A preliminary revision of Arisaema (Araceae) in tropical Africa and Arabia

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Summary. A provisional treatment is offered of the ten African and Arabian species of the genus *Arisaema* Mart. Two new species are described, *A. mooneyanum* Gilbert & Mayo and *A. somalense* Gilbert & Mayo.

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INTRODUCTION

The genus *Arisaema* comprises some 150 species and has an interesting disjunct distribution. The centre of diversity lies in the Yunnan province of China, with rich representation in the Himalayas and temperate east Asia. Further east the genus is represented by a few species in eastern North America and Mexico, but to the west extends only as far as Afghanistan at temperate and subtropical latitudes. In the tropics it occurs in upland areas of south Asia and is also represented, as an outlying group, in the mountains of central and northeast Africa and the southeastern tip of the Arabian peninsula.

The basis of modern taxonomic work in the genus is Engler's monograph in Das Pflanzenreich (Engler 1920). The African species were revised more recently in Robyns & Tournay (1955), who recognized five species. Our study, in which we include the Arabian taxa, was prompted by work on the Floras of Ethiopia and Tropical East Africa, and has revealed a rather more complex taxonomic picture requiring the recognition of ten species, nine occurring in Africa and two in Arabia.

Taxonomic problems

The present treatment is provisional since Arisaemas can only be thoroughly studied from living plants, and our work is based largely on herbarium material. More field collections are needed both to define geographical ranges more precisely and to investigate the appreciable morphological variation which occurs in several species. It is likely that a more complete knowledge of the variation patterns and reproductive biology will show our treatment to be simplistic with some species too narrowly conceived and other possibly significant variation ignored. The situation is also complicated by the existence of strong Asiatic links, as outlined below, which indicate the need for a much more broadly-based study before a satisfactory classification can be achieved.

Geographical patterns

Apart from *A. flavum* all the species are endemic to either Africa or Arabia. This high level of endemism obscures the morphological similarities that exist between the African/Arabian group and some Indian species. The most strikiing links are the species pairs *A. bottae* (Yemen)---*A. leschenaultii* (S India, Sri Lanka) and *A. enneaphyllum* (Africa)---A. *murrayi* (S India), while *A. consanguineum* (Himalaya, N Thailand) has many features in common with *A. mildbraedii* (Africa) and *A. ruwenzoricum* (Africa).

There are also disjunct species distributions in *Araceae* which correspond geographically with these apparent vicariant species groups in *Arisaema. A. flavum* occurs in Ethiopia and Yemen and from Afghanistan to western China while in other genera *Remusatia vivipara and Sauromatum venosum* have basically similar ranges, though more widespread and at lower altitudes in Africa. Hooper (1984) has recently drawn attention to similar distribution patterns in *Carex (Cyperaceae).*

Useful characters

Field observations of Ethiopian species (by MGG) suggest that the most useful characters are the colour and form of the inflorescence, features difficult to study from herbarium specimens. Colour notes, illustrations or photographs, and liquid-preserved material are thus of great importance in field studies of *Arisaema.* The morphology of the tubers remains poorly known but could be useful. The berries are sometimes distinctly striped when young, though the significance of this is not known. Observations which correlate fruiting and flowering plants would be helpful.

The specimens cited in the following account have been seen except where otherwise noted. For reasons of space, only a representative sample of the specimens seen is cited here; a complete list is available on request to the Librarian , Royal Botanic Gardens, Kew, Richmond TW9 3AE, U.K.

KEY TO THE SPECIES OF ARISAEMA IN AFRICA AND ARABIA

1. Leaves radiately divided to base, circular in outline:
   2. Spathe limb not or only very narrowly auriculate basally:
      3. Leaflets usually 8-15, oblanceolate to elliptic or lanceolate, margin irregularly erose-serrate to finely serrate-dentate, rarely subentire, or leaflets as few as 5 and broadly elliptic to obovate in *A. schimperianum*:
         4. Spathe tube relatively broad, 3"5--7"5 x 2"3--3"5 cm diam., often slightly constricted apically; limb mostly pure white . . . . . **1. *A. enneaphyllum***
         4. Spathe tube relatively narrower, 3--12 x 0"8--3 cm diam., not or hardly constricted apically; limb mostly green, rarely tinged purple-brown . . . . . **2. *A. schimperianum***
      3. Leaflets (3--)5--7(--9), broadly elliptic to obovate, entire, sometimes minutely crisped, occasionally narrower and obscurely serrate-dentate in *A. ruwenzoricum*:
         5. Spathe tube relatively broad, usually slightly constricted at apex before expanding into ovate limb; spadix appendix 1"4--2"7cm long inflorescences androdioecious . . . . . **9. *A. somalense***
         5. Spathe tube relatively slender, often slightly obconical, not constricted at apex; spadix appendix 2"7--9cm long; inflorescences nearly always dioecious:
            6. Leaves often subpedate; spathe tube 6-15cm long; pistillate spadix usually with a few sterile projections below appendix . . . . . **7. *A. ruwenzoricum***
            6. Leaves strictly radiate; spathe tube 3--9.5 cm long; pistillate spadix without sterile projections below appendix:
               7. Spathe often suffused with brown, tube 3.4--9.7 cm long, about one third or more of total spathe length, limb long-acuminate (Yemen) . . . . . **3. *A. bottae***
               7. Spathe green- and white-striped, not suffused with brown, tube 3--3.7 cm long, less than one third of total spathe length, limb long-acuminate with filiform tip (Ethiopia) . . . . . **4. *A. addis-ababense***
   2. Spathe limb broadly auriculate basally:
      8. Spathe yellow or greenish yellow usually finely veined with purple, heavily so at junction of tube and limb on inner surface; spadix appendix bright yellow at tip, darker at base; leaflets (6--)8--12, oblanceolate to broadly elliptic (Ethiopia) . . . . . **5. *A. mooneyanum***
      8. Spathe pale green to white, sometimes with reddish markings on outside of tube; spadix appendix pale green; leaflets 6--8, broadly elliptic to obovate (Tanzania) . . . . . **6. *A. ulugurense***
1. Leaves pedately divided to base, often kidney shaped (reniform) in outline:

