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A System of the Family Araceae in Japan and Adjacent Areas* I.

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Presentation of Data

Description. In general each taxon is not provided with a description. They are only contrasted in the keys and notes unless proposed as new or little known in our region. Furthermore, no account has been made of species which occur in cultivated state in our region, except a few important and old cultivated species.

Synonymy. Nearly all synonyms are given for the aroid flora of Eastern Asia; for the adjacent regions only important synonyms are given. Many reports on the local flora of Japan are excluded, except new taxa described or important data of distribution.

Types. I have examined type materials of nearly all validly published names by Japanese botanists, but I had not seen many type materials in Europe. These types, however, had been examined by T. Nakai, G. Koidzumi and H. Hara. They made figures and notes on the types, which partly reserved in the herbaria of University of Tokyo and of Kyoto University. These figures are available for this study. The types are recorded following the synonymy, and when type was not seen by me I have mostly indicated this by the abbreviation 'n. v.' or an explanation in the notes.

Specimens examined. Because of the size of this revision I have omitted long list of specimens in distinct and well known species. In these cases, the summarized distributions and habitats are given under each taxon. The specimens examined in this studies are kept in the herbaria listed below:

KYO Herbarium of Kyoto University, Kyoto.
KAG Herbarium of Kagoshima University, Kagoshima.

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* This is the systematic part of author's thesis reported November 1969 at Kyoto University. The general part of the thesis (account of taxonomic characters) will be published in the Japanese Journal of Botany.

MAK Makino Herbarium of Tokyo Metropolitan University, Tokyo.
SAPA Herbarium of Laboratory of Plant Pathology, Hokkaido University, Sapporo.
TI Herbarium of the University of Tokyo, Tokyo.
TNS The National Science Museum, Tokyo.

Literature. The important revisions, monographs, or floras are usually abbreviated or indicated as 'l.c.'. These are:

Engler, A. 1905. Araceae-Pothoideae. Pflanzenreich **21**.
———. 1911. Araceae-Lasioideae. Pflanzenreich **48**.
———. 1912. Araceae-Philodendroideae. Pflanzenreich **55**.
———. 1915. Araceae-Philodendroideae. Pflanzenreich **64**.
———. 1920. Araceae-Aroideae & Pistioideae. Pflanzenreich **73**.
———. & K. Krause, 1908. Araceae-Monsteroideae. Pflanzenreich **37**.
———. & ———. 1920. Araceae-Colocasioideae. Pflanzenreich **71**.
Kitamura, S. 1964. Araceae. Kitamura, Murata & Koyama, Col. Ill. Herb. Pl. Jap. **3**: 188–210, in Japanese.
Koyama, T. 1965. Araceae. Ohwi, Flora of Japan (Engl. ed.) 255–264 (1965).
Krause, K. 1908. Araceae-Calloideae. Pflanzenreich **37**.
Liu & Huang. 1963. Araceae of Taiwan. Quart. Jour. Taiwan Mus. **16**.
Schott, H. G. 1860. Prodromus Systematis Aroidearum.

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Araceae

Juss., Gen. Pl. 23 (1789), nom. consv. ut '*Aroideae*'; Lindl., Nat. Syst. ed. 2, 363 (1836), et Veg. Kingd. 127 (1847); Engl. in Nova Act. Acad. Nat. Cur. 39 (1876), in DC. Monogr. Phan. 2 (1879), in Engl.-Prantl, Pfl.-fam. **2** (3): 102 (1887–89), et Pfl.-reich **4** (23) (1905–1920); Hutchinson, Fam. Fl. Pl. ed. 2, 627–635 (1959).—*Aroideae* Juss. in Hort. Trianon (1759); Blume in Rumphia **1**: 76 (1835); Schott, Prodr. Syst. Aroid. (1860); Hook. f. in Benth. & Hook. f., Gen. Pl. **3**: 955–1000 (1883).—*Acoraceae* Lindl., Nat. Syst. ed. 2, 365 (1883).—*Orontiaceae* Lindl., Veg. Kingd. 193 (1847).

Terrestrial, climbing, epiphitic or aquatic (rarely floating) herbs with epigaeous erect stems, elongate rhizomes, hypogaeous stems or tubers, or woody and climbing stems; usually with bitter or milky juice. Leaves generally with hastate or sagittate, simple or compound, large lamina, margin entire, rarely pseudodenticulate; petioles vaginate except a few genera; leaf venations parallel to reticulate. Inflorescences apicillary or rarely axillary, bisexual or unisexual, forming spadix and usually

enclosed by spathe. Flower small, bisexual or unisexual; perianth when present, tepals 4-6, usually free and imbricate, persistent, mostly absent in the unisexual flowers; stamens 2-6 in bisexual flowers, alternipetalous, 10-1 in unisexual male flower and generally forming synandria; anthers extrose, rarely introse (*Acorus*), with slit to pore dehiscence, rarely turbinate with transverse, equatorial dehiscence; in male flower pistillode present or absent; ovaries superior or immersed in spadix (*Symplocarpus* and *Lysichitum*), with 1- to many (12) loculi; style various, sometimes absent; placentae parietal, axile, basal, or apical, with 1- to many-ovules; ovules anatropous, orthotropous, or campylotropous. Fruits berry, or coriaceous and rupturing, 1- to many-seeded. Seeds albuminous and generally small, or exalbuminous and large. Embryos various, usually in the middle of endosperm or large and curved in exalbuminous seed; cotyledons usually change to absorbing organ or nutritious organ (exalbuminous seeds). Chromosomes, haploid numbers 11, 12, 13, 14, 15, ... 27, 30, and polyploid series are present.

Genera ca. 120, mostly in wet tropics, few in dry or temperate regions, species ca. 1900. Fourteen genera in Japan, Formosa, Korea and Sakhalin.

Key to the Subfamilies of Araceae

1. Leaves narrowly linear, with parallel venation, without petiole, not involved in buds; stamens with introse or extrose anther. Rhizomate herbs in temperate regions ..... I. Acoroideae
1. Leaves with more or less wide lamina, usually petiolate, involved in buds; petioles usually vaginate; stamens with extrose anthers, or connate and forming synandria 2
  2. Leaves spathulate without petioles; stems much reduced. Aquatic floating herbs in tropics..... VI. Pistioideae
  2. Leaves various, usually with vaginate petioles 3
    3. Plants without laticiferous cell or duct; specialized groups with trichosclereids in stems and leaves; vessels present in the stem of a few groups; leaf simple, palmately tri-, poly-sected, or pinnatifid; petiole geniculate; flowers usually bisexual, tepals present or absent. Rhizomatous or climbing herbs in tropics ..... II. Pothoideae
    3. Plants usually with laticiferous cells or ducts; trichosclereids absent 4
      4. Leaf usually with much reticulated veins, simple or pedate to tripartite; petiole, in a few cases, geniculate; flower bisexual or unisexual; ovary with 1-2 locules containing a few ovules (usually 1-2); ovule anatropous, amphitropous or orthotropous (a few); seed mostly exalbuminous. Rhizomatous or tuberous terestrial herbs..... III, Lasioideae
      4. Leaves simple or pinnately parted by marginal dissection, with parallel or parallel-reticulate venation; vagina well differentiate and rarely produce free ligule; flower unisexual without tepals; stamens free or connated forming typical synandria; ovaries with 1-many loculi containing 1-many ovules; ovules anatropous, hemianatropous or orthotropous; seeds usually

small, albuminous, rarely large and exalbuminous. Rhizomatous, climbing, caulescent, or tuberous terrestrial herbs mostly in tropics ..... IV. Philodendroideae

4. Leaves simple, ternately, pedately, or radiately sected with much reticulate veins; flowers unisexual, rarely with tepals; stamens free or connate; ovaries usually 1 locular, rarely 2-4 locular, with 1-many ovules; ovules anatropous to orthotropous; seeds small to large, albuminous. Tuberous or rhizomatous terrestrial herbs or aquatic herbs ..... V. Aroideae

Key to the Tribes and Genera in Eastern Asia and Malaysia

I. Subfamily Acoroideae

Only a genus *Acorus* (Tribe Acoreae)

II. Subfamily Pothoideae

1. Flower with 6 tepals; ovaries 1 or 3 locular, with one ovule in each. Climbing herbs ..... Tribe Pothoeae
  2. Ovary trilocular ..... *Pothos*
  2. Ovary unilocular ..... *Pothoidium*
1. Flower usually naked, rarely with connated tepals 3
  3. Spathe deciduous from spadix after anthesis. Mostly climbing herbs with long internode of stem[1] ..... Tribe Monstereae
    4. Seed with endosperm; ovule many to few ..... *Rhaphidophora*
    4. Seed without endosperm; ovule 1-2 5
      5. Flower with connate tepals ..... *Anadendron*
      5. Flower naked 6
        6. Leaf pinnatifid with much reticulate veins; ovule 2 in a ovary ..... *Amydarum*
        6. Leaf simple, with parallel veins; ovule one in a ovary ..... *Scindapsus*
  3. Spathe persistent. Terrestrial herbs with short internode of stem ..... Tribe Spathiphylleae
    7. Ovary 2-4 locular with 1-8 ovules in each locule ..... *Spathiphyllum*
    7. Ovary unilocular with several ovules on basal placenta ..... *Holochlamys*

III. Subfamily Lasioideae

1. Flower bisexual with or without tepals; spadix without appendix 2
  2. Flower with tepals 3
    3. Seed without endosperm; caudex erect and hypogeous. Herbs in temperate regions ..... Tribe Symplocarpeae
      4. Ovary usually bilocular; spathe white or yellow ..... *Lysichitum*
      4. Ovary unilocular; spathe purplish ..... *Symplocarpus*

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1) *Rhaphidophora beccarii* is a terrestrial rhizomatous herb, and *Scindapsus beccarii* is an epiphytic herb with short internodes.

