Studies on Schismatoglottideae (Araceae) of Borneo IX: A new genus, Hestia, and resurrection of Apoballis

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ABSTRACT. Hestia S.Y. Wong & P.C. Boyce is described as a new genus from Sarawak typified by Hestia longifolia (Ridl.) S.Y. Wong & P.C. Boyce (syn. Schismatoglottis longifolia Ridl.), and based on combined molecular and morphological analyses the genus Apoballis Schott is resurrected. A key to the Schismatoglottideae sensu Wong & Boyce is presented, and Hestia is illustrated.

Keyword: Apoballis; Araceae; Borneo; Hestia longifolia; Sarawak; Schismatoglottideae; Schismatoglottis longifolia.

INTRODUCTION

Tribe Schismatoglottideae is the most speciose and diverse aroid taxon in Borneo, comprising in excess of the 100 species of which over 95% are endemic. Besides the largest genus, Schismatoglottis Zoll. & Moritzi, the tribe includes, six small ‘satellite’ genera, Aridarum Ridl., Bakoa P.C. Boyce & S.Y. Wong Bucephalandra Schott, Phymatarum M. Hotta, Piptospatha N.E. Br., and Schottara P.C. Boyce & S.Y. Wong, all of which are endemic to Borneo, except Piptospatha, which extends to the Malay Peninsula and Southern Peninsular Thailand (Bogner and Hay, 2000; Boyce and Wong, 2008). Schismatoglottis itself extends from Myanmar (Burma) to Vanuatu, and Southern China to New Guinea, but it is most abundant and diverse in Borneo. Wong et al. (in press) presents a molecular phylogeny of Tribe Schismatoglottideae, in which a Schistatoglottid Alliance comprising Schismatoglottideae, Cryptocoryneae and Philonotieae is proposed. The work is based on the chloroplast region: intergenic spacer trnL-F, coding region matK, the 3’ portion of the trnK intron of 78 taxa in the tribe with post-cladistic mapping of morphologies to enable detection of homoplasy among traditionally utilized higher taxon morphological markers.

The present paper redefines generic boundaries of Schismatoglottis based on evidence from molecular analyses and post-cladistic morphological observations. The recognition of a new monospecific genus, Hestia S.Y. Wong & P.C. Boyce, is proposed together with the resurrection of the genus Apoballis Schott.

Key to genera of Schismatoglottideae and their principle subgeneric divisions in Sunda

1a. Wings of petiolar sheath fully or almost fully attached to the petiole; seeds never with a micropyral appendage ........ 2
1b. Wings of petiolar sheath extended into a free ligular portion; seeds sometimes with micropyral appendage .............. 3

2a. Inflorescences on very slender peduncles, nodding at anthesis, peduncle at spathe insertion flexing 180° from vertical axis. Inflorescences narrowly campanulate, nodding. Plants of podsols ................................................................. Hestia
2b. Inflorescences erect to nodding at anthesis, if nodding, then either peduncle massive, or peduncle at spathe insertion at most 45° from vertical axis. Inflorescences fusiform with a constricted orifice, or if campanulate, then thick-walled and erect, never nodding. Plants of various substrates but never on podsols ................................................................. 4

3a. Modules monoephyllous, congested in a distichous arrangement; ligular sheath persistent .......................................................... Schismatoglottis insertae sedis
3b. Modules polyephyllous and leaves never distichous; ligular sheath when present marcescent ............................................. 5

4a. Spathle limb persistent into fruiting. Petiolar sheath usually fully deciduous; spadix interstice always present, invariably at least partly naked ................................................................................................................................. Apoballis

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4b. Spatha limb deciduous during anthesis, or marcescent. Petiolar sheath persistent or marcescent; interstice where present always fully clothed with sterile flowers..............................................................(Schismatoglottis) 13

5a. Spatha not constricted ........................................................................................................................................................................ 6

5b. Spatha constricted .............................................................................................................................................................................. 12

6a. Thecae of anther never with horn- or needle-like projections ........................................................................................... 7

6b. Thecae of anther each with a horn- or needle-like projection, although these sometimes visible only after female anthesis............................................................................................................................................................ 9