9. Spathe 3.5--7.2 cm long, limb bright yellow with purplish-brown patch at base within; spadix bisexual, appendix 0.5--0.7cm long; male flowers densely packed, contiguous . . . . . **10. *A. flavum***
9. Spathe 7--28 cm long, limb white or green; spadix appendix 1.4--9 cm long; male flowers widely separated:
    10. Spathe tube relatively broad and often slightly constricted at apex before expanding abruptly into ovate limb; spadix androdioecious, appendix 1.4--2.7 cm long, lacking sterile projections at base . . . . . **9. *A. somalense***
    10. Spathe tube relatively narrow and passing smoothly into deltoid hooded limb; spadix unisexual, appendix 3--9 cm long with sterile subulate projections at base:
        11. Leaves radiately to compactly subpedate, leaflets acuminate; spadix 9--17 cm long overall . . . . . **7. *A. ruwenzoricum***
        11. Leaves usually laxly pedate, leaflets with long filiform tips; spadix 5--10 (--11) cm long overall . . . . . **8. *A. mildbraedii***

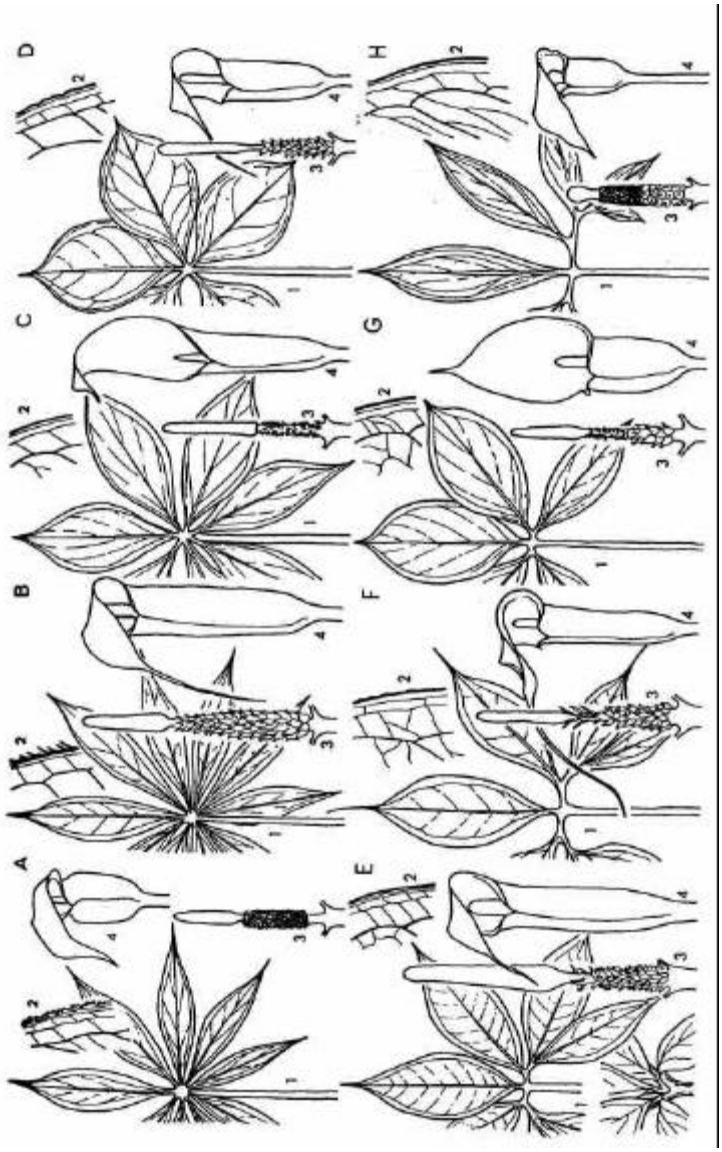
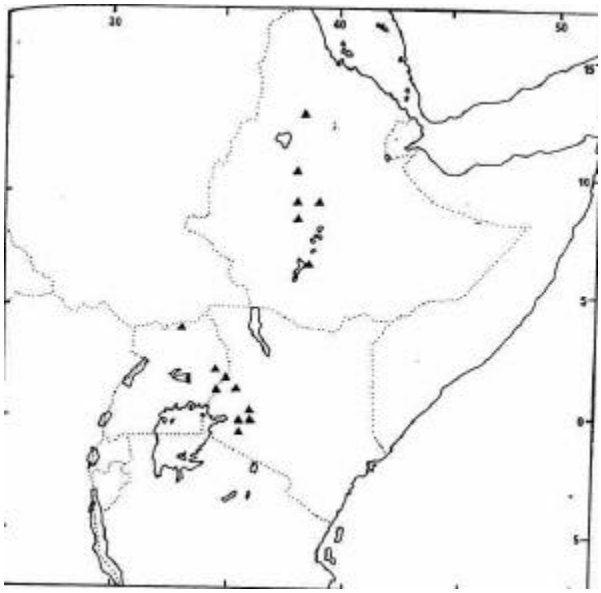


Fig. 1. Diagramatic key characters of *Arisaema* species
A: *A. enneaphyllum*; B. *A. schimperianum*; C. *A. bottae*; D. *A. addis-ababense*; E. *A. ruwenzoricum*
F. *A. mildbraedii*; G. *A. somalense*; H. *A. flavum*
1. leaf; 2. leaflet margin; 3. spadix; 4. inflorescence

1. Arisaema enneaphyhum *Hochst. ex A. Rich.*, Tent. Fl. Abyss. 2: 352 (1851); Schott, Prodr. Syst. Aroid.: 46 (1860); N. E. Brown in Dyer, Fl. Trop. Afr. 8: 144 (1901); Engler in Pflanzenr. 73 (IV. 23F); 179, fig. 38 F--H (1920); Robyns & Tournay in Bull. Jard. Bot. Bruxelles 25: 397 (1955); Cufodontis, Enum. Pl. Aeth.: 1503 (1971). Type: Ethiopia, Semien near Enschedcap,July 1838, *Schimper* 1125a (lectotype P, n.v.; isolectotypes BM, K). [*A. schimperianum* sensu Milne-Redhead in Bot. Mag. 175: t. 474, n.s. (1965); Agnew, Upland Kenya Wild Fl.: 701, 702 (1974), *non* Schott].

