

The Marvel of Peru (*Mirabilis jalapa*, Nyctaginaceae) in Auckland

Rhys Gardner

Introduction

Each December at home a dusty strip of volcanic ground turns into a red and yellow *Mirabilis* jungle. Much of this is regrowth from the parsnip-like roots of last year's plants, while the rest comes from an accumulation of the hard, marble-sized fruits, whose single seeds germinate copiously after a few days of soaking summer rain. The fruit also gets moved about a little, but although outliers appear among the vegetables and by the paths the plant has never been able to keep on spreading. This seems to be the usual case in New Zealand, so I began to study the flowers and fruits of my colony in particular hope of finding the reason for its good behaviour.

The flowers

Horticultural books sometimes describe *M. jalapa* as a weakly woody, coarse-stemmed subshrub and go on to say that its garish colouring and overconfident demeanour debar it from the better gardens. But children at least enjoy the prettiness of the flowers, and for them there is also (softened by a pun on 'particoloured') the opportunity for a little etymology in the home curriculum—both common names, as every child should know, come from the flowers: Marvel of Peru, for their often strangely splotched and splattered colour pattern, and Four o'clock, referring to their regular opening in the latter part of the afternoon.

Others may find just as much interest in the floral details (Fig. 1). The flowers of the Nyctaginaceae (*Bougainvillea*, *Pisonia*, etc.) are unusual in lacking a corolla, and here in *Mirabilis* the colourful perianth is actually a much-modified calyx. Outside of this, just

to confuse things, is a whorl of five green bracts, which look very much like normal, green sepals.

The *Mirabilis* perianth is said to be 'salverform', that is, its narrow tube is abruptly expanded into a near-circular, flat to slightly pleated 'limb' (Note 1). This shape, the yellow to red colouring, and the presence of nectar at the base of the tube from the afternoon onwards (own obs.) would seem to implicate butterflies or humming birds as pollinators. However, because each evening's flowers give off a fragrance that persists and perhaps even strengthens through dusk, it seems generally thought that in its homeland *M. jalapa* is mainly pollinated at night by large long-tongued moths, such as the sphinx moth. Note that the flowers (always?) last just a single night.

I have never seen any butterfly or moth (big or small) visiting my plants, but a great deal of seed is formed, and, after making the usual sort of surgical experiments with the male and female flower-parts, I believe this occurs by self-pollination rather than apomixis. The process is simple. In the newly opened flower the stigma stands well above the stamens. Early next morning, as the perianth limb begins to crumple, the last centimeter or so of the style recurves in a tight circle, bringing the stigma into contact with the dehiscent anthers or with pollen fallen into the perianth's folds (Figs 1, 2). This self-pollination and the subsequent self-fertilization are a regular feature of the system, and at the height of summer more than half the flowers make seed in this way.

Fig. 1. *Mirabilis jalapa*. Floral features (drawn by the author)

A. Flower, newly opened. Style straight, stigma exerted over stamens and mouth of perianth. Limb of perianth 5 cm diam. Enlargements: (i) cross-section at base of perianth tube, showing hairs inside, and staminal filaments adherent to tube; (ii) cross-section part-way up the 5-ribbed tube, here glabrous inside and staminal filaments free.

B. Perianth limb from above, nearly flat, the five centrally-ridged lobes alternating with five long-triangular, slightly raised bands of differently coloured tissue, which are the prolongations of the perianth tube's external ridges; in bud each half of the five lobes curl inwards from these ridges