7a. Spadix almost completely adnate to spathe; male flowers mostly sterile with a narrow zone of fertile flowers exposed by the spathe opening; peduncle declinate during fruit maturation but twisting to become semi-erect at fruit maturity; spathe persistent into fruiting, and then at fruit maturity swiftly drying, reflexing and opening basally by tearing at peduncle insertion to expose fruits but remaining distally convolute and while in this situation clasping the spadix. Seeds with blunt micropyle.................................................................................................................................................................................... Bakoa

7b. Spadix either entirely free or part of the female flower zone which is adnate to spathe; male flowers all fertile; peduncle erect (and then spathe limb caducous) or declinate (and spathe persistent) throughout the fruit dispersal; spathe limb either caducous early in anthesis or persistent until fruit maturity and then falling, still fresh, to reveal entire spadix and ripe fruits. Seeds with a pronounced, hooked, micropylar appendage....................................................................................................................... 8

8a. Spathe limb caducous early in anthesis (generally between female and male anthesis); peduncle erect at fruit dispersal; fruiting spathe a funnel-form splash-cup; spent parts of spadix falling post fertilization to leave only the female flower zone sitting in the base of the splash cup; pistils connate into a syncarpium, or free but coherentv....................................................................................................................................................... 9

9a. Thecae with needle-like projection extending only after female anthesis; projection tipped with a weakly peltate ovate-triangular flap. Appendix composed of pistillodes ........................................................................................................................................................ Schottariella

9b. Thecae with a horn- or needle-like projection present prior to female anthesis; with the projection pointed and never associated with a terminal flap. Appendix, where present, composed of staminodes........................................................................................................................................................................... 10

10a. Sterile interstice of spadix with flattened scale-like staminodes; anthers not excavated................................. Bucephalandra

10b. Sterile interstice absent or with truncate staminodes; anthers nearly always with the top excavated (except A. incavatum) ........................................................................................................................................................................................................................................ 11

11a. Thecae at each end of the anther (seen from above) ............................................................................................... Aridarum Sect. Aridarum

11b. Thecae adjacent on one side of the anther (seen from above) .......................................................................................... Aridarum Sect. Caulescentia

12a. Thecae of anther without horn- or needle-like projections; ovules on parietal placenta; seeds without a micropyral appendage.......................................................................................................................................................................................... Schismatoglottis Multiflora Group

12b. Thecae of anther, each with horn- or needle-like projections; ovules on basal placenta; seeds with a long, hooked micropylar appendage.................................................................................................................................................. Phymatarum

13a. Stem pleioanthic.............................................................................................................................................................. Schismatoglottis Caephytrata Group

13b. Stem hapaxanthic.................................................................................................................................................. Schismatoglottis Tecturata Group

14a. Petiole sheathing only at extreme base; each foliage leaf alternating with a cataphyll................................................................. Schismatoglottis Tecturata Group

14b. Petiole usually sheathing for at least a third of its length (rarely less); foliage leaves not alternating with cataphylls 15

15a. Inflorescence erect; spathe limb irregularly crumbling and breaking away at or after male anthesis; small to medium plants ........................................................................................................................................................................ Schismatoglottis Asperata Group

15b. Inflorescence nodding; spathe limb clasping the spadix and more or less marcescent after anthesis, finally falling with spent parts of spadix; massive pachycauls.................................................................................................................................................................................... Schismatoglottis Corneri Group

Hestia S.Y. Wong & P.C. Boyce, gen. nov.—Typus: Hestia longifolia (Ridl.) S.Y. Wong & P.C. Boyce, comb. nov. Figure 1

Herbae terrestris. Rhizomae in solum podzolicus infossus penitus. Surnculi hapaxanthicus ad basin valde facile disarticulantes. Inflorescentiis numerosus, nutans ab pedunculis basin spatibus profunde flexis. Flores masculi 1-3-andrici; flores feminei ovarium ovoideum, 2-loculare, ovulum plura ad parietalum loculi insertum. Parte femina sparsiflora, parte mascula valde densiflora, staminodia ad
basim et paullo apicem habens, baccae carnosae densiter dispositae in spathae fructiferorum anguste-campanulatum persistens.