Herb to 120 cm tall. Tuber subglobose, up to 8 cm diam. Leaves usually 2. Petioles with basal sheaths imbricate, forming pseudostem to about 75 cm tall, free apical part 7-25 cm long, green. Leaf blade radiately divided to base, circular in outline, leaflets 5--10 (--12), subequal in size, lanceolate, elliptic or oblanceolate, acuminate, base cuneate, 7--19 x 1.5--6.5 cm, margins irregularly erose-serrate, sometimes almost entire, teeth rarely long-acuminate and then only irregularly so. Inflorescence overtopping leaves, free part of peduncle 11--24 cm long, green. Spathe 9--24 cm long; tube broadly and shortly cylindric, slightly constricted apically, 3.5--7.5 x 2.3--3.5 cm, sometimes fused basally for up to 1.3 cm, outer surface green with obscure white longitudinal. stripes; limb ovate, acuminate, often narrowly auriculate at base, longer than tube (sometimes



MAP 1. Distribution of *Arisaema enneaphylium.*

more than twice as long), 6--17 x 2.8--5.8 cm, white on outer surface, inconspicuously white- and green-striped on inner surface near base, often blackish near margin at base, bent forwards over mouth of tube. Spadix, bearing flowers of only one sex, 4.3--8.6cm long, subequal to spathe tube; sterile appendix cylindric, conic or clavate, sometimes narrowed at base, 0.3--4 x 0.3--0.6 cm, green; staminate spadix with naked basal stipe 0.4--1 cm long, fertile part cylindric, 1.7--4.5 x 0.4--1.1 cm, flowers ± densely congested; Pistillate spadix ± sessile, fertile part cylindric to conic, 2.7--3.5 x 1--1.5 cm, flowers densely congested. Staminate flower composed of 2--3(--4) stamens, anthers dehiscing by subcircular, oblique apical slits. Pistils ovoid, 3--4 mm long green, ovary 2--3 mm diam., tapering with short style. Berries subglobose, 5--7 mm diam., 3--5 seeded. Fig. 1A, Map 1.

SUDAN. Equatoria, Mt Kinyeti, 24 April 1950, *Jackson* 1413A(K).
ETHIOPIA. Gojam, Choké Mts, 10° 40' N, 37° 50' E, 5 Aug. 1957, *Evans & Hiller* 89 (K); Shewa, between Guder and Gedo, 27 June 1975, *Ash* 3035 (K).

UGANDA. Karamoja, Mt Debasien, May 1948, *Eggeling* 5808 (K); Mt Elgon, 22 May 1948, *Hedberg* 1056 (K).
KENYA. Nyanza, Tinderet Forest Reserve, 26 June 1949, *Maas Geesteranus* 5198 (K); Rift Valley, NE Elgon, April 1954, *Tweedie* 1167 (K).
ECOLOGY. Open grasslands, rocky slopes, thicket margins, in shade of forest (Uganda and Kenya), probably near clearings or at the marg4 (2000-) 2250-3000 in.

A. enneaphyllum, is easily recognized when fresh by the white spathe limb and short, stout spathe tube with a slight apical constriction (fig. 1A). Despite this, it has been confused in herbaria with *A. schimperianum,* and indeed the types of both taxa are from the same mixed collection. The two species do occur together, at least in disturbed areas, but in general *A. enneaphyllum* prefers more open situations than does *A. schimperianum.*

Further field investigation is necessary to evaluate variation of the morphology of spathe and leaflet margins observed in *A. enneaphyllum.* In the northern part of the range the spathe tube margins are normally fused for an appreciable distance from the base, whereas in southern Ethiopia and Kenya they are usually entirely free. Possibly such a difference may be biologically significant since in some Indian species pollinating flies have been observcd emerging from the base of the spathe tube (Barnes 1934). The leaflet margin varies from the normal erose condition to the distinct serrations characteristic of *A. schimperianum* and found in Ethiopian collections of *A. enneaphyllum* from Gara Mulata, Harerge Region (e.g.*I.E.C.A.M.A.* H27, *J. de Wilde* 4756). More collections are needed from this area, where *A. schimperianum* also occurs.

The distinctive spathe colouring and shape of *A. enneaphyllum* are closely mimicked in *A. murrayi* (Graham) Hook., a species from the Western Ghats of India differing in the bisexual spadix and more slender appendix.

2. Arisaema schimperianum *Schott* in Bonplandia 7: 27 (1859) & Prodr. Syst. Aroid.: 47 (1860); N. E. Brown in Dyer, Fl. Trop. Afr. 8: 143 (1901); Engler in Pflanzenr. 73 (IV. 23F): 181, fig. 38 A-E (1920); Hutch. & Bruce in Kew Bull. 1941: 184 (1942); Robyns & Tournay in Bull. Jard. Bot. Bruxelles 25: 398 (1955); Cufodontis, Enum. Pl. Aeth.: 1503 (1971). Type: Ethiopia, Semien, near Enschedcap, July 1838, *Schimper* 1125b (isotypes BM, K).

Herb to 200 cm tall. Tuber discoid to depressed-globose, up to 5 cm diam. or more. Leaves 2-3. Petioles with basal sheaths imbricate forming green pseudostem to about 75 cm or more, free apical part of petiole 5 — 40 cm long. Leaf-blade radiately divided to base, circular in outline, leaflets (5-) 9-15, subequal in size, usually narrowly elliptic to elliptic or narrowly oblanceolate, rarely obovate, 4.5--27 x 1--9cm, acuminate, base cuneate, margins usually finely serrate-dentate with acuminate teeth up to 2 mm long, rarely subentire. Inflorescence equalling or overtopping leaves, free part of peduncle 9--35cm long, green. Spathe 8--31 cm long; tube cylindric to narrowly obconic, not or hardly constricted apically, 3--12 x 0.8--3 cm, outer surface green with white to yellow longitudinal stripes along veins; limb oblong-lanceolate, sometimes ovate, 5 — 21.5 x 1 — 5 cm, shorter or longer than tube, sometimes with very long filamentous tip, green, rarely purple-brown tinged. Spadix usually unisexual, rarely with flowers of both sexes present, 3.8—12.8 cm long, slightly longer than spathe tube; sterile appendix cylindric to conic, 2 — 9 x 0.2 — 1.4 cm, narrowed basally, sometimes truncate with stipe up to 1 cm long, apex rounded, pale green to yellowish green; staminate spadix $\pm$ sessile, fertile part subcylindric, 1.4 - 4.3 x 0.4- 0.8 cm, flowers $\pm$ distant; pistillate spadix $\pm$ sessile, fertile part gradually tapering upwards, 3 - 5 x 1.2 - 1.3 cm, flowers congested to $\pm$ distant. Staminate flower composed of 2-3 stamens, anthers dehiscing by sub-circular oblique apical slits. Pistils ovoid, 3-4.5 mm long, green, ovary 2-2.5 mm diam., tapering to short style with capitate whitish stigma. Berries subglobose, 0.5-0.8 cm diam., scarlet when ripe, green with yellowish stripes when immature, 3-4 seeded; seeds about 4 mm diam. Fig. 1B, Map 2.

