); Wutaishan, *Guan Ke-Jian 2589* (PE). – SICHUAN: Fengjie Xian, *Zhou Hong-fu & al. 11063* (PE); Baoxin Xian, *Song Zi-pu* (PE). – TAIWAN: Funing Xian**,** *C. W. Wang 88808* (PE). – YUNNAN: Kunming, *Qu Bin-yun 54709* (PE). – ZHEJIANG: West Tianmushan, *Deng Mao-bin 4094* (PE); Hanzhou, *Chang Shao-yao 2387* (PE). — KOREA: s.loc., *Taquet 399* (B, E); Fusan, *Faurie 215* (B). — JAPAN: Tokyo, Rhukyu, 6.5.1975, *N. Togash* (E); Yokohama, 17.5.1912 (E), *Maximowicz* (LE); Ryukyu Islands, Nakadaki, *R. Oldham 625* (K); Mt Yaese-dake, *Miyoshi Furuse 5637* (K).

9. *Pinellia pedatisecta* Schott in Oesterr. Bot. Wochenbl. 7: 341. 1857 ≡ *Pinellia tuberifera* var. *pedatisecta* (Schott) Engl. in Candolle, Monogr. Phan. 2: 567. 1879. – Holotype: China, Beijing, *Tatarinov* (P).
= *Pinellia wawrae* Engl. in Candolle, Monogr. Phan. 2: 567. 1879.
= *Pinellia cochinchinensis* (Blume) W. F. Wight in U.S.D.A. Bur. Pl. Industr. Bull. 142: 35. 1908 ≡ *Arisaema cochinchinense* Blume, Rumphia 1: 107. 1835.

Perennial with subglobose tuber to 4 cm in diam., bearing some tubercles around it. *Leaves* 1-3 or more; petiole 20-70 cm long, greenish, lower portion sheathing; blades pedate, leaflets 6-11, lanceolate, acuminate at apex, base cuneate, sessile; central leaflet 15-18.3 cm long, the following ones smaller, outermost ones 4-5 cm long; 7-12 primary lateral veins per side, forming an inner collective vein, an outer second collective vein near the margin. *Inflorescence* with peduncle 20-50 cm long, green; *spathe* lanceolate, not constricted between tube and limb, inside transverse septum absent, 10-19 × 1.5-2 cm, long-acuminate at apex, slightly convolute at base, green outside, greenish to whitish inside; *spadix* 14-20 cm long; female zone 1.5-3 cm long, adnate to spathe; male zone free from spathe, cylindric, 5-8 mm long; sterile zone between female and male flowers only 4-5 mm long; appendix 10-15 cm long, greenish to whitish, ± cylindric, 2-3 mm in diam. at base, upwards becoming filiform, suberect. *Female flowers* very densely arranged; pistil 2.1-2.2 mm long, ovary obovoid, c. 1.9 mm long and 1.2-1.3 mm in diam., green, stigma subsessile, orbicular, white, papillose. *Male flowers* with thecae elongate, c. 1.3 mm long, yellow, opening by a slit. *Berries* ovoid, 4-5 mm long and 3-5 mm in diam., pale to whitish green, 1-seeded; seed obovoid, 3.5 × 2.5 mm, brown, funicle robust. – Fig. 9.

Chromosome number. – 2*n* = 26 (Guo & Zhuang 1988, Li & al. 1997b).

Note. – *Pinellia pedatisecta* is the only species of *Pinellia* with always pedate leaf blades and lacking the transverse septum inside its spathe. It is easily distinguished from other species by having a spathe lacking a constriction between the tube and blade.

Its poisonous tuber is used in Chinese medicine for the treatment of enlarged lymph nodes and in urinary tract infections.

Habitat and distribution. – Endemic to China: Anhui, Fujian, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Shaanxi, Shanxi, Shandong, Sichuan, NE Yunnan, and Zhejiang. Growing in forests, valleys or shady areas; lower than 1000 m. Flowering from May to June, fruiting from July to September.

Selected additional specimens examined. – CHINA: ANHUI: Lan-ya Mountain, *Wangg Xing-wu x-333* (K); Chu Xian, *Fan Wen-zhe 82.1883* (NAS). – FUJIAN: *Fan-yu Station 1193* (NAS). –

Fig. 9. *Pinellia pedatisecta* – A: upper portion of plant; B: lower portion of plant; C: inflorescence, front view; D: inflorescence, longitudinal section and spathe partly removed, side view; E: pistil; F: pistil, longitudinal section; G: ovule; H: anther. – Scale bars: A = 3 cm, B = 6 cm, C = 1 cm, E-H = 1 mm. – Drawing after life plants cultivated in the Kunming Botanical Garden.

Guangxi: Guizhou, *M. Cavalerie 2441* (P). – Hebei: Beijing, *R. P. Licent 1027* (PE); Jietansi temple, *B. Batholomew & D. E. Boufford 2051* (K, E). – Henan: Lin Xian, *Fu Jun-qiu 553* (NAS), *Ye De-xien 387* (NAS); Dengfeng Xian, *Medicine Group 308* (NAS). – Hubei: Badong, *Ma Yun-jun 313* (HIB); Hofeng, *F. S. Pen 969* (HIB). – Hunan: Yongshun, *West Hunan Expedition 420* (PE); Yuelushan, *Yang Bao-ming 13* (HNNU); Sangzhi Xian, *Li Xue-geng 204213* (HNNU); Ling Xian, *Liu Lin-han 11086* (HNNU); Zixin Xian, *Cao Ren-ming 64.2.19* (HUTM). – Jiangsu: Nanjing, *C. Y. Chiao 2920* (E); Suzhou, *H. T. Chang 542* (NAS); Jiangpu, *Yue Jun-san 222, 254A, 689, 724* (NAS); Tai Xian, *Yue Jun-san 2690* (NAS). – Shaanxi: Huashan, *K. S. Hao 4206* (PE); Chengu Xian, *K. J. Fu 5443* (PE). – Shanxi: Jing Xian, *Bao Si-yin & al. 426, 1284* (PE); Xiao Wutaishan, *Bao Si-yin & al. 201335* (PE). – Shandong: Fei Xian, Meng Shan, *T. Y. Cheo & L. Yen 190* (P); Laoshan, *C. Y. Chiao 2920* (E, K, P, PE); Qingdao, *F. H. Sha 591* (PE); Tai-shan, *Kao Ping-fang 1350* (E). – Sichuan: Zhongqing, *S. C. Wang 1246* (NAS); Ba Xian, *Y. Z. Sun 1718* (NAS); Muping, *T. N. Liou 1201* (PE); Obian Xian, *T. T. Yu 775* (PE); Zhaohuua Xian, *T. N. Liao 242* (PE). – NE Yunnan: *J. Cavalerie* (P); Youngshan Xian, *Hu Yue-yin & al. 652148* (YIM). – Zhejiang: Kaihua Xian, *Zuo Da-xun 246, 424* (NAS); Longqian Xian, *Chang Shao-yao 4722* (PE).

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