Moderate clump-forming herb. Stem hypogeal, hapaxanthic, usually very deeply buried in the peat layer, shoots dis-articulating readily from stem. Leaves few per module but modules usually superposed to form dense clumps; petiole D-shaped, with the abaxial angles rounded to acute, sheathing in the lower part; wings of the sheath tapering, fully attached except for distal briefly ligulate portion; lamina

Figure 1. Hestia longifolia (Ridl.) S.Y. Wong & P.C. Boyce. A, Plant in habitat on podsol; B, Nodding inflorescences, the inflorescence to the left at female anthesis; upper right at male anthesis, lower right post-anthesis with spathe beginning to degrade prior to being shed; C, Spathe slightly gaping at female anthesis; D, Spadix with the spathe removed artificially to reveal the female and male flower zones; E, Inflorescence post-anthesis with spathe limb rotting at junction of lower spathe, later to be shed together with spent part of spadix; F, Infructescences with the distinctive narrowly campanulate lower spathe; G, Fruits.
oblanceolate, the base attenuate to narrowly rounded, the apex shortly acuminate and mucronate, the micro solid; primary veins c. 6-8 per side, flush adaxially, barely prominent abaxially, interprimary veins irregularly present, secondary and tertiary venation inconspicuous and flush with the lamina. Inflorescences sequentially maturing synflorescence; peduncle very slender, wiry, suberect and elongating in fruit, inflorescence nodding from the apex of the peduncle; spathe narrowly cylindrical, long mucronate apically; lower spathe, narrowly ovoid, differentiated from spathe limb by a weak constriction; limb narrowly lanceolate, clasping and very slightly inflating and gaping at anthesis, thence deliquescent-deciduous; spadix equalling limb portion of spathe in length; female flower zone, adnate to the spathe; interpistillar staminodes few amongst the ovaries, mainly concentrated into a somewhat interrupted single row along the spathe/spadix adnation and another basally at the insertion of the spadix on the spathe/peduncle; pistils globose, rather distant; stigma button-like, sessile; ovules few on a basal placenta; intersticestaminodes, slender-stalked, apically narrowly clavate, a little higher than the pistils; male flower zone cylindric; stamens close-packed, some with filaments partially united forming dimerous to trimerous male flowers, others solitary; anthers ±dumbbell-shaped from above with the connexivum forming a slight dome between the thecae; thecae opening through apical slit-like pores; pollen dusty; appendix tapering-cylindric to very narrowly ovoid, composed of very close-packed columnar flat-topped staminodes. Fruiting spathe narrowly campanulate, nodding, long-persistent, at fruit maturity deliquescing starting from the margin backwards towards the peduncle, and splitting longitudinally, fruits falling whole. Fruit ovoid-globose to somewhat compressed, ripening green, stigmatic remains dark brown. Seeds ellipsoid, strongly longitudinally ribbed, medium brown.

Distribution. MALESIA: disjunct between the Malay Peninsula, where it is known to only from Perak, and Borneo, where it is known from numerous but widely scattered localities in Sarawak and Brunei.

Habitat. In kerangas formations in lowland rain forest and lowland hill forest, and regrowth, always occurring on raised podsols in swampy areas, sometimes near streams to c. 250 m alt.

Notes. This is a very distinctive genus easily recognised by the rather numerous nodding inflorescences on relatively very long slender wiry peduncles. There is only a weak constriction present between the lower spathe and upper spathe and the orifice of the lower spathe is open during fruiting. The entire non-female portion of the spadix often dries and adheres to the spathe limb with the whole combined unit shredding.

Hestia longifolia has vegetative modules that readily disarticulate from the deep-seated rhizome. The function of the disarticulation in this podsol-obligated species is not clear, but it is speculated that it may be an adaption to fire resistance in a highly fire-prone habitat. Perhaps enabling the shoot unit to be destroyed in some way prevents damage to the main perennating system.

Etymology. Hestia is named for the daughter of Cronus and Rhea, she was one of the twelve Olympians until replaced by Dionysus. Hestia was the Roman Goddess of the hearth and its fire, and was accorded special honour at feasts and sacrifices. She was also the Goddess of Chastity. The name is chosen in allusion to the fire-prone habitat of the single species, and the barely opening spathe.