SUDAN. Equatoria, Imatong Mts, Kipia, 26 July 1939, *Myers* 11620 (K); Didinga Mts, summit of Mt Lotuke, 18 April

1939, *Myers* 10891 (K).
ETHIOPIA. Sidamo, 2 km SE of Wondo, 4 May 1969, *M & S Gilbert* 1350 (ETH, K); Arssi, 3 km SE of Asella, 6 May 1965, *W. de Wilde* 6583 (ETH, K).
UGANDA. Acholi, Imatong Mts, Langia, April 1943, *Purseglove* 1434 (K).
ZAÏRE. Haute Zaire, Nioka, 19 June 1951, *Talon* 1133 (BR, K); Djugu, Mont-Adjo, 15 June 1957, *Froment* 166 (BR)
.
ECOLOGY. Scattered plants in open forest or at thicket margins, rarely epiphytic, sometimes persisting in open grassland after tree clearance but not forming large groups; 1800-2800 m.

A. schimperianum is widespread in Ethiopia, but otherwise occurs only in the Imatong Hills on the Uganda-Sudan border and in NE Zaire. Records we have seen from Kenya are misidentifications of *A. enneaphyllum.*

In the Sidamo region of Ethiopia a distinctive form *(Gilbert & Jefford* 4327) occurs in which the spathe has a strongly hooded limb with a very glaucous, papillate outer surface. Further collections may show this to merit taxonomic recognition. Other variation of possible taxonomic significance includes the occurrence of brownish spathes in the southwestern part of the range and subentire leaflets in material from Zaire and the Imatongs.

3. Arisaema bottae *Schott,* Prodr. Syst. Aroid, 42 (1860); Engl. in Pflanzenr. 73 (IV. 23F): 184 (1920); Schwartz in Mitt. Inst. Allg. Bot. Hamburg 10: 345 (1939). Type: Drawing (Schott Aroideae No. 942) of a specimen at P of *Botta* collected in Yemen (holotype W, n.v.; photo K).

> [*Arum pentaphylium* sensu Forssk., Fl. aegypt.-arab. CXX, no. 526, Centuria VI, no. 6, p. 157 (1775), *non* L. (I 753). Based on: Yemen, 'In monte Barah', *Forsskål* s.n. (C, n.v., microfiche K)].
>
> [?*Arisaema enneaphyllum* sensu Deflers, Voy. Yemen: 215 (1889); Schwartz in Mitt. Inst. Allg. Bot. Hamburg 10: 345 (1939), *non* Hochst. ex A. Rich.].

Tuberous herb to 90 cm tall. Leaves 1-2. Petiole sheathing peduncle for about 50 cm, free apical part 7-40 cm long. Leaf blade radiately divided to base, sub-circular in outline, leaflets usually 5, sometimes 7, subequal, broadly elliptic to elliptic, 6.5-27 x 2.5-12 cm, acuminate, cuneate at base, margins entire. Inflorescence equalling or overtopping leaf, free part of peduncle 11-27 cm long. Spathe 9.5-21 cm long; tube subcylindric to obconic, not constricted apically, 3.4-9.5 x 1.3-2.3 cm, green or suffused with brown, with paler or whitish veins; limb ovate-lanceolate, long-acuminate, curved forward over tube mouth, 6.5-12 x 2.3-6 cm, brownish green to green, frequently with paler to whitish stripes along veins, basal margins narrowly auriculate, revolute. Spadix unisexual, 5.4-11 cm long; sterile appendix narrowly conic, apex rounded, ± stipitate and lacking sterile projections at base, 2.7-7.7 x 0.6 - l.2 cm, white to greenish white; fertile part subsessile, conic, 2.5-3.5 x 0.7-1.2 cm. Staminate flower composed of 2-3 stamens. Pistil ovoid, dark, glossy green with white, capitate stigma. Berries unknown. Fig. IC, Map 3.

NORTH YEMEN. W spur of Jebel Sumarah, 23 Aug. 1977, *Radcliffe-Smith & Henchie* 4721 (K); Jebel Sabir, Taiz, 19 May 1975, _7. *R. L Wood* 75/206 (K); Tebel Manar, Ibb, 22 June 1979, 1. *R. L Wood* 2873 (K); gully between Shemama and main part ofjebel Miswar, 20 June 1980, J. *R. L Wood* 3321 (K).

ECOLOGY. Frequent to abundant in disturbed open habitats such as field borders, banks and hedges; it has also been found in a shaded gully; 2700-3000 in.

A. bottae strongly resembles *A. leschenaultii* Blume, a species from southern India and Sri Lanka which differs in having sterile projections at the base of the appendix in pistillate inflorescences, and often more numerous

leaflets.

Records of *A. enneaphyllum* from Yemen given by Deflers (1889) and Schwartz (1939) are probably misidentifications of *A. bottae,* but we have not seen the collections on which they are based.

4. Arisaema addis-ababense *Chiovenda* in Atti R. Accad. d'Italia, Mem. Cl. Sc. Fis., etc. 11: 59 (1940); Robyns & Tournay in Bull. Jard. Bot. Bruxelles 25: 399 (1955); Cufodontis, Enum. Pl. Aeth.: 1503 (1971). Type: Ethiopia, Shoa, Addis Abeba, *Senni* 1308 (lectotype FT, chosen by Robyns & Tournay, 1955).

Herb to 70 cm tall. Tuber subglobose, 1-2 cm diam., budding readily. Leaves 1-2. Petioles with long sheaths, forming an olivaceous, purplish-brown-streaked pseudostem to 60 cm long, free apical part 4-17 cm long. Leaf blade radiately divided to base, subcircular in outline, leaflets 5(-7), subequal in size, broadly elliptic, elliptic to oblanceolate, 6.5-15.5 x 1.6-6.3 cm, acuminate to long-acuminate, base cuneate, margins crisped to entire. Inflorescence shorter than, equalling or slightly overtopping leaves, free part of peduncle 11-16 cm long. Spathe 11- 12 cm long; tube cylindric to slightly obconic, not constricted apically, 3-3.7 x 1.1-1.8cm, outer surface green with white stripes along veins; limb ovate-lanceolate, 6.7-9 x 2.7-3 cm, long-acuminate with filifom tip 2.5-3.5cm long, green with whitish veins. Spadix unisexual, 5.2-5.5 cm long; sterile appendix cylindric, ± stipitate at base, 2.9-3.4 x 0.4-0.5cm, green or creamy green; fertile part 2.1-2.5 x 0.4-0.6 cm. Flowers ± distant; staminate flowers composed of 2-3 stamens, anthers dehiscing by oblique apical slits. Pistils ovoid, 2-2.5mm long narrowed into short style, stigma small, capitate. Berries several-seeded, 0.8cm diam., in cylindric fructescence.Fig.1D, Map 3.