3. Seed with or without endosperm; caudex ascending or erect and epigeous; often aculeate or verrucose. Herbs in tropics ..... Tribe Lasieae
5. Ovary several- to 1-ovulate; seed with or without endosperm; ovule attached to below the middle part of the wall ..... *Cyrtosperma*
5. Ovary 1-ovulate; seed without endosperm; ovule tholifixed ..... *Lasia*
2. Flower without tepals ..... *Picnospatha*
1. Flower unisexual; spadix usually with an appendage; leaf usually poly-sected. Tuberous herbs in tropics and subtropics ..... Tribe Amorphophalleae
6. Ovary unilocular; ovule basifixed ..... *Tomsonia* & *Pseudodracontium*
6. Ovary bi- or unilocular; ovule attached to the septum ..... *Amorphophallus*

IV. Subfamily Philodendroideae

1. Flower usually bisexual. Herbs in temperate or subfrigid regions..... ..... Tribe Calleae, *Calla*.
1. Flower unisexual. Terrestrial herbs with erect, ascending or climbing stem in tropics 2
2. Seed without endosperm; ovary unilocular and 1-ovulate.....Tribe Aglaonemeae
3. Stem epigeous; inland herbs ..... *Aglaonema*[1)]
3. Stem creeping; in mangroves ..... *Aglaodorum*
2. Seed with endosperm; ovary unilocular and usually with several ovules 4
4. Primary and secondary lateral veins more or less running parallel with each other; male flowers usually not forming typical synandrium 5
5. Spathe and male part of spadix usually persistent after anthesis; ovary usually with axile placentation; ovule anatropous .... Tribe Homalomeneae, *Homalomena* & *Diandriella*
5. Upper part of spathe and spadix usually deciduous after anthesis[2)]; ovary usually with parietal or basal placentation; ovule anatropous, hemianatropous or orthotropous ..... Tribe Schismatoglottineae
6. Spadix usually with large or small sterile apical part..... 7
7. Pollen sac without horn; ovary with parietal placentation or with a few ovules basifixed; petiolar vagina usually without free ligule ....*Schismatoglottis*
7. Pollen sac usually with a horn; ovary with basal placentation or rarely with parietal placentation; petiolar vagina with free ligule; a few species without horn of pollen sac[3)] 8
8. Male flower with many tubercules; ovary with basal placentation .... *Phymatarum*
8. Male flower without tubercules..... 9
9. Parietal placentation ..... *Bucephalandra*
9. Basal placentation ..... *Microcasia*

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1) A few species have creeping stem, i.e. *Aglaonema brevispathum*.
2) *Schismatoglottis homalomenoidea* group and *Piptospatha havilandii* have persistent spathes.
3) They are *Microcasia truncata* and related species of Sarawak.

6. Upper part of spadix covered by fertile male flowers; petiolar vagina with free ligule 10
10. Ovary with basal placentation ..... *Aridarum*
10. Ovary with parietal placentation ..... *Piptospatha*
4. Secondary veins started from primary lateral veins more or less parallely ascend and then are collected between the primaries forming reticulate venation; male flowers usually forming a typical synandrium.....Tribe Colocasieae
11. Spadix without appendix; tuberous herbs 12
12. Parietal placentation ..... *Remusatia*
12. Basal placentation ..... *Gonatanthus*
11. Spadix usually with appendix or sterile apical part of male inflorescence 13
13. Ovary with an ovule ..... *Hapaline*
13. Ovary with several ovules 14
14. Parietal placentation; ovule anatropous or hemianatropous; seed many and small..... *Colocasia*
14. Basal placentation; seed few (1–6), usually larger 15
15. Ovule orthotropous or hemianatropous; leaf simple rarely pinnatifid .....*Alocasia*
15. Ovule anatropous; leaf pinnatilobed or pinnatifid..... *Schizocasia*

V. Subfamily Aroideae

1. Terrestrial herbs with rhizomes or tubers ..... Tribe Areae
2. Spadix free from spathe..... 3
3. Ovules 1–2, basal; leaves simple, or tri- to pedati-sected; spadix with rudiments between male and female inflorescences, monoecious ..... *Typhonium*
3. Ovules many to few, rarely 1, basal; leaves tri-, pedati-, or radiati-sected, rarely simple; spadix without rudiments between male and female inflorescences of monoecious plants, generally dioecious..... *Arisaema*
2. Female part of spadix adonate to spathe; ovule 1, basal ..... *Pinellia*
1. Aquatic herbs ..... Tribe Cryptocoryneae, *Cryptocoryne*

VI. Subfamily Pistioideae

Only one genus, *Pistia* (a species in tropics).

Enumeration of the Species

I. Subfamily Acoroideae

C. A. Agardh. Aphor. Bot. 133 (1822); Schott, Melet. 22 (1832).

Only two genera, *Acorus* in N. Hemisphere and *Gymnostachys* in Australia. The two genera distinctly differ from each other by the floral morphology (Eyde et al. Am. J. Bot. **54**: 478–479, 1966). But many vegetative characters are common to these two genera such as the simple and narrow leaf with parallel venation, and not involute in the bud; the creeping rhizome; and the leaf like spathe not enclosing

the spadix. The type of pollen is also common to these two, unisalcate.

These two genera have the most primitive vegetative characteristics. Their flowers show general monocotyledonous features with a few much specialized anatomical characters. Therefore such specialized floral characters are not so important as to divide them into two subfamilies.

Tribe **Acoreae** Lindl. Nat. Syst. ed. 2, 365 (1836), excl. *Gymnostachys, Tupistra* & *Aspidistra*; Engl. in Nov. Acta Acad. Nat. Cur. **39**: 141 (1876), et in Pfl.-reich **21**: 308 (1905), incl. syn.; Hutchinson, Fam. Fl. Pl. ed. 2, 630 (1959).—*Acorinae* Schott, Prodr. 576 (1860); Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 963 (1883). Type: *Acorus* L. Monotypic.

Acorus L. Sp. Pl. 342 (1753); Schott, Prodr. 577 (1860); Engl. in Pfl.-reich **21**: 308 (1905), incl. syn. Type: *A. calamus* L.

Key to the Species and Varieties

1. Leaves with a distinct midrib; flowering spadix 6–10 mm in diam.; not evergreen; tetraploid, sterile ..... 1. *A. calamus* var. *angustatus*
1. Leaves without midrib or with obscure midrib; flowering spadix 3–6 mm in diam.; evergreen ..... 2. *A. gramineus*
  2. Spadix completely sterile ..... var. *japonicus*
  2. Spadix more or less fertile..... 3
    3. Leaves 7–40 cm. long, 1.5–5 mm. wide ..... var. *pusillus*
    3. Leaves 30–60 cm. long, 4–9 mm. wide ..... var. *gramineus*
    3. Leaves 60–100 cm. long, 10–17 mm. wide ..... var. *macrospadix*

1. **Acorus calamus** L. Sp. Pl. 342 (1753).

Var. **angustatus** Bess. Ueb. die Fl. des Baik. in Beibl. zur. Fl. **1**: 30 (1834); Engl. in Pfl. -reich **21**: 312 (1905), incl. syn.—*A. asiaticus* Nakai in Rep. Fir. Sc. Exp. Man. sect. **4** (4): 105 (1936). Type: Shansi, Nakai, Honda & Kitagawa (holotype in TI).—*A. calamus* L. var. *asiaticus* (Nakai) Pers.; Makino, New Ill. Fl. Jap. 809 (1962).—*A. spurius* Schott in Ann. Mus. Lugd. Bat. **1**: 284 (1863-4).—*A. tatarinowii* Schott in Öst. Bot. Ztschr. 101 (1859).—*A. calamus.*; auct. Asia orient.

This variety is widespread in E. Asia, from central China to Siberia and Japan; usually on deep wet sandy, clayey or peaty soil of swamp grassland or river and rice field side, rarely cultivated for medical plant.

2. **Acorus gramineus** Soland. in Ait. Hort. Kew **1**: 474 (1789); Schott, Prodr. 580 (1860); Engl. in Pfl.-reich **21**: 312 (1905), incl. syn.

Var. **gramineus**.—*A. gramineus* Soland. l.c.; Liu & Huang in Quart. Jour. Taiwan Mus. **16**: 127 (1963). Fig. 1-D.

China. Kiangshi: Mt. Lu-shan, Nagasawa 218 (KYO), Liu (KYO). Kwangtung: Naam kwan shan, Tsang 20278 (KYO); Loh-fau shan, Tsui 20 (KYO); Pak-wan sheung, Tsui 112 (KYO). Formosa: Mt. Arisan, U. Faurie 96 (KYO).

Var. **macrospadix** Yamamoto, Contr. Fl. Kaon. **1**: 13, 28 (1943).—*A. gramineus*

Soland.; Engl. in Pfl.-reich **21**: 312 (1905), p.p. Fig. 1-E.

China. Hainan: Ku Tung, Lei 340 (KYO). Thailand. Chiengmai: Doi Sutep, 1000 m, Tagawa & Yamada T-14 (KYO).

Var. **pusillus** (Sieb.) Engl. in DC. Monogr. Phan. **2**: 218 (1879), et in Pfl.-reich **21**: 313 (1905); T. Koyama in Ohwi, Fl. Jap. 264 (1965).—*A. pusillus* Sieb. in Berh. Batav. Genoot. **12**: 2 (1830). Fig. 1-A & B.

Japan. Kyushu. Kumamoto: Kumamoto-shi, cult., Y. Shimada 10120-B (TNS). Honshu. Hiroshima: Hiroshima-shi, cult., T. Tsuyama (TI). Tottori; Hase, N. Kinashi (KYO); Miyano-shita, N. Kinashi (KYO). Kyoto: Yase, cult., M. Hiroe 13557 (KYO). Gifu: Miyama-mura, Hara & Kurosawa (TI). Nagano: Nishiuchi-mura, S. Momose (TI). Shizuoka: Yugashima (TI); Joren-no-taki, T. Nakai (TI). Tokyo: Mt. Takao, ? cult., H. Muramatsu (TI). Fukushima: Miharu, cult. (TNS). Yamagata: Tsuruoka, cult., T. Nagasawa (TNS). Iwate: Morioka, cult., Y. Fukuda (KYO).