Hestia longifolia (Ridl.) S.Y. Wong & P.C. Boyce, comb. nov.


Specimens examined. MALAYSIA. PERAK: Tanjung Pondok, Burkill & Hanif 13246 (K, SING); Maxwell’s Hill, Curtis 2082 (SINGT); Bukit Larut, Hay et al. 9063 (UPM); Taiping Hill, Henderson 10253 (SING); Taiping, along rd to Maxwell’s Hill, Nicolson 1069 (SING); Kuala Temangoh, Ridley 14307 (SING); Gunung Hijau, Ridley s.n. (SING); ‘Perak Hills’, Ridley s.n. (K); Maxwell’s Hill, Ridley s.n. (SING); Relau Tujor, Wray 1784 (CAL), 2193 (CAL, SING). SARAWAK: Kuching Division: just outside Kubah NP, above intake dam on Sg. Bungen, Boyce 770 (K); Bau, Kampung Grog, 1 Mar 2004, P.C. Boyce & Jeland ak Kisai AR-233 (SAR); Bau, Kampung Grog, 3 Jun 2004, P.C. Boyce & Jeland ak Kisai AR-433 (SAR); Bau, Gunung Towai, 16 Oct 2004, P.C. Boyce & Jipom ak Tsai AR-730 (SAR); Bau. Kampung Bogag, Gunung Tibugai, 01°21’31.1’’; 110°03’48.7’’, 6 Jan 2005, P.C. Boyce & Jeland ak Kisai AR- 948 (SAR); Bau, Kampung Bogag, Gunung Tibugai, 01°21’31.1’’; 110°03’48.7’’, 12 Jan 2005, P.C. Boyce, R. Kneer & Jeland ak Kisai AR-960 (SAR); Bau, Kampung Grog, 18 Jun 2005, P.C. Boyce & Jeland ak Kisai AR-1239 (SAR); Bau, Krokon, Kampung Tringgus, Sungai Bong, 01°15’32.2’’; 110°05’27.6’’, 26 Jun 2005, P.C. Boyce, Jeland ak Kisai & Wong Sin Yeng AR-1847 (SAR); Matang, Kubah National Park, Sg. Senduk trail, 01°37’24.1’’; 110°10’04.5’’, 4 Aug 2007, P.C. Boyce, Wong Sin Yeng & Simon Maclean AR-2133 (SAR); Bau, Bongo Range, trail to Tegora Mine, 01°19’41.5’’; 110°09’19.0’’, 8 Sep 2007, P.C. Boyce, Wong Sin Yeng & Alexander Kocyan AR-2192 (SAR); Serian, Brooke 9605 (L). Sarikiei Division: Sarikiei, Ulu Sarikiei, Rumah Nyuka, 23 Jun 2006, P.C. Boyce & Wong Sin Yeng AR-2042 (SAR). Kapit Division: Belaga, km 10 Bakun - Bintulu-Miri road junction, 02°50’51.7’’; 114°01’57.6’’, 14 Oct 2005, P.C. Boyce, Jeland ak Kisai & Jipom ak Tsai AR-1417 (SAR). Limbang Division: Limbang, Nanga Medamit, Mulu N.P., trail from Camp 5 to Kuala Terikan, 04°12’58.0’’, 111°53’20.1’’, 29 Sep 2007, P.C. Boyce et al. AR-2227 (SAR); Limbang, Nanga Medamit, Mulu N.P., Sungai Abun Kiri, tributary from Sungai Terikan, from the back of Mentawai Research Station, 04°14’07.4’’; 114°52’27.6’’, 2 Oct 2007, P.C. Boyce et al. AR-2286 (SAR); Limbang, Nanga Medamit, Mulu N.P., trail from Kuala Terikan to Camp,
Resurrection of *Apoballis*