ETHIOPIA. Shewa, Addis Abeba, Entoto, near Italian Embassy, 4 Aug- 1970, *Ash* 495 (K); behind French Embassy, 24 June 1973, *M. G. & S. B. Gilbert* 2565 (ETH, K); 2 km NE of Italian Embassy, 31 July 1965, de Wilde & de Wilde-*Duyfjes* 7435 (ETH, K); vallone Iggais, 9 July 1937, *Giordano* 1191 (FT).

ECOLOGY. In shaded sites in area formerly covered by *Olea-Juniperus forest,* now mainly found under shrubs of *Carissa edulis,* apparently never growing in the open; c. 2550-2650 m.

Fig 2. *Arisaema mooneyanum*. A. leaf; B. staminate inflorescence; C. pistillate spadix; D. habit x 1/9
A,C from Gilbert & Jefford 4275; B from Ash 770; D from photograph. Drawn by Christine Grey-Wilson

This species is somewhat intermediate between *A. bottae* and *A. schimperianum*. It is so far known only from the northern outskirts of Addis Abeba on the slopes of the Entoto escarpment, and it is possible that it may eventually prove to be no more than a distinctive local variant of the much more widespread *A. schimperianum.* More collections are needed from Shewa to resolve this point, and for the time being *A. addis-ababense* is maintained, since the depauperate collections of *A. schimperianum* that most closely resemble it (e.g. *Gilbert & Jones* 1977 from Sidamo) are easily distinguished by the erose-dentate leaf margin.

5. Arisaema mooneyanum *M. Gilbert & Mayo* sp. nov. *A. bottae* Schott affinis, sed foliolis magis numerosis, limbo spathae basi valde auriculato et fusco-vel nigres*f*enti-purpureo, spatha non albostriata, appendice spadicis ad apicem flava, spadice interdum bisexuali differt. Typus: Ethiopia, Sidamo region, *M. G. Gilbert & T. G. Jefford* 4275 (holotypus K; isotypi ETH, EA?).

Robust, perennial, tufted herb to about 50 cm tall. Tuber discoid to depressed-globose, about 5 cm diam., with numerous subsidiary tubers on the margins. Leaves 1-2, subtended by 1-2, oblong to lanceolate, yellowish-green cataphylls, drying brownish. Petiole uniform green throughout with short pseudostem, free apical part of petiole 17-30 cm long. Leaf blade radiately divided to base, circular in outline; leaflets (6)8-12, subequal in size, oblanceolate to broadly elliptic, 6.5-26 x 1.5-6.5 cm, long-acuminate, base cuneate, margins entire or serrulate with basal teeth to I mm long. Inflorescences usually overtopping the leaves, larger central shoot with female or bisexual inflorescence, often surrounded by several smaller male inflorescences from lateral shoots. Free part of peduncle 10-20 cm long, green or suffused with maroon towards apex, up to 1.5 cm in diam. Spathe 16-39 cm long; tube cylindric, not constricted apically, 6.5-13 x 1-3 cm, outer surface glaucous, greenish-yellow, sometimes heavily suffused with purple; limb ovate, broadly auriculate at base with revolute margins, 10-25 x 3.7-9 cm, curved forwards from 90E to 180E to tube, long-acuminate, both surfaces glossy, brown or very dark purple to almost black at the base, upper part olivaceous with fine, dark brown veins. Spadix unisexual or bisexual, 8-17 cm long, longer than spathe tube; sterile appendix subcylindric and somewhat flattened, 4.5-10 x 0.6-1.5 cm, apex rounded, base gradually narrowed to sharply truncate with distinct stipe, bright yellow at tip, often with brownish band at level of spathe mouth; fertile part very variable, 2-9 x 0.5-2 cm. Flowers of both sexes congested to ± distant; staminate flower usually composed of 2, sometimes 3 stamens, anthers dehiscing by oblique apical slits; pistils flask-shaped, 2.5-5 mm long, ovary green, stigma small, capitate, paler. Fruit unknown, Fig. 2, Map. 3.

ETHIOPIA. Bale, Angasu, near Goba, 6E 57' N, 39E 48' E, I I April 1958, *Mooney* 7138 (K, ETH); Sidamo, 14 km S of Kebre-Mengist, 16 April 1971, *Ash* 770 (K); 8 km S of Bore, 5E 53' N, 39E 00' E, 12 April 1974, *Ash* 2442 (K); km, 390 marker, Awasa-Neghelle road, 15 April 1975, *M. G. Gilbert & Jones* 191 (ETH); 2 km S of Fisseha Guenet, 6E03' N, 38E11' E, 8 May 1976, *M. G. Gilbert & Jefford* 4275 (holotype K; isotype ETH).

ECOLOGY. Locally abundant in grasslands which have probably been created by clearance of montane forest; 2390-3450 m.

This species is named after H. F. Mooney in recognition of his vital role in the development of the Ethiopian National Herbarium.

A. mooneyanum is notably stockier and more robust than *A. enneaphyllum* and *A. schimperianum*, which grow in the same area. One population has been seen in which all three species intermingle, but in general the latter

two grow in less disturbed habitats while *A. mooneyanum* appears to have exploited relatively recent forest clearance by means of its vigorous vegetative reproduction.

Mooney 7138 is included here, but differs from typical *A. mooneyanum* in the almost non-auriculate, white-striped spathe and fewer broader leaflets. It is from a higher altitude than other populations and shows more similarity to *A. bollae.* Good collections from the area between Dinshu (where typical A. *mooneyanum* occurs) and Goba are needed for a better assessment of its status.

Meyer s.n. and *Bally & E. F. Gilbert* 13031, represented by illustrations (K!) of plants grown at Kew, are close to *A. mooneganum,* differing in their more pronounced hysteranthy and green spathe. These collections, which come from almost exactly the same locality as *A. addis-ababense,* appear to represent a rare population which, in contrast to typical *A. mooneyanum,* does not form dense colonies.

6. Arisaema ulugurense *M. Gilberl & Ma o* in Mayo, Fl. Trop. E. Afr. Arac.: 64 (1985). Type: Tanzania, Uluguru Mts, *Drummond & Hemsley* 1535 (holotypus K).