Var. **japonicus** M. Hotta, var nov.—*A. gramineus* Soland.; auct. japon. et Korea.

Planta sterilis. Fig. 1-C.

Korea. Cheju (Quelpaert), Taquet 2148 (KYO).

Japan. Kyushu. Kagoshima: Isl. Yaku-shima, G. Masamune (TI). Miyazaki: Mt. Kirishima (KYO). Kumamoto: Ichiumura, K. Mayebara (KYO). Fukuoka: Mt. Hiko-san, U. Faurie 93 (KYO). Nagasaki: Sakaegawa valley, F. C. Greatrex 8134 (TI); Izuhara, Tsushima, T. Yabe (TI); Isl. Iki, K. Oki (TI). Shikoku. Kochi: Hitaka-mura, G. Murata 17934 (KYO). Honshu. Yamaguchi: Miyano-mura, J. Nikai 83 (TI). Hiroshima: Hiroshima-shi, T. Tsuyama (TI). Kyoto: Takao, N. Kinashi (KYO); Hozugawa, G. Koidzumi (KYO); Mt. Kompira, M. Tagawa 410 (KYO). Shiga: Setagawa, G. Koidzumi (holotype in KYO); Mt. Ibuki, Koidzumi (KYO); Ozigahata, Murata & Fukuoka 77 (KYO). Osaka: Amami-mura, G. Murata 6100 (KYO); Katsuoji, G. Murata 19321 (KYO). Nara: Takami-mura, G. Murata 6878 (KYO). Wakayama: Oshima, Y. Tsukamoto (KYO). Nagano: Minamisaku-gun, K. Sato 1426 (TI). Shizuoka: Futamata, H. Kanai (TI); Kusanagi, J. Sugimoto (KYO); Mishima, M. Togashi (KYO). Kanagawa: Mt. Oyama, T. Sato (TI). Tokyo: Hannou, S. Okuyama (KYO). Chiba: Nanaura-mura, Nakai, Ito & Maruyama (TNS); Higashinamigaeri-mura, Y. Tamura (TI). Niigata: Kurokawa, Togashi & Yamazaki 6596 (TI). Yamagata: Yamadera, Ohashi & Yasumura 3119 (TI). Akita: Tobishima, G. Koidzumi (KYO). Fukushima: Aizu Higashiyama, K. Nemoto (TNS).

In Japan there are two forms of *A. gramineus*, i.e. (1) rather large and sterile clones (var. *japonicus*), and (2) rather small and fertile clones (var. *pusillus*). These two varieties are growing in a same small valley of Takatsuki-shi, Osaka. In this valley, the var. *pusillus* generally occurs on wet rock or crack and flowers lately (about 10 days later than the var. *japonicus*). On the largeness, the transplanting test shows that the plant sizes are herediary. Both varieties of Takatsuki have the same chromosome number, 2n=22 and 11 bivalent chromosomes in pollen mother cells.

The var. *japonicus* is similar to the typical variety of Formosa and China, but

Fig. 1. Varieties of *Acorus gramineus*: A & B, *A. gramineus* var. *pusillus* (A, cultivated clone, B, wild clone from Tottori); C, var. *japonicus* (from Kyoto); D, var. *gramineus* (from China, Kiangsi); E, var. *macrospadix* (from Thailand, Chengmai). Scale in cm.

it has completely sterile spadix. This variety is not directly related to the typical variety of southern part of our region, and is a specialized form in the north.

II. Subfamily Pothoideae

Engl. in Nova Acta ..... **39**: 140 (1876), & in Pfl.-reich **21**: 20 (1905), excl. trib. Zamioculcaseae & Acoreae.—*Monsteroideae* Engl. in Nova Acta ..... **39**: 142 (1876); Engl. & Krause in Pfl.-reich **37**: 4 (1908).—*Monoclines* Schott, Prodr. 345, excl. subtrib. *Callinae*, *Lasinae*, *Dracontioninae*, *Orontioninae* & *Acorinae*. Type: *Pothos* L.

Engler's two subfamilies, Pothoideae and Monsteroideae, were distinguished by the presence or absence of trichosclereids (Engler 1920). But these two subfamilies have many common characteristics, e.g. climbing habit (some groups), vessels in the stem (specialized groups), reticulated venation of the leaf, usually geniculated petiole, bisexual flower, etc. In the genus *Pothos*, the trichosclereids are know in three species, *P. rumphii* var. *gigantea* (Engler 1905), *P. repens* (Dan H. Nicolson, Am. J. Bot. **47**: 598-602, 1960), and *Pothos* sp. (*P. barbatus* aff., Hotta 14227). *Amydarum* and *Anadendron* of Engler's Pothoideae are very closely related to *Scindapsus-Rhaphidophora* group except the absence of the trichosclereid. From these evidences we may safely conclude that Pothoideae and Mosteroideae are closely related and placed in a subfamily.

The tribe Zamioculcaseae have much specialized compound leaves and not dissected tubers of *Amorphophallus* type. This African tribe is not closely related to *Pothos* and *Scindapsus-Rhaphidophora* group.

Pothoideae have 3 tribes in Malaysia and southern part of E. Asia.

Tribe **Potheae** Engl. in Nova Acta ..... **39**: 140 (1876); Nakai, l.c. 216, excl. *Anadendron*.—*Pothoinae* Schott Prodr. 558 (1860); Hook. f. in Benth. & Hook. f., Gen. Pl. **3**: 963 (1883). Type: *Pothos* L.

Two genera *Pothos* and *Pothoidium* had been reported from southern part of our region. Monotypic genus *Pothoidium* is closely related to the sect. *Loureiriani* of *Pothos*, except its specialized floral characters.

Pothos L. Sp. Pl. 968 (1753); Schott, Prodr. 558 (1860); Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 999 (1883); Engl. in Pfl.-reich **21**: 21 (1905), incl. syn.

Ca. 20 species; mostly trop. Asia to Malaysia, a few species in New Guinea and a species in Madagascar. One species in Taiwan.

1. **Pothos seemannii** Schott in Bonpl. 45 (1857), et Prodr. 564 (1860); Engl. in Pfl.-reich **21**: 29 (1905), cum syn.; Lui et Huang, l.c. 140—*P. warburgiana* Engl. in Engl. Bot. Jahrb. **25**: 2 (1898), et Engl. in Pfl.-reich **21**: 28 (1905). Types: *P. seemannii* Schott = Hongkong, Seemann. n. v.; *P. warburgii* Engl. = Kuanania, Formosa, Warburg 10663, n. v.

Distr. Southern China, Formosa and Okinawa (Kitadaito-jima, introduced). In Formosa, this is a common climbing aroid in lowland hill forests.

Pothos seemannii is a northern species characterized by the small plant and the globose or obovoid spadix. According to Engler, *P. warburgii* is similar to *P. seemannii*

but differs by much narrower leaves. The leaves of many specimens from Formosa show much variability in size and shape. Therefore we include *P. warburgii* in *P. seemannii*.

Potoidium Schott in Oester. Bot. Woch. **7**: 70 (1857); Hook. f. in Benth. & Hook. f., Gen. Pl. **3**: 999 (1883); Engl. in Pfl.-reich **21**: 44 (1905), cum syn.; Liu & Huang, l.c. 139.

Monotypic genus distributed in Moluccas, Celebes, Philippines and Formosa.

1. **Pothoidium lobbianum** Schott, l.c.; Engl. & Krause, l.c.; Liu & Huang, l.c. This species has recently been reported from Botel Tobago Island of Formosa.

Tribe **Monstereae** Engl. in Nov. Act ..... **39**: 143 (1876), et in DC. Monogr. Phan. **2**: 65 (1879); Engl. & Krause in Pfl.-reich **37**: 17 (1908).—*Monsterinae* Schott, Prodr. 346 (1860), p.p.—*Rhaphidophoreae* Engl. in Nov. Acta ..... 143—*Pothoeae* Engl. l.c. 140, p.p., quoad gen. *Anadendron* & *Amydarum* (*Epipremnopsis*).—*Calleae* Schott, Prodr. 345 (1860), p.p., excl. subtr. *Callinae*.—*Scindapsieae* Nakai, l.c. 216—*Rhaphidophoreae* Nakai, l.c.—*Stenospermationieae* Nakai, l.c. Type: *Monstera* Adans.

Scandent herb without laticiferous cell or duct; stem, leaf and floral parts usually with trichosclereids; leaf simple or pinnate by fenestration, primary lateral veins running subparallel from midrib to margine, secondary and tertiary veins parallel or reticulated; petiole usually with geniculum; spathe deciduous; spadix cylindrical, without appendix; flower mostly bisexual di- or tri-merous; without tepal or with reduced and connated tepals (*Anadendron*); ovule 1-many, ana- or amphitropous; seed small to large, and large seed usually without endosperm.

Rhaphidophora Hassk. in Flora **25**: 11 (1842); Schott, Prodr. 377 (1860); Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 992 (1883); Engl. & Krause in Pfl.-reich **37**: 17 (1908), cum syn.; Bakhuizen v.d. B., R. C. in Blumea, sup. **4**: 91 (1958).—*Epipremnum* Schott in Bonpl. **5**: 45 (1857); Hook. f., l.c. 993; Engl. & Krause, l.c. 54, cum syn.—*Afroraphidophora* Engl. in Engl. & Prantl, Nat. Pfl.-fam., Ergänz. **2**: 31 (1906). Type: *R. lacera* Hassk.

Monstera alliance (*Monstera* and *Stenospermatium*) of S. America and *Rhaphidophora* alliance of S. E. Asia and Malaysia are closely related to each other. These genera separated usually by characters simple but difficult to observe, namely, number of placentae and ovules, and type of placentation. The number of placentae and ovules in a ovary is much variable in some cases. Also the type of placentation is variable in some cases, e.g. from basal to parietal, and from axile to parietal placentation, by the view point of vasculary supply system of ovary. The venation type of Monstereae, parallel to reticulated, is also variable.