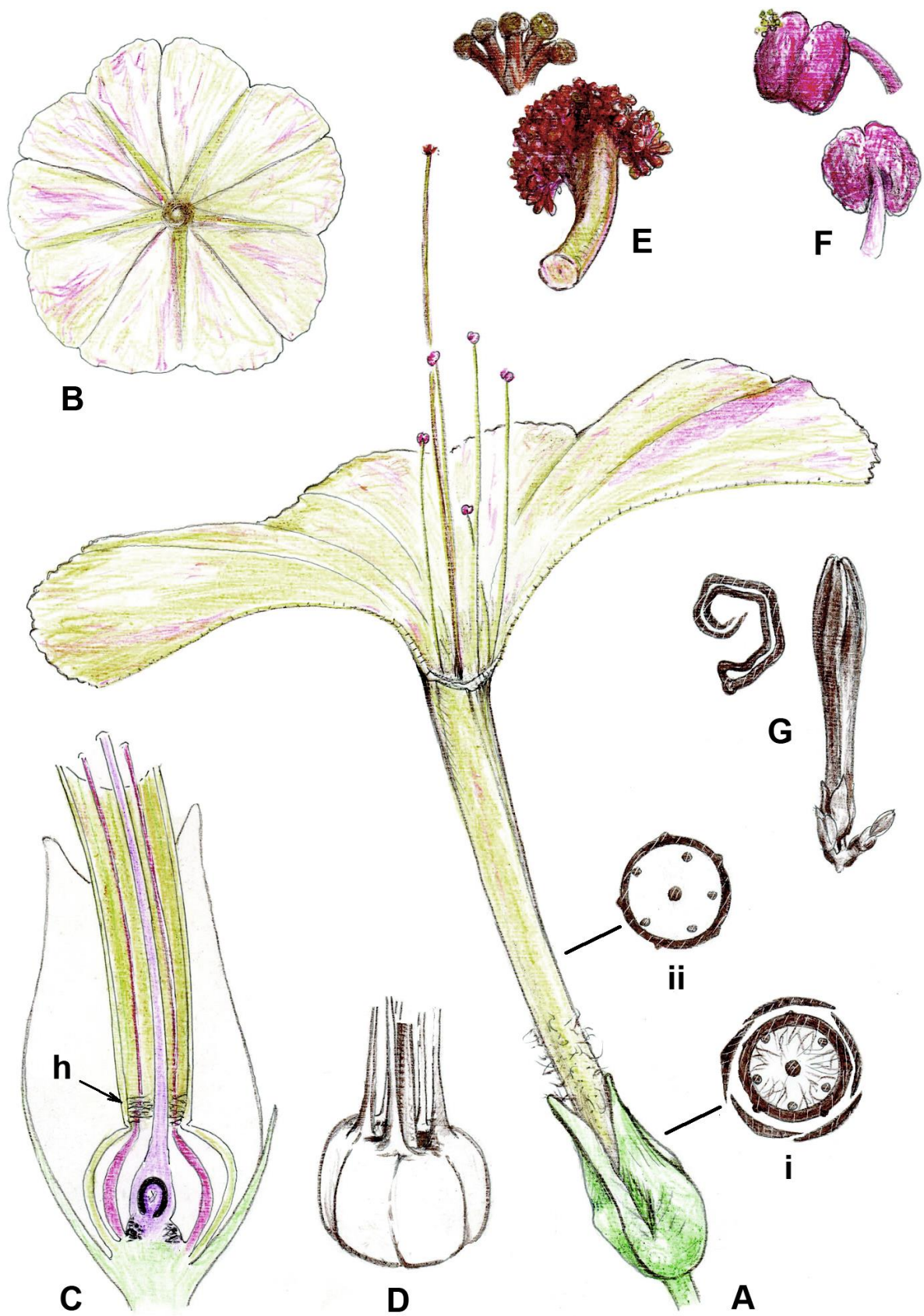
C. Base of flower, longitudinal section. Ovary (pale pink) with a single basal ovule. Ring of hairs **h** around inside of tubular part of perianth base, which further below is expanded into a pale green, firmly fleshy bowl c. 3 mm diam; inside it the base of the staminal apparatus (coloured dark pink).