Herb to 100 cm tall. Tuber depressed-globose, 3-4 cm diam. Leaves 1-2. Petiole with basal sheaths imbricate forming green to brownish-red pseudostem, free apical part of petiole 30-34cm long, green to brownish-red. Leaf blade radiately divided to base, circular in outline, leaflets 6-8, subequal in size, broadly elliptic to obovate, acuminate, base cuneate, 11-20(-38) x 4-8(-13) cm; margins entire. Inflorescence subequal to leaves. Spathe 16-28 cm long; tube cylindric to obconic, not constricted apically, 5.5-8 x 2.5-3 cm, outer surface pale green to white, sometimes with reddish markings; limb broadly ovate, long-acuminate, base broadly auriculate with revolute margins, 11-20 x 5-8 cm, longer than tube, dull green, darker than tube (Schlieben's field data states 'flower white'). Spadix unisexual, 8-10.5 cm long, longer than spathe tube; sterile appendix clavate-cylindric, 5-7 x 0.5-1.2 cm, apex rounded, truncate and stipitate at base with 4-8 mm long stipe, pale green; staminate spadix ± sessile, fertile part cylindric, 2.5-3.5 x 0.5-0.8 cm, flowers distant; pistillate spadix unknown. Staminate flower composed of 1-3 stamens, anthers dehiscing by subcircular, ± oblique apical slits. Fruiting spadix 9 x 4cm. Berries subglobose, about I cm diam., 1-3 seeded, turning orange (? eventually red); seeds subglobose, 5-6 mm diam. Fig. 3, Map 3.

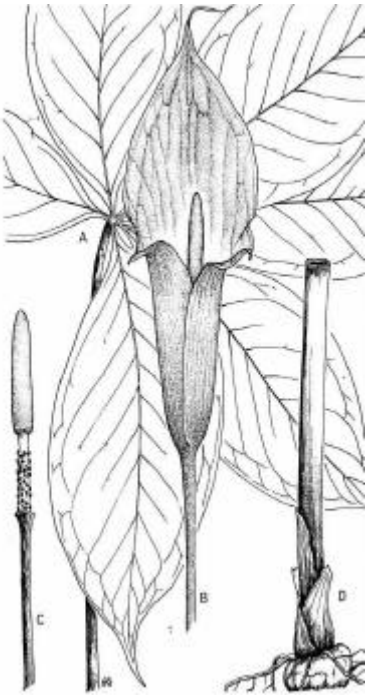


Fig. 3. Arisaema ulugurense. A. leaf; B. staminate inflorescence; C. pistillate spadix x 2/3
D. base of petiole and cataphylls x 2/3;
A from Cribb & Grey-Wilson 10457; B-D from Drummond & Hemsley 1535
Drawn by Christine Grey-Wilson

TANZANIA. Morogoro, Uluguru Mts, below Lukwangule plateau, 27 Jan. 1976, *Cribb & Grey-Wilson* 10457 (K); Lukwangule plateau, above Chenzema -Mission, 13 March 1953, Drummond & *Hemsle* 1535 (holotype K); Mgeta R. above Bunduki, 1 Jan. 1975, *Polhill & Wingfield* 4639 (K); Lukwangule highland, mountain savanna above the cloud forest, 21 Feb. 1933, *Schlz'eben 3538* (BR); Lukwangule plateau, 7 Dec. 1969, *Harris &* al. 3762 (EA).

ECOLOGY. In montane scrub and forest; 2000-2200 in.

This species combines the auriculate spathe of *A. mooneyanum* with the broad leaflets of *A. bottae* and *A. addis-ababense.* It is the only member of the genus from Tanzania and as such is peculiarly isolated; there seems no obvious explanation for the lack of records from other mountains in Tanzania.

7. Arisaema ruwenzoricum *N. E. Brown* in Dyer, Fl. Trop. Afr. 8: 143 (1901); Engl. in Pflanzenr. 73 (IV. 23F): 183 (1920); Robyns & Tournay in Bull.jard. Bot. Bruxelles 25: 399 (1955). Type: Uganda, Toro District, Kivata, *Scoll-Elliot* 7773 (holotype K; isotype BM).

Herb to 120 cm tall. Tuber depressed-globose, 2-6 cm diam. Leaves usually 2. Petioles with basal sheaths imbricate forming green, purplish- or red-mottled pseudostem up to 100 cm tall, free apical part 8-23 cm long. Leaf blade subcircular to reniform in outline, compound, radiate to ± compactly pedate, divided to base, leaflet bases up to 0-7 cm apart; leaflets 5-7(-9), central 1-3 the largest, lateral leaflets decreasing in size outwards, elliptic to obovate, acuminate, base unequally cuneate, largest 8-26 x 2.5-10.5 cm, margins entire or crisped, rarely obscurely serrate-dentate. Inflorescence ± equalling or overtopping leaves, free part of peduncle 14-26 cm long, green. Spathe 16-28 cm long; tube cylindric to somewhat obconic, not constricted apically, 6-15 x 1.7-3.5 cm, outer surface glaucous green with white, yellowish or purplish stripes along veins; limb ovate or oblong-ovate, long-acuminate, 10-13 x 3.5-5 cm, longer or shorter than tube, often with filamentous tip up to 4 cm long, green. Spadix normally unisexual, 9-17 cm long, just overtopping spathe tube; sterile appendix cylindric to clavate, sharply narrowed and subtruncate basally with short stipe, 5-9 x 0.7-1.4 cm, apex rounded, pale green to greenish-yellow; staminate spadix subsessile, fertile part subcylindric, 2.5-7 x 0.7-1.4 cm, flowers distant; pistillate spadix subsessile, fertile part gradually tapering upwards, usually with a few, subulate, sterile projections at appendix base, about 4.5 x 1.1 cm, flowers ± congested. Staminate flower composed of 3-5 stamens, anthers dehiscing by subcircular, oblique apical slits, sometimes confluent. Pistil ovoid, 3-4 mm long, green, ovary 2-2.5 mm diam., tapering to short style with capitate stigma. Fruiting spadix to 12 cm long, without appendix. Berries subglobose, 0.5-1 cm diam., 2-4 seeded; seeds 4-5 mm diam. Fig. I E, Map 3.

UGANDA. Toro. Bwamba Pass, April 1933, *Eggeling* 1322 (K); Kanyasabu, 20 March 1948, *Adamson 10* (K, EA). ZAIRE. Kivu, R. Nyamwamba, Albert National Park, near Kalong6, 12 Feb. *1953, Frederzcq in de Witte* 10479 (BR); Ruwenzori, Butagu, 12 April 1914, *Bequaert* 3580 (BR).

ECOLOGY. Bamboo or tree heather zones in damp shaded sites, sometimes epiphytic amongst moss in tree fork; (1800-)2400-3200 m.