Bakhuizen (1958) already doubted the generic boundary among *Monstera*, *Rhaphidophora* and *Epipremnum*. He united *Rhaphidophora* and *Epipremnum*. I agree in his opinion, but I have not seen so many specimens of *Monstera* alliances of S. America. Therefore in this paper, I treat *Rhaphidophora* and *Epipremnum* as a genus.

1. **Rhaphidophora perkinsiae** Engl. in Bot. Jahrb. **37**: 115 (1905); Engl. &

Krause in Pfl.-reich **37**: 37 (1908); Liu & Huang, l.c. 141.—*R. liukiuensis* Hatusima in Acta Phytotax. Geobot. **20**: 56 (1962). Type: Ryukyu. Iriomote: Amitori, S. Hatusima 23119 (KAG).

This species was formerly reported from Philippines and recently from Botel Tobago Island of Formosa. *R. liukiuensis* has somewhat larger leaf with rounded base and smaller spathe and spadix. It seems to me that this is a northern extreme form of this species.

2. **Rhaphidophora pinnata** Schott in Bonpl. **5**: 45 (1857), et Prodr. 384 (1860).—*Epipremnum mirabile* Schott, Gen. Aroid. t. 79 (1858).—*E. pinnatum* (L.) Engl. in Pfl.-reich **37**: 60 (1908), cum syn.; Liu & Huang, l.c. 137, p.p.

Formosa. Locality unknown, T. Nagasawa (KYO).

Okinawa. Yaeyama: Iriomote, G. Koidzumi (KYO); Ishigaki, T. Yamazaki (TI); Yaeyama, Tashiro (TI); Miyako, G. Koidzumi (KYO), Y. Nakasone 19 (KYO). Okinawa: Tashiro (TI); Shuri, Z. Tashiro (KYO). Kerama: Kumeshima, H. Kuroiwa (KYO).

Distr. Widely distributed from S. E. Asia to Polynesia.

3. **Rhaphidophora formosana** (Hayata) M. Hotta, comb. nov.—*Epipremnum formosanum* Hayata, Ic. Pl. For. **5**: 239 (1916); Liu & Huang, l.c. Type: Funkiko, B. Hayata (holotype in TI).—*E. pinnatum* sensu Liu & Huang, l.c., p.p. non Engl.

Formosa. Koshun, E. Matsuoka (KYO), I. Sasaki T-362 (TI); Senpei, S. Okamoto (KYO); Urai~Rimogan, M. Tagawa 289 (KYO); Bankinsing, U. Faurie 960 (KYO); T. Nagasawa (KYO); Hoshie tract, Nanto Co, T. C. Huang 2023 (TI); Musha, 4000 ft., B. Hayata (TI); Mt. Kappanzan, T. Sato 401 (TI); Mt. Taihei, Y. Yamamoto (TI); Taihoku, T. Makino (TI); Nanko, Dec. 30, 1897 (TI).

This species is closely related to *R. pinnata*, but easily distinguishable from it by the narrower leaf with the acute segments and the acute leaf base. *R. pinnata* is distributed usually in lowlands and *R. formosana* in mountains of Formosa.

III. Subfamily Lasioideae

Engl. in Nov. Acta Nat. Cur. **39**: 144 (1876), et. in Pfl.-reich **48**: 1 (1911).—*Pythonieae* Schott, Prodr. 122 (1860).—*Pothoideae* Engl. in Nov. Acta Nat. Cur. **39**: 140 (1876) p.p., quoad *Symplocarpeae* & *Zamioculcaseae*.—*Calloideae* Engl. in Engl. & Prantl, Pfl.-fam. **2** (3): 112 (1889); Krause in Pfl.-reich **37**: 140 (1911), p.p., quoad *Symplocarpeae*. Type: *Lasia* Lour.

Terrestrial rhizomatous or caulescent or tuberous herbs; lacking trichosclereid and vessel in the stem; laticiferous cells present or absent (*Zamioculaseae* and *Symplocarpeae* except *Orontium*). Leaf simple ovate to sagittate, or compound; commissural veins usually much reticulated; flowers bisexual or unisexual; bisexual flowers with usually 4 tepals, and 4 stamens with extrorse anthers; unisexual flowers usually without tepals (except Zamioculcaseae); stamens free or connate; ovary with 1-3 loculi, septa usually well differentiated; fruits juicy or coriaceus and rupturing; seed usually without endosperms.

Lysichitum, *Symplocarpus*, *Orontium* and *Calla* have many problems concerning

their phylogeny. They have primitive morphological characters, i.e. not specialized leaf (except *Calla*), bisexual flowers, etc. In 1876, Engler put the tribe Syplocarpeae in the Pothoideae. Afterward he proposed Calloideae including two tribes, Calleae and Syplocarpeae, basing on the elongate laticiferous cells, simple leaves never sagittate, and terrestrial and paludose habit. But *Lysichitum* and *Symplocarpus* have no laticiferous cells (Rosendahl 1909). These two tribes differ each other on many characters, i.e. leaf venation, petiolar type, floral anatomy, nutrition type of seed, chromosome number, etc.

Symplocarpeae is a specialized group adapted to the temperate regions. Except the specialized floral characters and lacking of laticiferous cells, this tribe is related to *Lasia-Amorphophallus* group by the reticulate fine structure of leaf venation, exalbuminous seeds, septa of ovary, etc.

Tribe **Symplocarpeae** Engl. in Nov. Act. Nat. Cur. **39**: 141 (1876).—*Orontieae* R. Br.; Schott, Prodr. 398 (1860), p.p.; Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 962 (1883), quoad Orontioninae & *Symplocarpus*. Type: *Symplocarpus* Salisb.

Lysichitum Schott in Öst. Bot. Woch. **3**: 62 (1857); Krause in Pfl.-reich **37**: 148 (1908), cum syn.—*Arctiodracon* A. Gray in Mem. Am. Acad. ser. 2, **6**: 408 (1858-59). Type: *L. camtschatcense* (L.) Schott.

1. **Lysichitum camtschatcense** (L.) Schott in Öst. Bot. Woch. **3**: 62 (1857); Krause, l.c. 148 (1908), excl. specim. ex Nordam.; T. Koyama in Ohwi, Fl. Jap. 263 (1965).—*Dracontium camtschatcense* L. Sp. Pl. 968 (1753).—*Lysichitum japonicum* Schott ex Miq. Cat. Mus. Bot. Lugd. Bat. 96 (1870).—*Arctiodracon japonicum* A. Gray, l.c. 408 (1858-59). Fig. 2.

Distr. Kamchatka, Kuriles, Ussuri, Sakhalin, Hokkaido, and northern and central Honshu (generally in the Japan Sea side).

Habitat. In open swamps or swamps in scattered forests, usually forming large colonies.

Symplocarpus Salisb. ex Nuttall, Gen. N. Am. Pl. **1**: 105 (1818), nom, consv.; Krause, l.c. 150 (1908), cum syn.—*Spathyema* Raf. in Med. Repos. New York **5**: 352 (1808), nom. rejec. Type: *S. foetidus* (L.) Nutt. (*Dracontium foetidum* L.).

Key to the Species

1. Leaves opening at or after anthesis (spring); fruit ripening in the flowering year; leaf large with cordate lamina ..... *S. foetidus* var. *latissimus*
1. Leaves opening before anthesis (summer), and nearly withered at anthesis; fruit ripening next year (spring to summer); leaf small with usually ovate-elliptic lamina ..... *S. nipponicus*

1. **Symplocarpus foetidus** (L.) Salisb. ex Nutt. Gen. N. Am. Pl. **1**: 105 (1818).

Var. **latissimus** (Makino) Hara in Jour. Jap. Bot. **17**: 638, fig. 53 (1941), cum syn. Type: Iwasaki, H. Hara (TI, holotype).—*S. renifolius* Schott ex Miq. in Ann. Mus. Lugd. Bat. **2**: 202 (1866), nom. nud.; T. Koyama, l.c. 263 (1965).—*Spathyema*