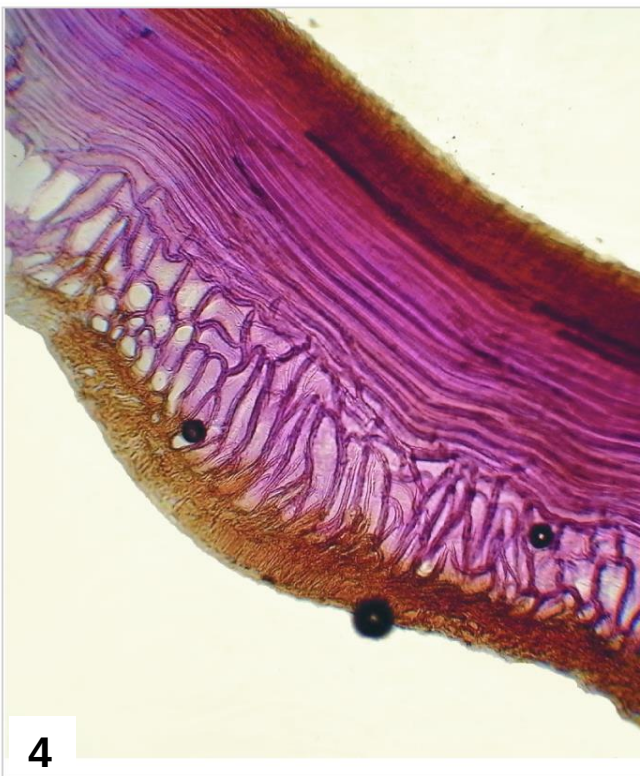
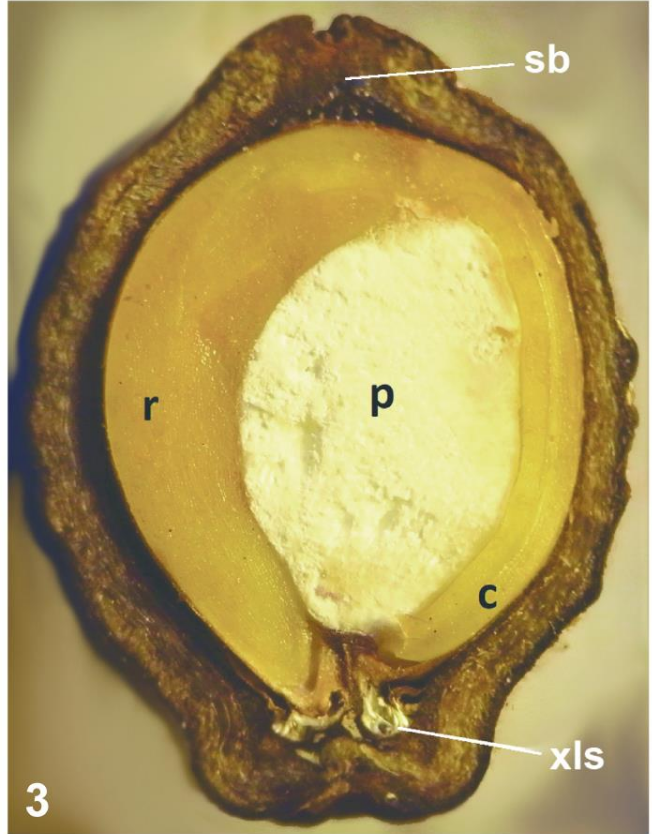
D. Base of staminal apparatus. The filaments are fused at their base into a thickened bowl-like structure c. 2.5 mm diam., where the nectar-secreting tissue might be located.

E. Stigma viewed from below is capitate, obscurely bipartite, and ultimately 'brocculiform' (the divisions several times branched and densely papillate). Enlargement above of the papillate end of branch. Stigma is 2.5 mm diam.; papillae to 0.1 mm diam.

F. Anthers, dorsifixed, margins crenate. Anthers 1.5 mm long.

G. Flower bud, showing the pleating of the perianth lobes. Enlargement above is a cross-section of a single lobe of the perianth limb, showing the manner of its folding—as seen from the outside, the left half of the lobe is incurved to lie against the right half and this double structure is curved in an anticlockwise fashion. Bud 4 cm long, at the limb 8 mm diam.





Figs. 2–5: **2.** *Mirabilis jalapa* flower at 9 a.m., beginning to close. Stigma fully recurved and bearing some large yellow pollen grains. Perianth 5 cm diam. **3.** *Mirabilis jalapa* anthocarp, 8 mm long. Base of style (**sb**) visible as a darker brown zone enclosed by the brown woody calyx-derived wall. **xls**: raphides; **p**: perisperm (the storage tissue); **c**: cotyledons; **r**: radicle. **4.** *Mirabilis jalapa* anthocarp wall. Radial longitudinal section. Wall at maximum extent 0.8 mm thick at widest point. **5.** *Mirabilis jalapa* anthocarps split at base to allow seed germination. Scalebar = 1 cm. Photographs by the author.