This species appears to be restricted to high altitudes in the Ruwenzori mountains and to be replaced at lower altitudes by the more widespread A. *mildbraedii*

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8. Arisaema mildbraedii Engl. in Mildbraed, Wiss. Ergebn. Deutsch. Zentr.-Afr.-Exped. 1907-1908, 2(l): 55 (1910) & in Pflanzenr. 73 (IV. 23F): 173, fig. 35 (1920); R. E. Fries in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 10: 89 (1927); Robyns & Tournay in Bull. Jard. Bot. Bruxelles 25: 401 (1955). Type: Zaire, Lake Kivu, Idjwi Is., Sept. 1907, *Mildbraed* 1216 (lectotype B; Photo BR).

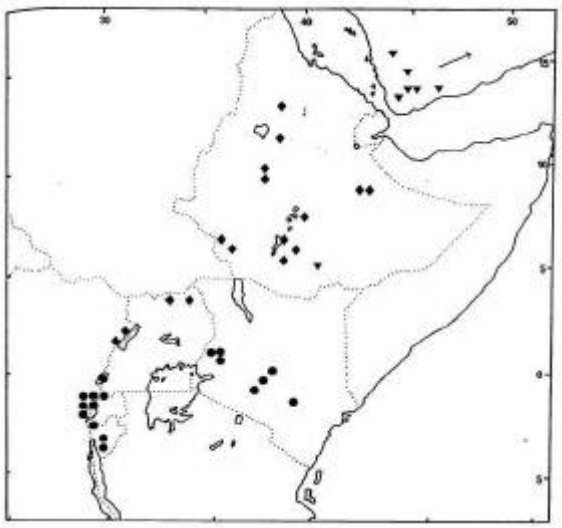
A. bequaertii De Wild. in Rev. Zool. Afr., Suppl. Bot., 9 (1): B25 (192 1) & Pl. Bequaert. 1: 177 (1922). Type: Zaire, Ruwenzori, Butagu, 1800-2000 in, 25 April 1914, *Bequaert* 3914 (holotype BR).

A. masisiense De Wild. ('masisiensis') in Rev. Zool. Afr., Suppl. Bot. 9(l): B26 (1921) & Pl. Bequaert. 1: 178 (1922). Type: Zaire, Masisi, 29 Dec. 1914, *Bequaert* 6419 (holotype BR).

Herb to 1.2 in tall. Tuber subglobose, about 5 cm diam. Leaves 1-2. Petioles with basal sheaths imbricate, forming green, crimson-speckled pseudostem to about 45 cm tall, free apical part (5-) 1 7-40 cm long. Leaf blade usually laxly pedate, rarely compactly pedate, reniform in outline, leaflet bases (0.3-)0.7-2.2 cm apart; leaflets (4)6-8, elliptic-oblanceolate, long-acuminate with filiform tips up to 8 cm long, (5-)8.5-32 x (1.2-)3-11 cm, outermost smaller than the rest, margins entire or obscurely crisped. Inflorescence ± equalling or overtopping leaves, free part of peduncle 6-30 cm long, green. Spathe 7-23 cm long; tube cylindric to obconic, not constricted apically, 3-9.5 x 1.3-3 cm, outer surface green with cream-yellow to white stripes; limb ovate, long-acuminate, arching forward and downward over tube mouth, 4-16.5 x 2-4.7 (-6) cm, much longer than tube with filamentous tip 2-7 cm long, similar in colour to tube but with broader stripes basally. Spadix normally unisexual, 5-10(-l 1) cm long, overtopping spathe tube; sterile appendix cylindric to clavate, subtruncate basally, usually ± stipitate, 3-6 x 0.2-0.9 (-1.2) cm, apex rounded, green; staminate spadix with fertile part 3.5-4.5 x 0.3-0.5 cm, rarely with sterile projections at appendix base; pistillate spadix with fertile part 2-2.5 (-5.5) x 0.9-1.3 cm, usually with sterile projections at appendix base. Staminate flower composed of 2-3 stamens. Pistil ovoid, 3-4 mm long, ovary 2-3 mm diam., narrowing upwards into a short style, stigma capitate. Berries subglobose, up to 1 cm diam., 1-3 seeded, borne in sub-cylindric spike up to 9.5 x 4 cm; seeds subglobose, 6 mm diam. Fig. 1F, Map 2.

ZAIRE. Kabare, Kahusi road, 27 Dec. 1958, *A. Lé0nard* 2206 (BR); Rutshuru, E Mushari, 13 Dec. 1951, *Spilaels* 284 (BR); N Kivu, Virunga, Kikomero, 20 Sept. 1954, *Stauffer* 415 (K).
RWANDA. Ruhengeri, E of Butaro, 9 Oct. 1974, *Auquier* 4467 (BR); Kinigi, 30 Jan. 1972, *Bamps* 3019 (BR).
BURUNDI. Bururi, Tora, Nov. 1969, *Lewalle* 4072 (K); Muramvya, Nyabigondo, 1 Nov. 1967, *Lewalle* 2176 (BR).
UGANDA. Mbale, Mt Elgon, 25 May 1924, *Snowden* 895 (K).
KENYA. Trans-Nzoia, Mt Elgon, 21 April 1931, E.,7. *& C. Lugards.n. (K);* Fort Hall, Thika, Chania Gorge, 4 May 196 *1, Verdcourt & Lucas* 3103 (BR, K); North Nyeri, Mt Kenya, 6 Dec. 1974, *Williams* 64 (BR, K).

ECOLOGY. Montane forests, bamboo thicket, tree plantations and forest edges, typically in very damp, shaded sites; 1400-2500 m.



MAP 2. Distribution of *Arisaema flavum* **–** (arrow indicates extension of range to Himalayas); *A. schimperianum* **—** ; *A. mildbraedii***M**

Several collections from Mt Elgon, Kenya, have rather compactly pedate leaves, and in other parts of the range plants occur with leaflets only longacuminate and lacking the usual long, filiform tips. There is thus some overlap with *A. ruwenzoricum*, and it is likely that these taxa will prove to be better recognized as subspecies after more detailed field studies have been made.

9. Arisaema somalense *M. Gilbert & Mayo* sp. nov. *A. enneaphyllo* affinis, sed foliis interdum subpedatisectis, foliolis paucioribus latioribus acuminatis integris, spadice androdioecio differt. Typus: Somali Republic, Al Hills, *C. L. Collenette* 250 (holotypus K; isotypus FT).

