Appendix

The following extract, a piece of nature study from an old Indian Flora (P. F. Fyson, *The flora of the Nilgiri Hills and Pulney hill-tops*, 1914, p. 270), concerns the pollination of an Indian representative of the family, *Planchonella tomentosa* (now *Xantolis tomentosa*):

"The buds point down at about half a right angle, with the style protruding and always curled upwards. The stigma appears to be receptive at an early stage, though more so later on. When the flower opens the petals spread widely, with the anthers that have already dehisced, pressed up against them by their stiff filaments. The staminodes are curled inwards with rounded backs and tips curved up against the style, so covering the nectariferous disc. This latter is usually dry but if stimulated by the contact of a bristle becomes wet with a copious exudation of honey. An insect visiting the flower for honey would have to hang on to the flower and in probing for the narrow slits between the staminodes, by which alone access to the honey is possible, would shake the corolla and be dusted with pollen; the style being curved upwards out of the way would not receive this pollen. The flower closes again before dropping off, and autogamy would occur as the corolla and stamens fall off past the style."

Titan arum (*Amorphophallus titanum*) flowers in New Zealand for the first time

Ewen K. Cameron

Fig. 1. The local radio kept announcing the exciting news and c.10,000 visitors flocked to the Wintergarden in the Auckland Domain to see the first titan arum flowering in New Zealand on Sunday 1 Dec 2013. The queue double-looped around the courtyard between the two glasshouses. All photos by EKC.

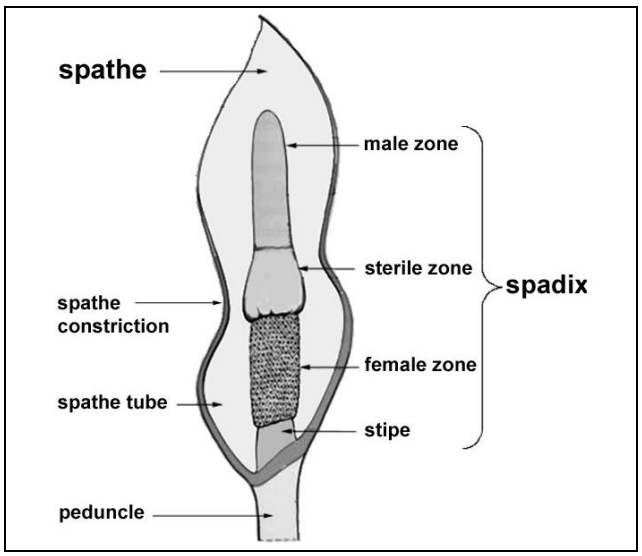

Fig. 2. A stylised diagram of an arum inflorescence (image improved by Joshua Salter).

On the 30 November 2013 a titan arum (*Amorphophallus titanum*) flowered in the Tropical House at the Wintergarden in the Auckland Domain, attracting large crowds (Fig. 1) as it was the first time this species has flowered in New Zealand. It belongs to the arum family (Araceae) and the 'flower' as such is not a single flower, but a cluster of flowers – an inflorescence. The central fleshy spike, the spadix, has a zone of male flowers and below them a separate zone of female flowers; the spadix is wrapped in a leaf-like bract, the spathe, which is open above allowing pollination (Fig. 2). Well-known cultivated members of the family include philodendrons (*Philodendron*) and calla or arum lilies (*Zantedeschia*). The name titan arum was coined by David Attenborough during the filming of the *Private Life of Plants* series (1995). Titan arum is often considered the largest inflorescence of herbaceous plants (cf. the palm genus *Corypha*) but *Amorphophallus gigas* is alleged to be taller (Mabberley 2008).

The titan arum was discovered and described in a different genus (*Conophallus*) in 1878 by the Italian botanist Odoardo Beccari and transferred to *Amorphophallus* the following year. There are about 150 species in the genus *Amorphophallus* occurring in the Old World tropics (Mabberley 2008). A translation of the scientific name:

amorphous (Greek) – shapeless or deformed
phallus – penis (referring to the spadix)
titanius – very large

Titan arum is native to the tropical rainforests of Sumatra (Indonesia) and is locally known as *bunga bangkai*, roughly translated as 'corpse flower'. It is

Fig. 3. A single giant, umbrella-like compound leaf of titan arum. Princess of Wales Conservatory at Kew Gardens, England, 13 Jun 2011.

Fig. 4. Petiole (18 cm diam.) of a 4 m tall leaf. Photo: 7 Apr 2014. Figs. 4-10 taken in the Tropical House (TH), Wintergarden, Auckland Domain.

Fig. 5. Titan arum inflorescence 2.5 m tall – the spathe started opening 3 hrs after photo taken. Photo: 11am, 30 Nov 2013.

Fig. 6. Fully open titan arum, scent in weak pulses; the 2-hour wait was worth it. Photo: 8pm, 1 Dec 2013.