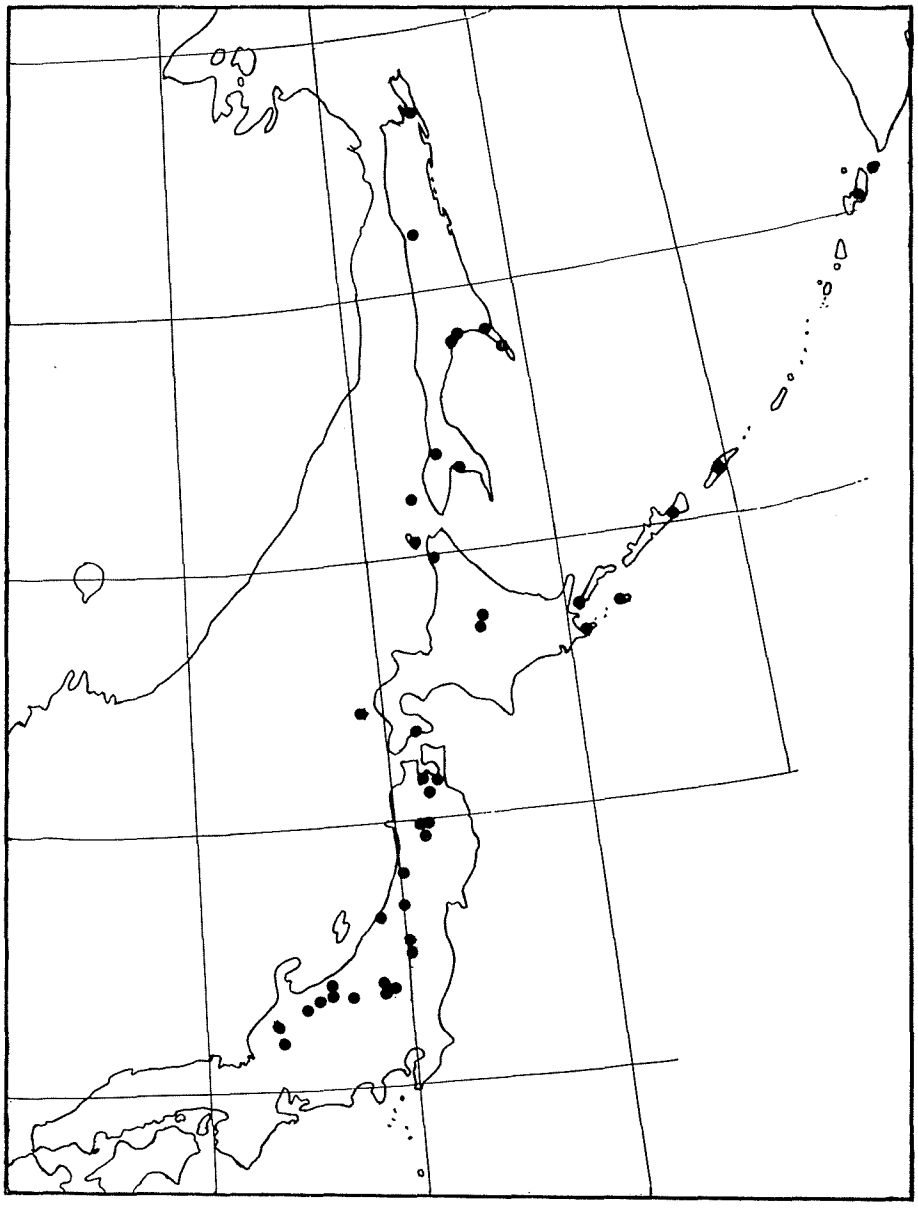

Fig. 2. Geographical distribution of *Lysichitum camtschatcense.*

foetida Raf. forma *latissima* Makino in Zissai Engei **26**: 574 (1940), pro. syn., nom. sub-nud.—*Symplocarpus foetidus* Nutt. forma *latissimus* Makino, l.c., et Ill. Pl. Jap. 810, t. 3237.

Distr. Amur, Sakhalin, S. Kuriles, Hokkaido, Honshu and Korea. The Korea specimens are sterile, and have large cordate leaves. The identification of these sterile specimens is uncertain.

Habitat. in moist floors of light temperate forest, in open humid places, or in humid edges of forest, rarely growing in dense *Cryptomeria* forest or in *Pinus pumila* thickets.

2. **Symplocarpus nipponicus** Makino in Jour. Jap. Bot. **5**: 24 (1928), et Ill. Pl. Jap. 810, t. 3238; Nakai in Ic. Pl. As. Or. **4**: 307, pl. 105 (1941), cum syn.; T. Koyama, l.c. 264 (1965). Type: Shimotsuke, H. Sekimoto (not found in TI & MAK).—*Spathyema nipponica* (Makino) Makino in Jour. Jap. Bot. **6**: 33 (1929).

Hokkaido. Kushiro: Akkeshi, T. Tsuji (SAPA). Ishikari: Sapporo, C. Sudo (SAPA); Hokudai Nojo, K. Saito (SAPA). Shiribeshi: Tomarikawa, Misumi & Igarashi (SAPA).

Honshu. Aomori: Kouji-mura, Kudo, excl. flowers with spathe (KYO). Akita: Kaniba-onsen, H. Hara (TI); Akita-si, S. Muramatsu (April with fruits, June with fruits and flowers, TI); Kamikawaharu-mura, M. Matsuda (TI); Odate-shi, M. Matsuda (April & May, TI); Akita-shi, M. Matsuda (TI). Iwate: Sakuragawa-mura, H. Iwabuchi, photo. (TI). Niigata: Kurokawa, 50 m, Togashi & Yamazaki 6734 (TI). Fukushima: Nishishirakawa, N. Imai 7 (KYO). Tochigi: Ochiai-mura, H. Sekimoto (TI, KYO); Fubasami, T. Nakai (TI), F. Maekawa 86-966 (TI); Tochigi-shi, Y. Furuse (TI); Kogashi, H. Sekimoto (TI), T. Yamazaki (TI); Fubasami, T. Makino (in 1938 & 1940, MAK); Mt. Shikano, T. Makino (MAK); Oya, M. Nakamura (TNS). Gunma: Mt. Shibutsu, M. Mizushima (TI). Tokyo: Kiyose, T. Yamazaki (TI). Nagano: Suwa, H. Tobita 49 (TI), 50 (KYO); Minamisaku, K. Sato 1529 (TI); Kamikochi, T. Nakai (TI); Sugadaira, Y. Ibaraki (TNS), T. Yano (TNS); Noziriko, J. Yoshikawa 3854 (TNS). Fukui: Tsuruga, Z. Tashiro (TI, TNS, KYO); Kitamaekawa, no. 3 (KYO). Kyoto: Hanase, Z. Tashiro (KYO); Ofuse, M. Togashi (KYO), Togashi 7344 (TI); Ohara, M. Hiroe 16886 (KYO); Ashiu, M. Hotta 15709 (KYO, chromosome number 2n=28); Mt. Daihi, M. Hotta 11260 (KYO). Hiroshima: Yuki, I. Maruyama (TI). Shimane: Miino, I. Maruyama (May & June, KYO); Fusemura (TNS).

Korea. Kangwen: Mt. Ote, I. Kashimura (TI); Mt. Kumkang, T. Nakai (TI). S. Pyengang: Uangtok, T. Nakai 12481 (TI). S. Hamgyeng: Wonsan, T. Nakai (TI). N. Hamgyeng: Ranan, R. Saito 900-B (KYO), R. Saito (KYO).

Distr. Hokkaido, Honshu and Korea.

Habitat. Moist floors and edges of deciduous forests or moist open places of road sides.

Two species of *Symplocarpus* are growing side by side in some places but they are usually distinctly different each other by flowering and fruiting seasons (Sekimoto, H. 1929. Jour. Jap. Bot. **6**: 319).

Tribe **Amorphophalleae** Engl. in Nov. Acta Nat. Cur. **39**: 144 (1876).—*Pythonieae* Schott, Prodr. 122 (1860); Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 958 (1883).—*Lasieae* Engl. l.c. 144, p.p., quoad *Enchidonium* & *Dracontium*.—*Dracontioninae* Schott Prodr. 416 (1860), excl. *Symplocarpus*. Type: *Amorphophallus* Bl. ex Decne.

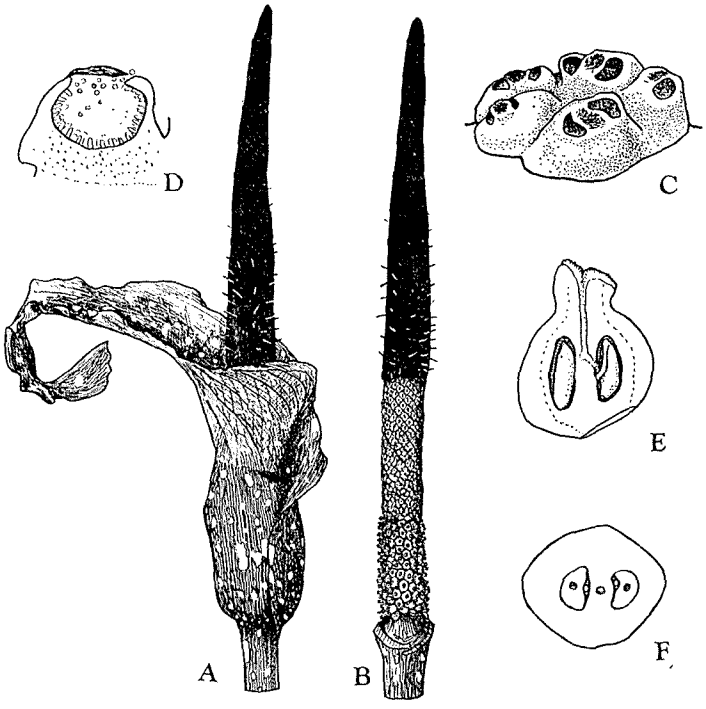

Fig. 3. *Amorphophallus hirtus* var. *kiusianus*. A & B, Spathe and spadix, x ca. 1/2; C & D, Male flowers; E & F, Section of ovaries.

Amorphophallus Bl. ex Decne. Herb. Timor. 38 (1835), nom. consv; Bl. in Rumphia **1**: 139 (1835); Engl. in Pfl.-reich **48**: 75 (1911), cum syn.—*Pythion* Mart. in Flora **14**: 459 (1831), nom. rejec. Type: *A. campanulatum* (Roxb.) Bl. ex Dec. (=*Arum campanulatum* Roxb.). About 80 species mostly Old World tropics and subtropics of rather dry regions. One species distributed to southern Japan.

1. **Amorphophallus rex** Prain ex Hook. f. Fl. Br. Ind. **6**: 514 (1893); Engl. in Pfl.-reich **48**: 75 (1911).—*A. gigantiflorus* Hayata, Ic. Pl. Form. **6**: 101 (1916); Liu & Huang in Quart. Jour. Taiwan Mus. **16**: 130 (1963), syn. nov. Types: *A. rex* Hook. f.=Narcondam Isls, Andaman, Prain, n.v.; *A. gigartiflora* Hayata=Kareikosho, S. Yuki (small female inflorescence and 3 figures in TI).

Taiwan. Kaoshun: Kuraru (TI).

Distr. Himalayas, S. Asia and Malaysia.
This species might be introduced to Taiwan for a staple food plant.

2. **Amorphophallus hirtus** N. E. Brown in Jour. Linn. Soc. Bot. **36**: 181 (1903).

Key to the Varieties

1. Appendix covered with many long hairs ..... var. *hirtus*
1. Appendix glabrous or with a few hairs ..... var. *kiushianus*

Var. **hirtus.**—*A. hirtus* N. E. Brown; Engl. in Pfl.-reich **48**: 67 (1911); Yamamoto in Jour. Trop. Agr. **5**: 346 (1933); Liu & Huang, l.c. 130. Type: Ape's hill, Takao, Formosa, Henry 1914 (K, fig. in TI).—*A. niimurai* Yamamoto, l.c. 346; Liu & Huang, l.c.