Perennial herb to about 60 cm tall. Tuber unknown. Leaf solitary, subtended by 2 oblong-lanceolate, pale-drying cataphylls. Petiole uniform green, basal sheaths forming short pseudostem, free apical part 12-19 cm long. Leaf blade radiately to pedately divided, circular to reniform in outline; leaflets (3-)5-7, broadly elliptic, 10-17.5 x 4-10.5cm, central ones largest, acuninate, base cuneate, margins entire. Inflorescence overtopping leaves, free part of peduncle 15-24cm long. Spathe 10.5-14.5cm long, 'green outside, white inside'; tube cylindric, usually constricted apically, 3.5-5 x 1.6-2.5cm, green; limb ovate, narrowing at base, 7-9.5 cm long, 3.2-7.2 cm broad, white, 'frequently bent sharply backward'. Spadix 5-8 cm long, longer than spathe tube, androdioecious, the bisexual inflorescences with a usually short zone of staminate flowers above the pistillate ones; sterile appendix subcylindric to slightly conical, 1.4-2.7 x 0.4-0.7 cm, apex rounded, base narrowing gradually, pale; fertile part 3-6 x 0.6-1 cm. Flowers of both sexes congested to ± distant; staminate flowers usually composed of 2 stamens, anthers dehiscing by oblique apical slits; pistils flask-shaped, 2.5-3 mm long, stigma capitate. Fruit unknown. Fig. 1G, Map 3.

SOMALI REPUBLIC. Northern Region: Eastern Al Madu Range, Galole, 13 Oct. 1956, *Bally* 11083 (K, EA?); Al Hills, Sugli (10E58'N, 48E53'E), 11 Nov. 1929, *C. L. Collenette* 250 (holotype K; isotype FT).

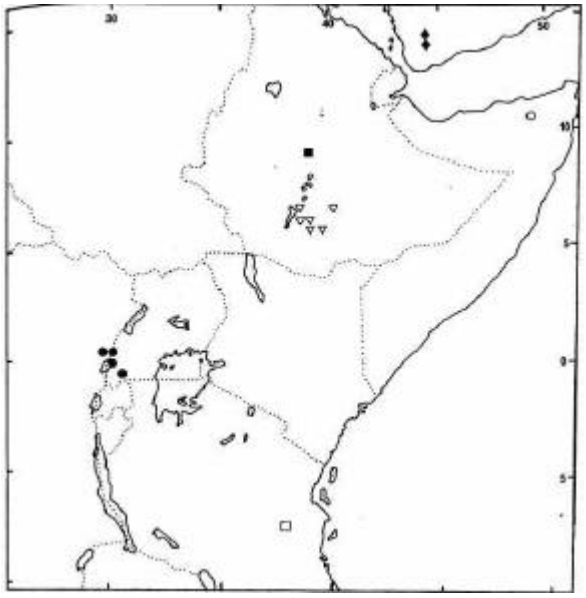
ECOLOGY. *Juniperus* forest on N-facing slope, in shady damp sites among large boulders; 1470-1575 m.

These collections have been variously referred to *A. mildbraedii, A. ruwenzoricum and A. addis-ababense*, a reflection of the mixture of features they present. The inflorescence, however, most closely resembles that of *A. enneaphyllum.* In view of its very isolated geographical location, it seems best to treat this as a new species. Though known only from the two cited collections, both consist of four plants each, giving a reasonable guide to the variation.

10. Arisaema flavam *(Forssk.) Schott*, Prodr. Syst. Aroid.: 40 (1860); J. D. Hooker in Bot. Mag. 126: t. 7700 (1900); Engler in Pflanzenr. 73 (IV. 23F): 172, fig. 34 (1920); Schwartz in Mitt. Inst. Allg. Bot. Hamburg 10: 345 (1939). Type: North Yemen, Jebel Sobr near Ta'izz, *Forsskål* s.n. (holotype C, n.v.; microfiche K).

Arum flavum Forssk., Fl. aegypt.-arab. CXX, no. 525, Centuria VI, no. 5, p. 157 (1775); Christensen in Dansk. Bot. Arkiv 4(3): 27 (1922). *Dochafaflava* (Forssk.) Schott, Syn. Aroid.: 24 (1856).
Arisaema abbrevialum Schott in Oest. Bot. Zeitschr. 7: 382 (1857) & Prodr. Syst. Aroid.: 39 (1860). Type: India, Simla, July 1849, *Hooker f. & Thomson s.n.* (holotype K).

Usually small and slender herbs, up to 50 (-75) cm tall, tuber budding readily around upper margin. Leaves 2. Petioles with long, imbricate sheaths forming pseudostem up to 30 cm long, free apical part often finely striated with pale pinkish-brown, 2-17 cm long. Leaf pedately divided to base, reniform in outline, leaflets 7-11, the central ones larger, the lateral ones decreasing in size outwards, lanceolate to elliptic, 3-10.5 x 0.6-3.8 cm, acuminate, base cuneate, margins entire. Inflorescence normally overtopping leaves, free part of peduncle 6-18.5 cm long. Spathe 3.5-7.2 cm long; tube broadly cylindric, slightly constricted apically, 0.9-2 x 1-1.5 cm, green, sometimes cancellate; limb oblong-ovate, long-acuminate, bright yellow with purplish-brown patch at base within, not or hardly auriculate, 2.6-5.5 x 1.1-2 cm, folded sharply forwards over spathe mouth. Spadix always



MAP 3. Distribution of *Arisaema bottae* —; *A. addis-ababense* •; *A. mooneyanum* –; *A. somalense* Ï; ***A.*** nwienzoricum **M**; A. ulugurense El

ETHIOPIA. Sidamo, 37 km SE from Neghelle on road to Filtu, 17 April 19 *Ash* 2415 (BR, K); 32 km SW from Neghelle on road to Wachile, 21 April 1971, *Ash* 813 (K). 1977,
NORTH YEMEN. Jebel Hubaysh, 1 km S of Dhuhua, 5 Aug. 1977, Radcliffe-Smith & Henchie 4482 (K); between Saddah and Kitab, 29 April 1979, J. R. I. Wood 2769 (K).
SOUTH YEMEN. 1-6 km NW of Ras Thirah, 14-28 Aug. 1962, *Lavranos* 1800 (K).
SAUDI ARABIA. 10 km NW of Abha, 23 Oct. 1983, *J. S. Collenelle* 4580 (K!).

ECOLOGY. In Ethiopia in shade of *Ficus* over limestone, 1400-1600 m; in the Yemens, frequent on stony slopes between 1700 and 2600 in; reaches 4000 in in Tibet.

One of the most widespread species in the genus (also found in Afghanistan, Pakistan, Himalayan India, Nepal, Bhutan, Tibet and Szechuan), but apparcntly very constant throughout its range. The Ethiopian records come from an unusually dry habitat for *Arisaema* and this tolerance for aridity may have played a part in its wide distribution.

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