Fig. 7. Spathe closed, no scent. Photo: 8.30am, 2 Dec 2013.

classed as 'Vulnerable' on the IUCN Red List of threatened plants – much of its natural habitat is being cleared for oil palm plantations. The underground tuber, a corm, usually weighs up to 50 kg, but one at the Botanic Garden at Bonn (Germany) weighed 117 kg (Liptrot 2013). Each year the plant usually grows one leaf that can be up to 6 m tall (Fig. 3) and lasts for over a year. It has been suggested that the lichen-like patches on the petiole (Fig. 4) are mimicry to prevent collision by animals which could easily damage the trunk-like petioles (Hejnowicz & Barthlott 2005). The corm enters a short dormant period (unusual in rainforest species) before producing another leaf, or every few years it flowers instead of producing a leaf.

"The flowering structure grows 10 cm per day [and may reach 3m tall], then heats up to human body temperature to broadcast its smell like smoke from a chimney. A Kew chemist found that its signature scent of "rotting animal in a pan of sauerkraut" is due to dimethyl sulphides. The stench attracts insects [carrion beetles and flies] to carry pollen between titan arum plants" (a label at Kew Gardens, June 2011).

The female flowers are receptive first, the male flowers releasing pollen the next day; in nature, this timing ensures cross-pollination with another flowering plant. However, solitary cultivated blooms occasionally manage to self-pollinate. If flowers are successfully pollinated, the surrounding spathe eventually falls off, exposing the maturing seeds; when ripe, the cherry-sized fruits turn a bright orange-red, a colour attractive to birds (including hornbills) which in nature pick the berries off and dispersed the seed (http://botit.botany.wisc.edu/Titan_Arum_Archive/).

The first plant in the world to flower in cultivation was at the Royal Botanic Gardens Kew in 1889 to a riotous reception (from seed sent by Beccari). The second was in 1894 at Land's Plantentuin Buitenzorg, Kebun Raya Bogor in Java (Indonesia). Up until 1993 there had only been 22 publicised flowering events from cultivated plants worldwide, but since then there has been another 143 publicised blooms, with the Auckland one being the most recent (http://en.wikipedia.org/wiki/List_of_publicised_titan_arum_blooms_in_cultivation).

The first one to flower in Australia was in Cairns (Fletcher Botanic Gardens) in 2003, then at the Royal Botanic Gardens Sydney the following year, and more recently at the Royal Botanic Gardens Melbourne in December 2012. There are plenty of time lapse sequences of the inflorescence opening online (check *YouTube*).

The flowering of the one at the Auckland Domain Wintergarden was well-advertised and the public came flocking in. On Saturday morning (Fig. 5) the

Fig. 8. Spadix collapsed over previous night. Photo: 2pm, 4 Dec 2013.

Fig. 9. Spadix withered and top of spathe wilted. Photo: 8 Dec 2013.

Fig. 10: New leaf (2.4m tall) of plant that flowered on 30 Nov 2013. Photo: 7 Apr 2014 with Eveline Perl, gardener at TH.

staff suspected it wouldn't open until the next day. On Sunday I had the Auckland Bot Soc picnic to attend at Tawharanui Regional Park. After the picnic and bush walk a few of us decided to check the titan arum out. We arrived c. 6 pm, and parking in the Domain was at a premium. We patiently queued with everyone else for nearly two hours (Fig. 1) to be rewarded with the colourful spathe magnificently open (Fig. 6) and pulses of quite manageable sulphide-like aroma. It was wonderful to participate in what I suspect was the largest one-day botanical event in the history New Zealand. Over the next few weeks the plant withered up (Figs. 7-9, Table 1); and by the end of January there appeared to be no living tissue left above the ground. After a very short dormancy, surprisingly then, on the 10 February a new leaf shoot emerged from the centre of the corm. It has since developed quite slowly and on 7 April it was only c. 2.4 m tall, with a petiole diameter 10 cm at 1 m, and was yet to unfold (Fig. 10). Compare this with another titan arum plant in the same glasshouse, whose new leaf appeared at the same time as the one on the plant that flowered, and is now (7 April) 4 m tall, with a petiole diameter 18 cm at 1m and the leaf blade expanded (similar to the one in Fig. 3). Presumably the flowering of the other plant has robbed its corm of its reserves so that it must now build them up. However, the prospects look good for a flowering next year of the second plant – don't miss it if it does.

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Table 1. The diary of the Auckland Domain titan arum.

2008	One of two corms c. 2 years old acquired in a plant exchange by Domain Nursery.
11 Nov 2013	A bud emerged from the 50kg corm after 6 months dormancy.
18 Nov 2013	Top of white spathe visible, (therefore not a leaf).
30 Nov 2013	2pm the spathe began to open in the Tropical House maintained at 28°C (Fig. 5).
1 Dec 2013	Spathe fully open (Fig. 6) and smelly in pulses; the Wintergarden gates opened at 6.30am, closed at 7.30pm with the last visitors leaving at 9.15pm; the day's total c.10,000 visitors.
2 Dec 2013	Spathe still open, but wilting a little, scent very faint.
3 Dec 2013	Spathe closed by 8.30am, no scent (Fig. 7).
4 Dec 2013	Spadix collapsed overnight (Fig. 8).
8 Dec 2013	Spadix withered (Fig. 9).
20 Dec 2013	Spathe now withered.
3 Feb 2014	Totally dried up, plant retained in Tropical House.
10 Feb 2014	A new leaf shoot emerged.
7 Apr 2014	New leaf only c.2.4m tall and yet to unfold (Fig. 10).

References

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