Formosa. Koshun: Koshun, T. Kawakami (TI); Ryusensui (TI); Kusukusu (TI).

Var. **kiusianus** (Makino) M. Hotta, comb. nov.—*A. konjac* Koch var. *kiusiana* Makino in Bot. Mag. Tokyo **25**: 16 (1911).—*A. kiusiana* (Makino) Makino in Bot. Mag. Tokyo **27**: 244, fig. 5 (1913); Kitam. in Kitam. et al. l.c. 194, pl. 50-321, t. 132; T. Koyama, l.c. 255.—*A. henryi* N. E. Br. in Jour. Linn. Soc. Bot. **36**: 181 (1903); Engl., l.c. 93; Liu & Huang, l.c. Types: *A. konjac* Koch var. *kiusianus* Makino= Shiroyama, Kagoshima, T. Uchiyama (lectotype in TI); *A. henryi* N. E. Br.=Ape's hill, Kaoshun, *A. Henry* 776 (K, fig. in TI).

Distr. Formosa, Amami-Oshima and southern part of Kyushu incl. Isl. Yaku & Tanega-shima, Shikoku (Kochi: Ioki-mura, cult. in Kyoto, M. Tagawa (KYO)). Moist floors of evergreen forest, not so common.

Engler proposed monotypic section Dysamorphophallus (1911) based on *A. hirtus* by its hairy appendix of the spadix. But *A. hirtus*, *A. henryi* and *A. kiusianus* are very closely related to each other except hairiness of appendix. *A. kiusianus* grows well and reproduces by seeds in the Botanical Gardens of Kyoto University. In these of the garden the hairiness of appendix is much variable from glabrous to hairy (usually 10-20 hairs). In the line-drawings of type specimen (in TI), *A. hirtus* and *A. henryi* are distinguishable only by the hairiness of appendix. The intermediate form between the two species is reported from Formosa as *A. niimurai*. All these species have usually linear-oblong leaf segments, the spathe acute at the apex, convolute at the base, and verrucose inside and the long spadix with long conical appendix. Type specimens of *A. henryi* and A. *hirtus* were collected at the same locality. Therefore, the two extreme forms are trated as two varieties in this paper.

3. **Amorphophallus konjac** C. Koch in Ber. Allg. Gartenz. 188 (1858); T. Otsuki in Jour. Jap. Bot. **7**: 76 (1930); T. Makino, l.c. 810, t. 3240; T. Koyama, l.c. 255.—*A. rivieri* Durieu var. *konjac* (C. Koch) Engl. l.c. 85 (1911), cum syn.—*A. rivieri* Durieu in Cat. des Graines du Jard. 12 (1869); Engl. l.c., cum syn.

Distr. Indochina, Southern China & ? Philippines, cultivated for food (used for mannan powder) in Japan, rarely naturalized.

IV. Subfamily Philodendroideae

Engl. in Nov. Acta Nat. Cur. **39**: 146 (1876).—*Colocasioideae* Engl., l.c. 148.—*Calloideae* Engl. in Engl. & Prantl, Pfl.-fam. **2**(3): 112 (1889), excl. *Symplocarpeae*.—*Pachyzeugmaticae* Schott, Prodr. 135 (1860), incl. *Caladinae*, *Philodendreae*, *Richardieae*, & *Asterostigmeae*. Type: *Philodendron* Schott.

This subfamily is characterized by the laticiferous cells or ducts, the specialized parallel venation or the reticulate venation derived from the modification of the parallel venation, usually erect or decumbent stems, and the unisexual flowers usually without tepals.

The difference between Engler's Philodendroideae and Colocasioideae are not clear morphologically.

Schott (1860) described tribe Calleae including *Calla* together with many genera which have bisexual flowers without tepals, i.e. *Monstera*, *Rhaphidophora*, *Scindapsus*, etc. Engler's Calloideae include *Calla* together with *Symplocarpus*, *Lysichitum* and *Orontium*. *Calla*, nevertheless, distinctly differs from other genera mentioned above. This genus is characterized by the parallel venation of leaves, the free ligule of petiolar vagina, the laticiferous elongated cell or ducts, the bisexual flower with basal placentation, and the albuminous small seeds. This genus is closely related to Philodendroideae (sensu Engler) by the character mentioned above.

In the tribe, Philodendreae, Engler described 3 subtribes, e.g. Homalomeninae, Schismatoglottidinae and Philodendrinae. Also Schott's Philodendreae included 7 subtribes. Philodendreae are very large and much variable tropical group having enormorous morphological variations in the floral and vegetative characters. The phylogeny and natural classification of this large group is still unsorbed problems.

Tribe **Calleae** Schott Prodr. 345 (1860), excl. *Monsterinae*; Engl. Nov. Acta..... **39**: 141 (1876); Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 961 (1883), quoad *Calla*.—Callinae Schott, l.c. Type: *Calla* L., monotypic.

Calla L. Sp. Pl. 968 (1753); Schott, Prodr. 345 (1860); Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 989 (1883); Krause in Pfl.-reich **37**: 145 (1908), cum syn.

One species widely distributed in cold temperate or frigid zones of the N. Hemisphere.

1. **Calla palustris** L. Sp. Pl. 968 (1753); Krause, l.c. 154 (1908), cum. syn.; T. Koyama, l.c. 263 (1965).

Distr. In Eastern Asia: Sakhalin, Hokkaido, and northern part of Honshu (Mt. Yakeishi, Iwate and Higashitori-mura, Aomori), also in northern Korea. Standing in water or in swampy grass land from sea-level up to 1300 m in Hokkaido.

Tribe **Homalomeneae**, stat. nov.—*Homalomeninae* Schott, Prodr. 307 (1860), excl. *Zantedeschia*; Engl. Nov. Acta ..... **39**: 147 (1876), & Engl. & Krause in Pfl.-reich **55**: 24 (1912).—*Philodendreae* Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 959 (1883), p.p., quoad *Homalomena* & *Chamaecladon*.—*Richardieae* Hutchinson, Fam. Fl. Pl. 630 (1959), p.p., quoad *Homalomena*. Type: *Homalomena* Schott.

Homalomena Schott, Melet **1**: 20 (1832), et Prodr. 308 (1860); Engl., l.c. 25 (1912), incl. syn.

About 80 species distributed from India to New Guinea and a few species occur in tropical America; only one species reported from northern Formosa.

1. **Homalomena aromatica** (Roxb.) Schott, Melet. **1**: 20 (1832); Engl. l.c. 59 (1912).—*Calla aromatica* Roxb. Fl. Ind. **3**: 513 (1832).—*Homalomena kelungensis* Hayata, Ic. Pl. Form. **8**: 135 (1919); Liu & Huang, l.c. 138 (1963). Type: *H. kelungensis* Hayata=Kelung, Formosa, B. Hayata (TI, holotype and 2-isotypes).

H. kelungensis collected once in northern end of Formosa. By its oblong spathe without middle constriction, this species belong to the sect. *Homalomena*, and in spite of being a little smaller, this species is very similar to *H. aromatica* of wide distribution.

Tribe **Schismatoglottineae,** stat. nov.—*Schismatoglottidinae* Schott, Prodr. 318 (1860); Engl. l.c. 24 (1912).—*Philodendreae* Hook. f. in Benth. & Hook. f. Gen. Pl. **3**: 959 (1883), p.p.—*Richardieae* Hutchinson, l.c. 630, p.p. Type: *Schismatoglottis* Zoll. et Moritzi.

This tribe well differentiated in Malaysia.

Schismatoglottis Zoll. et Moritzi. Verz. Java 1842-44 ges. Pfg. 83 (1846); Schott, Prodr. 320 (1860); Engl. in Pfl.-reich **55**: 82 (1912), cum syn.

Only one species is cultivated in southern Formosa.

1. **Schismatoglottis calyptrata** (Roxb.) Zoll. et Moritzi, l.c. 83; Engl. l.c. 114.—*Calla calyptrata* Roxb. Fl. Ind. **3**: 514 (1832)=*Arisarum esculenta* Rumph. Herb. Amb. **5**: t. 111 (1747).—*Colocasia kotoensis* Hayata, Ic. Pl. Form. **5**: 247 (1915); Liu & Huang in Quart. Jour. Taiwan Mus. **16**: 136 (1963), syn. nov. Type: Botel Tobago Island, Kawakami (holotype in TI).

The holotype of *C. kotoensis* is a form of *S. calyptrata*, occasionally cultivated for a staple food from India to Malaysia.

Tribe **Colocasieae** Engl. in Engl. & Prantl, Pfl.-fam. **2** (3): 137 (1887-89); Engl. & Krause in Pfl.-reich **71**: 10 (1920), incl. syn.—*Caladieae* Schott, Prodr. 135 (1860), excl. *Peltandra*, *Anubias*, *Typhonodorum*, *Syngonium*, & *Zamioculcas*. Type: *Colocasia* Schott.

Seven genera in southern Asia and Malaysia, and 5 genera mainly in tropical America. *Remusatia* with one species and *Alocasia* with two species in the southern part of our region. *Colocasia esculenta* is widely cultivated in our country.

Remusatia Schott in Melet. **1**: 18 (1832); Krause in Engl. & Krause, l.c. 16 (1920), cum syn.

Only one species reported from the mountain area of Formosa.

1. **Remusatia formosana** Hayata, Ic. Pl. Form. **8**: 136 (1919); Liu & Huang, l.c. 141 (1963). Type: Keitao, May 1916 (holotype in TI).

Formosa. Mt. Chorinsan, G. Nakahara (TI); Hori-sha, T. Kawakami (TI).

This species is very similar to Himalayan *R. vivipara*. The reliable specific study is impossible because of the poor condition of our specimens.

Colocasia Schott in Melet. **1**: 18 (1832), & Prodr. 137 (1860); Krause, in Engl. & Krause, l.c. 62 (1920), cum syn.—*Leucocasia* Schott in Öster. Bot. Woch. **7**: 34 (1857); Nakai in Bull. Nat. Sci. Mus. Tokyo **31**: 127 (1952).