Herbaceous. **Stem** pleonanthic, epigean, erect to decumbent. **Leaves** few to many, often clustering terminally; **petiole** usually glabrous, sometimes minutely puberulent, leaf sheath fully attached, tapering, persistent to slowly degrading in the marginal distal part; **lamina** oblanceolate to ovato-sagittate, sometimes variegated, glabrous adaxially and abaxially, basal cuneate to sagittate, apex acute to long acuminate; primary and secondary venation bipinnate, tertiary venation obscure. **Inflorescence** solitary or synflorescence, up to 5 together; **spathe** long, up to 20 cm; **lower spathe**, ovoid, differentiated from the spathe limb with gradual or abrupt constriction; spathe limb obl-long-lanceolate, **upper spathe** persistent until well after anthesis, then deliquescent, opening only slightly, the distal portion remaining convolute, with the ventral part of the male zone exposed; **spadix** equaling or less than spathe; **female flower zone**, more or less cylindrical, obliquely inserted to adnate for up to 1/3 of its length; pistils globose, sessile; interpistillar staminodes present or absent; **interstice** prominent, mostly naked with a few groups of small more or less sessile staminodes; **male flower zone** cylindrical to slightly tapering, the lower part corresponding with the spathe constriction; stamens crowded, dumbbell to irregular shaped; **appendix** present. **Fruiting spathe** urceolate, declinate; **Fruits** and **seeds** not seen.


**Habitat.** Terrestrial in primary lowland to hill forest, sometimes rheophytes. 50-1,500 m alt.

**Notes.** *Apoballis* comprises the *Schismatoglottis Rupestris* Group previously recognized by Hay & Yuzammi (2000). Molecular analysis undertaken in the previous study (Wong et al., in press) has shown that for all taxa sampled (*Apoballis acuminatissima* and *A. mutata*), *Apoballis* is the basal to *Schismatoglottideae sensu* Wong & Boyce.

*Apoballis* is defined by the decious leaf sheath and prominent naked interstice interspersed sparsely with staminodes. The spathe usually hardly opens, and is semi-persistent into fruiting.


*Apoballis belophylla* (Alderw.) S.Y. Wong & P.C. Boyce, comb. nov.


*Apoballis grandiflora* (Alderw.) S.Y. Wong & P.C. Boyce, comb. nov.


*Apoballis hastifolia* (Hallier f. ex Engl.) S.Y. Wong & P.C. Boyce, comb. nov.


*Apoballis javanica* (Engl.) S.Y. Wong & P.C. Boyce, comb. nov.


*Apolballis okadae* (M. Hotta) S.Y. Wong & P.C. Boyce, comb. nov.


*Apolballis ovata* (Schott) S.Y. Wong & P.C. Boyce, comb. nov.: *Schismatoglottis ovata* Schott = *Schismatoglottis sylvestris* Alderw. = *Schismatoglottis sylvestris* var. *subcordata* Alderw.


**Schismatoglottis sensu Wong & Boyce**

The resurrection of *Philonotion* Schott (Wong et al., in press) and the genera dealt with above leaves a core *Schismatoglottis* that is so far monophyletically supported. *Schismatoglottis* now comprises the Calyptrata Group, Multiflora Group, Tecturata Group, Asperata Group and Corneri Group *sensu* Hay & Yuzammi (2000). The taxonomy and systematics of the Multiflora and Asperata Groups is currently under review by the authors.

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**LITERATURE CITED**


婆羅洲砂勞越的天南星科落檐族研究 (IX)：
新屬 Hestia 發表及 Apoballis 屬的重新承認

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本文發表產於婆羅洲砂勞越的天南星科一新屬 Hestia S.Y. Wong & P.C. Boyce 模式種為 Hestia longifolia (Ridl.) S.Y. Wong & P.C. Boyce (Schismatoglottis longifolia Ridl. 為其同物異名)。此外，結合分子與形態分析的資料，我們恢復了 Apoballis Schott 屬的地位，而將 12 種原隸屬於 Schismatoglottis 的植物學名做了新組合處理。本文並提供落檐族 (Schismatoglottideae sensu Wong & Boyce) 的檢索表與 Hestia longifolia 的彩色圖版以資辨識。

關鍵詞：Apoballis；天南星科；婆羅洲；Hestia longifolia；砂勞越；落檐族；Schismatoglottis longifolia