Fruit and seedling

In most flowering-plants the fruit is formed just by the ripened ovary, but in the Nyctaginaceae its most substantial part is made by the basal part of the calyx. At first fleshy and bowl-like, this enlarges after fertilisation, toughens, and closes over the ovary to firmly envelop it and its single seed. The whole fruit-like structure is technically described as an 'anthocarp', i.e., a "flower-fruit"—see for example our Flora's descriptions of the bird-catcher plant, *Pisonia*. No protection to the seed is given by its coat or by the wall of the ripened ovary—these are very thin and lie so close to one another as to be indistinguishable to the naked eye. Clearly the calyx has taken over this role, providing us with an example of what morphologists call 'transference of function'.

When the anthocarp of *M. jalapa* is cut longitudinally and examined with a hand-lens two structures can be seen between the ovary and the outer, calyx-derived wall (Fig. 3). One is expected and the other is not. The first is the fused base of the ring of stamens, shrunken and contorted around the base of the ovary. The second lies outside this, as a ring around the low pedestal on which the ovary stands: a glistening white cluster of 'raphides', crystals of calcium oxalate; these are more usually seen as intracellular objects.

The anthocarp wall is not quite 1 mm deep and is largely composed of a thick inner layer of longitudinally orientated stone cells and a variably thinner transversely-oriented outer layer (heaviest under the little bumps spattered over the fruit surface (Fig. 4). Such is the 'proximate explanation' for the anthocarp's external appearance. The 'ultimate explanation', i.e., the evolutionary one, is a mystery. In the flowering plants knobby rather than smooth fruit-stones are quite frequent. It might help

them get picked up by the dispersal agent, or govern their rate of passage through the gut. What the agent for dispersing *Mirabilis* in Peru might be I do not know—given the texture of the fruit it would have to be some very unfussy animal.

If a *Mirabilis* fruit is soaked in water for a few days then given a firm squeeze it splits in several places longitudinally around its cogwheel-like base. The radicle of the embryo can then emerge. Sometimes though, when the splitting is not great enough, the "stuck" radicle sends out numerous adventitious roots. Either way, the embryonic shoot apex and the two large green cotyledons soon swell enough to push off their cap of anthocarp (Fig. 5).

It seems to me that the fruit in my garden's seed bank has no significant enemies (not even the motor mower). So, as with the flower, there appears to be no feature of this part of the plant's life-cycle that is clearly responsible for its inability to become more than just a seasonally welcomed 'wildflower weed'.

Note 1 The term 'salverform' derives from the near-obsolete English word *salver*, meaning a very superior kind of tray used when presenting food or drink to royalty, etc. The Oxford English Dictionary relates *salver* not (as one might guess) to the metal silver but to French and Spanish words used in the 17th C. and earlier. These had the particular meaning of a presentation that had been tested and found free of poison, the ultimate origin here lying with the medieval Latin *salvar*, to make safe (see also <https://www.acsilver.co.uk>). The term, as 'salver-shaped' was used by both John Lindley and Asa Gray in the first part of the 19th C. in their texts; I have not traced earlier occurrences. A competing Greek term is 'hypocrateriform', which means, rather obscurely, less than bowl-shaped. This, the OED says, appeared in English in 1760. (Gray observed that "hypocraterimorphous" was preferable, since it did not mix Greek with Latin.)

Knee-deep botany in the time of Covid-19 – Titch Place Stormwater Pond, Sunnyvale

Yumiko Baba and Cameron Kilgour

Our bubble of two was tucked in, in the quiet suburb and cultural oasis of Sunnyvale (NOT Sunnynook!), West Auckland. During lockdown we took the opportunity to explore some of the planted and weedy suburban streamside vegetation and reserves in our area. These areas fall within the catchment and floodplains of both Oratia and Waikumete streams. One stormwater pond in particular grabbed our attention due to it being almost completely dry

and having an interesting array of wetland species growing in the mud, despite the usual human detritus and modern artifacts of the urban environment.

Titch Place storm water pond is one of four artificial storm water ponds located near to Waikumete Stream and both Sherrybrooke Esplanade and Albionvale Esplanade Reserve, which are