Two species are cultivated in our country.

1. **Colocasia esculenta** Schott, l.c.; Kitamura in Acta Phytotax. Geobot. **14**: 6 (1949). See for the synonyms under the varieties.

This species is very widely cultivated throughout tropics and many wild or naturalized clones found in S. Asia, Malaysia and the Pacific Islands. The spathes, spadices and appendages varies considerably (Fig. 4, A & H). Many cultivated clones been observed about the floral organs. Therefore infraspecific classification of this have not polymorphic species is still uncertain. I have accepted the wide conception of *C. esculenta* Schott as proposed by Kitamura (l.c.). His formae, however, have been changed to the rank of cultivar. Krause also described 7 varieties based mainly on the cultivated clones. Most of them also reduced to the rank of cultivar. Bailey recognized two species of cultivated taro by the form of the appendage: *C. esculenta* with short appendages, and *C. antiquorum* with long appendages. These two extreme forms seem to be quite different. There is, however, many intermediate types.

Three endemic species, *C. formosana* Hayata, *C. konishii* Hayata, and *C. keitaoensis* Hayata, were reported from Formosa. They are undoubtedly cultivated or naturalized forms of *C. esculenta*.

Key to the Varieties and Cultivar Groups

1. Plants with long stolons; appendage of the spadix long; diploids; mostly wild or naturalized, a few cultivated in tropics ..... Var. *aquatilis*
1. Plants without stolons; appendages various; diploids or triploids; mostly cultivated ..... Var. *esculenta*
  2. Chromosome number 2n=28 (diploids); lateral tuber with normal leaves; appendages short (?) 3
    3. Plants large; main tuber large; lateral tuber not so many; mostly cultivated in tropics ..... Cv. group *esculenta*
    3. Plants small; main tuber as small as the laterals; mostly cultivated in warm temperature areas ..... Cv. group *senkuchi*
  2. Chromosome number 2n=42 (triploids) or unknown; lateral tubers often without normal leaves or with a few ones; appendages short or long 4
    4. Main tuber long and erect partly epigaeous ..... Cv. group *longa*
    4. Main tuber hypogaeous 5
      5. Plants very large, often 1-1.8 m high; lateral tubers often with a few normal leaves ..... Cv. group *mikashiki*

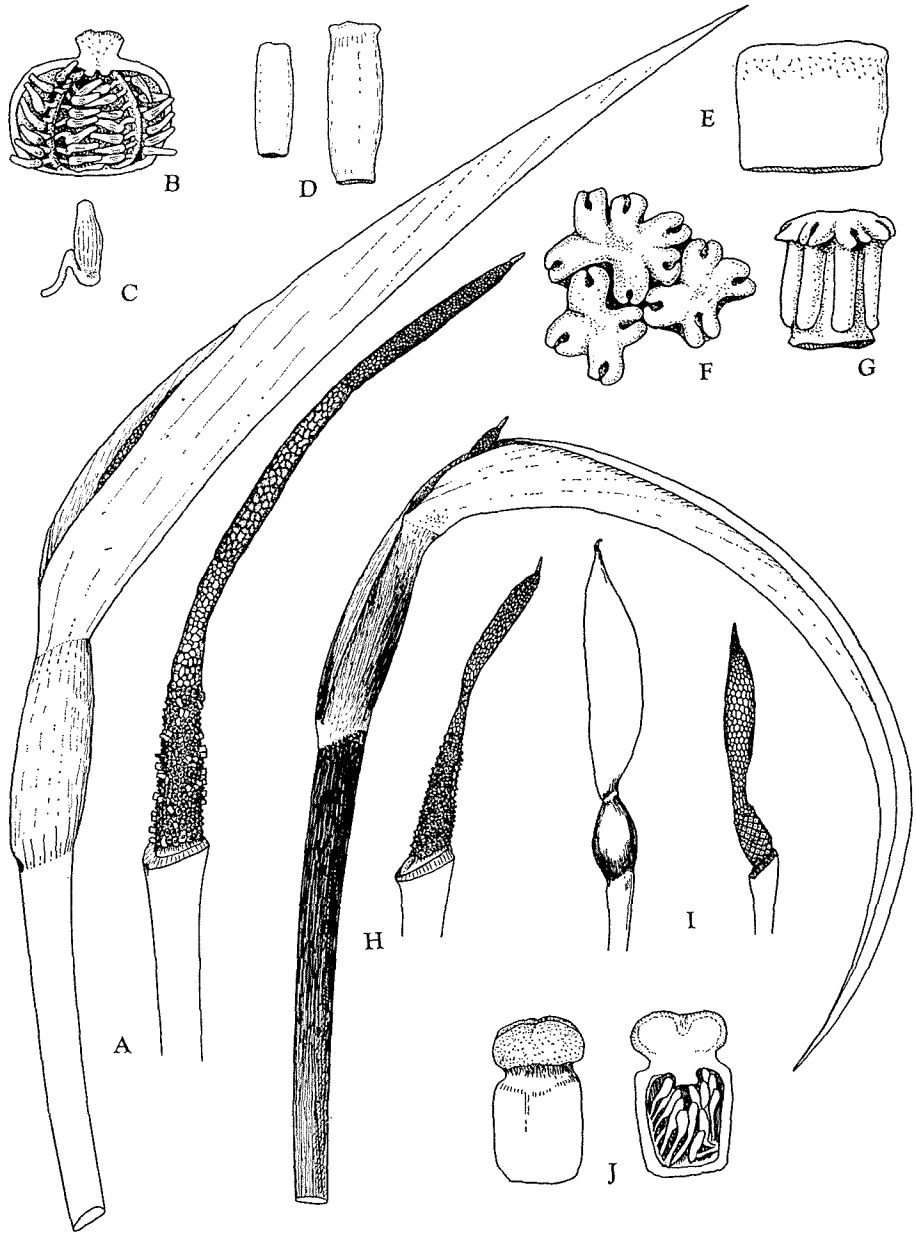

Fig. 4. *Colocasia*. A-H, *C. esculenta*. A-G, cl. *Eguimo*, triploid; A, spathe and spadix; B, ovary; C, ovule; D, staminod in female part of inflorescence; E, abortive ovary; F, front view of male flower; G, side view of male flower; H, (cl. *Vavai*, native of Fiji, diploid), spathe and spadix; I & J; *C. gigantea* var. *esculenta* (cl. *Hasuimo*, diploid); I, spathe and spadix; J, ovaries (A, H, I, ×1/2; B, D, E, F, G, J, ×15; C, ×40).

5. Plants usually 60–120 cm high; lateral tuber usually with scaly leaves..... ..... Cv. group *koimo*

var. **aquatilis** (Hassk.) Kitamura in Acta Phytotax. Geobot. **14**: 7 (1949).—*C. antiquorum* Schott var. *aquatilis* Hassk. Pl. Jav. Rariores 150 (1848).—*Caladium nymphaeifolium* Vent. Hort. Celes 30 (1826).—*Colocasia nymphaeifolia* (Vent.) Kunth, Enum. Pl. **3**: 37 (1840).—*Arum nymphaeifolium* Roxb. Fl. Ind. **3**: 495 (1832); Wight, Ic. **3**: t. 786 (1844).—*C. antiquorum* Schott var. *nymphaeifolia* (Vent.) Engl. in DC. Monogr. Phan. **2**: 492 (1879).—*C. antiquorum* Schott var. *euchlora* (C. Koch) Schott, Syn. Aroid. 42 (1856); Krause in Engl. & Krause, l.c. 67 (1920).

Ryukyu. Okinawa: Yonahadake, T. Yamazaki 196 (TI); Unten & Goetsu, cult. in Misato, Tawada 838 (KYO).

Wild plants and primitive cultivated varieties belong to this variety. In Okinawa, a naturalized form occurs on riverbanks, or along marshes.

var. **esculenta.**—*C. esculenta* Schott, l.c.; Kitamura, l.c.—*Arum esculentum* L. Sp. Pl. 965 (1753).=*Caladium aquatilis* Rumph. Herb. Amb. **5**: 318, t. 110 (1747).—*C. antiquorum* Schott var. *esculenta* (L.) Schott, Syn. Aroid. 41 (1856); Krause, l.c. 67 (1920).—*Arum colocasia* L. Sp. Pl. 965 (1753).=*Arum aegypticum* Rumph. l.c. 317, t. 109.—*C. antiquorum* Schott in Melet. **1**: 18 (1832), et Prodr. 138 (1860); Krause, l.c. 65 (1920), cum var. *typica*, var. *fontanesii*, var. *illustris*, var. *esculenta*, var. *globlifera*, et var. *acris*. See for the synonyms also under the cultivar groups.

Cultivar group **esculenta.**—*Arum esculentum* L.; *Arum colocasia* L.; *C. antiquorum* Schott var. *illustris* (Bull) Engl.; *C. antiquorum* Schott var. *globrifera* Engl. et Krause, excl. type, p.p.; *C. esculenta* Schott forma *patens* Makino. Fig. 4-H.

This group is widely cultivated in tropical countries from S. E. Asia to the Pacific Islands for its starchy main tubers and the leaves used for vegetables (a few varieties). In Japan it is cultivated in rather warmer part.

Cultivar group **senkuchi.**—*C. esculenta* Schott forma *oyasetage* et forma *yatsugashira* Makino.

Only a few cultivated varieties known from Japan: *Oyasetage*, *Yatsugashira*, *Aosenkuchi* (*Mizuimo* in Okinawa), and *Akasenkuchi*.

Cultivar group **longa.**—*C. esculenta* Schott forma *longa* Kitam.

A cultivated variety in Japan, rather recently introduced from Formosa: *Taiwanimo* (*Takenokoimo*).

Cultivar group **mikashiki.**—? *C. violacea* Hort. ex Hook f.—*C. esculenta* Schott forma *rosea* Makino, p.p.

A cultivated variety recognized in Japan: *Mikashiki*.

Cultivar group **koimo.**—*C. antiquorum* Schott var. *globulifera* Engl. & Krause; *C. antiquorum* Schott var. *typica* Engl., p.p.; *C. esculenta* forma *toonoimo*, forma *eguimo*, forma *rosea*, p.p., forma *rotundifolia* et forma *taimo* Makino; *C. esculenta* Schott forma *marginata*, forma *atropurpurea*, et forma *onnawase* Kitamura; *C. rosea* Nakai. Fig. 4-A~G

Many cultivated varieties for their starchy small lateral tubers, are known

from the temperate Asia (China & Japan): *Tsuchiimo* (*Taimo*), *Tounoimo*, *Ebiimo*, *Eguimo*, *Tsurunoko*, *Hasuimo*, etc.

2. **Colocasia gigantea** Hook. f. Fl. Br. Ind. **6**: 524 (1893); Makino in Bot. Mag. Tokyo **9**: 262 (1895); M. Hotta in Acta Phytotax. Geobot. **20**: 157 (1962).—*Leucocasia gigantea* Schott in Öster. Bot. Woch. 34 (1857).—*L. esculenta* Nakai in Bull. Nat. Sci. Mus. Tokyo **31**: 127 (1952), et l.c. 33: 27 (1953).

Cultivated for the edible petioles in warmer part of Japan: *Hasuimo* (*Shiroimo*, *Higozuiki*).

L. esculenta Nakai was described from the cultivated plant of Japan. Except its smallness of all parts (leaves, spadix, and spathe) this species has no specific distinction against *C. gigantea* of Malaya.

Alocasia Neck. Elem. **3**: 289 (1790); Schott, Prodr. 144 (1860); Krause, l.c. 71 (1920), cum syn.; T. Koyama, l.c. 262.

About 50 species known from tropical Asia, Malaysia and New Guinea, and *A. macrorrhiza* is naturalized in Australia and the Pacific Islands. Two species in the southern part of our region.

1. **Alocasia cucullata** (Lour.) Schott in Öster. Bot. Woch. 410 (1854), et Prodr. 156 (1860); Hook. f. Fl. Br. Ind. **6**: 525 (1893); Krause, l.c. 77, f. 12 (1920); Liu & Huang, l.c. 128 (1963).—*Arum cucullatum* Lour. Fl. Cochinch. 656 (1793); Wight, Ic. **3**: t. 787 (1844).

Formosa. Shohachiri, Taihoku, Shimada (TI); Kaizan-kou, T. Makino (TI).

Ryukyu. Okinawa: Naha (KYO).

Kyushu. Kagoshima: Amami Oshima, Y. Ikuma 268 (TNS).

Distr. From India to southern Japan.

By the observations of the herbarium specimens and living plants in the botanic gardens, the plants of our region have abnormal female flowers without ovules. The stem branches so many at the upper part, and seems to be an abnormal form. This species is closely related to *A. odora* by the nearly same leaf texture. By the leaf shape and the course of primary lateral veins, *A. cucullata* distinctly differs from *A. odora* in adult stage, but the seedling leaves of the latter have similar shapes and vein systems to the former.

2. **Alocasia odora** (Roxb.) C. Koch in Ind. Sem. Hort. Berol. App. 5 (1854); Krause, l.c. 90 (1920).—*Arum odorum* Roxb. Hort. Bengl. 764 (1814); Wight, l.c. **3**: t. 797 (1844).—*Alocasia tonkinensis* Engl. in Engl. & Krause, l.c. 91 (1920).—*A. macrorrhiza* sensu auct. jap. et form., non Schott.—*Colocasia antiquorum* Schott var. *typica* Engl. l.c. 66 (1920), p.p., quoad specim. ex Formosa (*Faurie* 524).

By the concave spathe, and the slightly peltate leaf, this species differs from *A. macrorrhiza* of the tropics. The range of *A. odora* is limited to subtropical and warm temperate regions of India, Indochina, southern China, Formosa and southern Japan.

Recently *A. okinawensis* Tawada (Bot. Mag. Okinawa **2**: 28, 1965) was described

from Ryukyu. This species have leaf characters intermediate between *A. odora* and *A. cucullata*. The relationships among those three species are as yet not clear.

Subfamily Aroideae

Engl. in Nov. Acta Nat. Cur. 39: 150 (1876), et Pfl.-reich **71**: 28 (1920).

This large subfamily is represented by only 3 genera occur in our region, i.e. *Typhonium*, *Pinellia*, and *Arisaema*, all belonging to the tribe Areae.

Typhonium Schott in Wien. Zeitscher. **3**: 72 (1829), et Prodr. 105 (1860); Engl. l.c. 108 (1920), incl. syn.—*Arum* L. Sp. Pl. 965 (1753), p.p., excl. typus.—*Heterostalis* Schott in Öster. Bot. Woch. **7**: 261 (1859). Type: *T. trilobatum* Schott.

Only a species known from the southern part of our region.

1. **Typhonium divaricatum** (L.) Decne. in Ann. Nat. Hist. **3**: 367 (1834); Bl. in Rumphia **1**: 130, t. 36 (1835); Wight, Ic. **3**: t. 790 (1844); Schott Prodr. 106 (1860); Engl. l.c. 115 (1920); Liu & Huang, l.c. 142 (1963); Kitamura in Kitam. et al. Col. Ill. Herb. Pl. Jap. **3**: 195, pl. 50-322 (1964); T. Koyama, l.c. 262.—*Arum divaricatum* L. Sp. Pl. 966 (1753).—*Arum trilobatum* Thunb. Fl. Jap. 234 (1784).

Formosa. Taiwan, S. Nagasawa (KYO); Taipei, S. Yanao 491 (TI); Taihoku, Nose (TI).

Ryukyu. Yonakuni: G. Koidzumi (KYO). Miyako: Y. Nakasone (KYO). Okinawa: Kunigami, S. Tanaka (TI), S. Sonohara (KYO), cult. in Tokyo, M. Ogata (TI); Nago, T. Kanashiro 499 (KYO); Shimajiri, Walker & Sawada 6895 (KYO); Shuri, Sakaguchi (KYO).

Kyushu. Kagoshima: Naze~Yamato, Amami, G. Koidzumi (KYO); Naze, U. Faurie 4277 (KYO); Kuji~Yuwan, Amami, G. Koidzumi (KYO); Kagoshima, Y. Nakano (KYO); Kazimi, S. Hino (KYO); Yamakawa, Z. Tashiro (KYO), S. Tokunaga (KYO), H. Muramatsu (TI).

Distr. From India to Malaysia and southern Japan.

Pinellia Tenore, Sem. Hort. Nap. (1830), et in Atti R. Acad. Sc. Nap. **4**: 57 (1839); Schott, Prodr. 20 (1860); Engl. l.c. 220 (1920), cum. syn.; T. Koyama, l.c. 255 (1965).—*Arum* Thunb. Fl. Jap. 233 (1784), p.p.—*Atherurus* Bl. in Rumphia **1**: 136, t. 31 & 37 (1835).

This is an endemic genus in Eastern Asia. *Pinellia* is characterized by the spadix of which female part adonate to spathe, the ovary with a basal ovule, and the long filiform appendage of the spadix. Two species are found in our region.

Key to the Species

1. Leaves 3-foliolate, with bulblets on the petiole ..... *P. ternata*
1. Leaves deeply 3-parted, no bulblet on petiole ..... *P. tripartita*

1. **Pinellia ternata** (Thunb.) Breit. in Bot. Zeit. **37**: 687, f. 1-4 (1879); Makino in Bot. Mag. Tokyo **15**: 135 (1901); Engl. l.c. 222, f. 55, A-M (1920); Liu & Huang, l.c. 139 (1963); Kitamura in Kitam. et al. l.c. 196, pl. 50-323, t. 133 (1964); T. Koyama, l.c. 256 (1965).—*Arum ternatum* Thunb. Fl. Jap. 233 (1784).—*Arisaema ternatum*

(Thunb.) Schott, Melet. (1832), et Prodr. 60 (1860).—*Atherurus ternatus* Bl. in Rumphia **1**: 136 (1835).—*Arisaema loureiri* Bl. l.c. 108.—*P. tuberifera* Tenore, l.c.; Miq. Fl. Jap. 95 (1866).—*Typhonium tuberculigerum* Schott in Ann. Mus. Lugd. Bat. **1**: 123 (1863-64); Miq. l.c. 133.—*P. angustata* Schott in Miq. Ann. Mus. Lugd. Bat. **1**: 123 (1863); Fr. et Sav. Enum. Fl. Jap. **2**: 3 (1879).—*P. ternata* var. *angustata* (Schott) Engl. in DC. Monogr. Phan. **2**: 567 (1879).—*P. ternata* f. *angustata* (Schott) Makino, l.c.

Distr. From southern China to Korea and Japan; in waste fields, road sides and cultivated lands. Many botanists consider that this species is a naturalized weed in Japan introduced from China in prehistoric age.

P. ternata is a polymorphic species. So many varieties and formae were described by a single diagnostic character such as: f. *angustata* (Schott) Makino= *P. angustata* Schott with linear leaflets; f. *purpurascens* Makino with spathe purple inside; f. *viridis* Nakai with green spathe; var. *subcuspidata* Honda with cuspidate spathe. These variants have neither geographical nor ecological significance.

2. **Pinellia tripartita** (Bl.) Schott, Syn. 5 (1856), et Prodr. 20 (1860); Engl. in Pfl.-reich **73**: 222 (1920); Kitamura in Kitam. et al. l.c. 196, pl. 50-324 (1964); T. Koyama, l.c. 256.—*Atherurus tripartitum* Bl. in Rumphia **1**: 137, t. 31 & 37 (1835).—*Arisaema tripartitum* Engl. in DC. Monogr. Phan. **2**: 538 (1879).—*Pinellia tripartita* Schott var. *atropurpurea* Makino in Bot. Mag. Tokyo **15**: 135 (1901).

Distr. Japan from Amami Islands to western Honshu. In evergreen forests, often on rocky slopes by streams. A form having purplish spathe, var. *atropurpurea* Makino, is infrequently growing alongside of the normal plants.