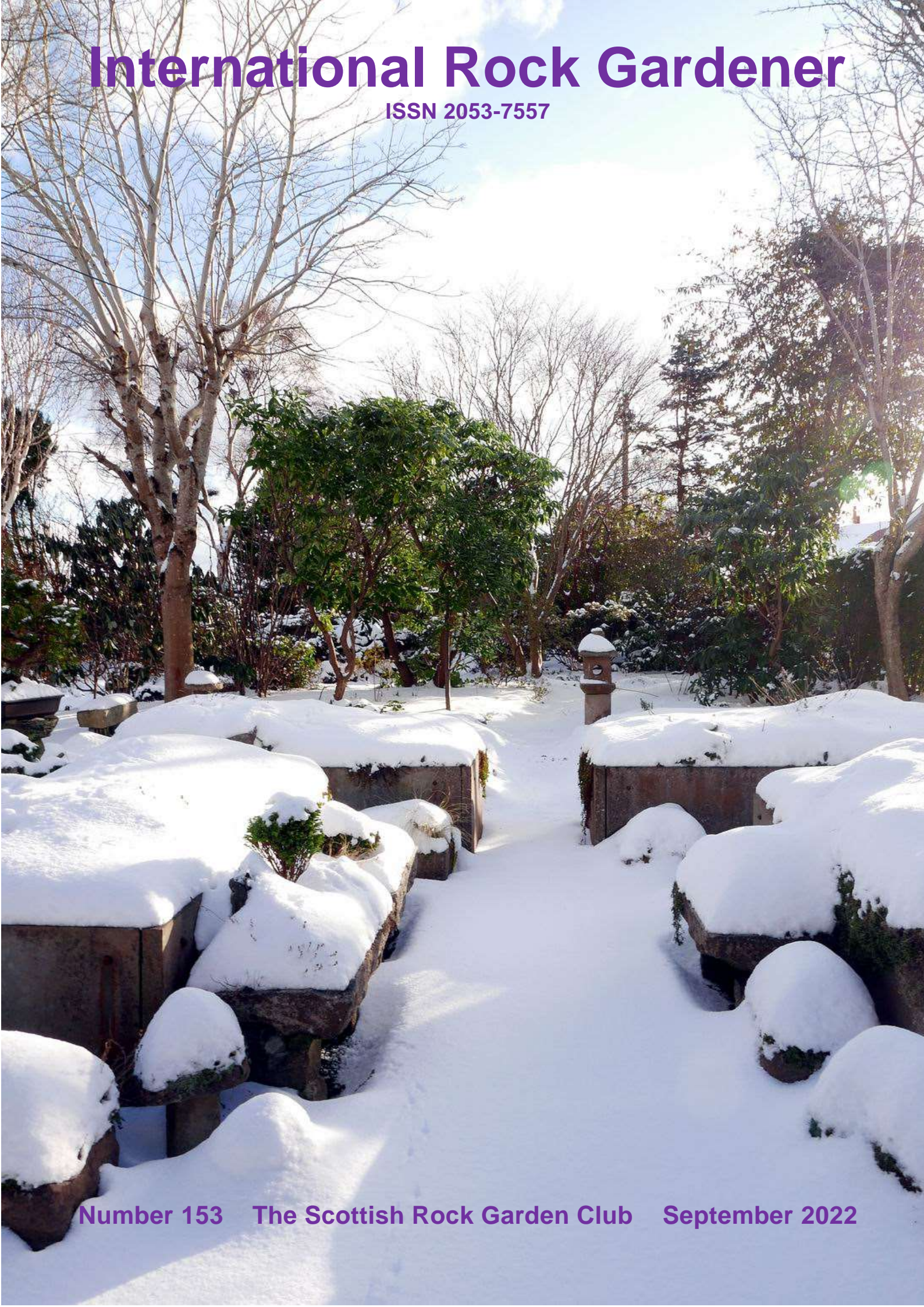


International Rock Gardener

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A warm welcome back to John and Anita Watson, who this month contribute an article on a new *Viola* species from northern Patagonian upland and its eponymic *Yramea* fritillary butterflies. Elsewhere, we present information from the huge archive of SRGC twice-yearly journals to tempt you to study the wealth of knowledge therein – all these journals, plus an index, are available to read or download here: <https://www.srgc.net/srgcjournal.asp> - Enjoy!

The recycled articles here are about building and landscaping raised beds – in this case in the Aberdeen, north-east Scotland garden of two of the IRG editorial team – J. Ian Young and Margaret Young. The photos are mostly by J. Ian Young, as in our **cover image: Snow in an Aberdeen garden, over raised beds and troughs.**

Snow, is, of course, widely recognised as the most natural, and best, winter cover for alpine plants. Our initial article describes the device we used for covering the beds in their early years, but as is mentioned later, we discovered that with our fast draining planting mix, not to mention changing climate conditions, these covers were no longer needed.



Image from old, scanned photo of the early construction of our raised slab beds.

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--- Species Description ---

A new northern Patagonian upland *Viola* species and its eponymic *Yramea* fritillary butterflies.

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fig. 1. South America, with the location of *Viola yrameae* marked.

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Introduction

This new annual species was first published as a botanical drawing in 1988, when identified as a widespread familiar taxon which had been known to science since 1833. The accompanying morphological description differed slightly but critically from the earlier species, however. During our extensive investigation of *Viola* subg. *Neoandinium* we recognised the misunderstanding and also the fact that the plant as depicted had not been described hitherto. We have collected specimens ourselves, and it has since been photographed by others. Accordingly, we present it here, together with a key distinguishing it from other annuals of the section. We also review the important part-mutualistic global relationship between the taxonomic group of *Viola* as a whole and butterflies of the Argynnini tribe, including *Yramea*, the genus after which the novelty is named.

Introducción

Esta nueva especie anual se publicó por primera vez como dibujo botánico en 1988, cuando se identificó como un taxón familiar bien distribuido y conocido, que se había descrito en 1833. Sin embargo, la descripción morfológica que la acompaña difiere levemente pero de manera crítica. Durante nuestra extensa investigación de *Viola* subg. *Neoandinium*, reconocimos el malentendido y también el hecho de que no se había descrito antes. Hemos recolectado especímenes nosotros mismos, y desde entonces ha sido fotografiado por otros. En consecuencia, presentamos aquí, junto con una clave que la distingue de otras especies anuales similares de la sección. También revisamos la importante relación global y parcial mutualista entre *Viola* en su conjunto y las mariposas de la tribu Argynnini, incluido el género *Yramea*, que lleva el nombre de la novedad.



fig. 2. A view looking from the south of the Patagonian Province Neuquén, Argentina, where *Viola yrameae* is endemic. (Photo John Watson)

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The genus *Viola* L., its subgenus *Neoandinium* Marcussen, and the new species of section *Subandinium* J.M. Watson & A.R. Flores.

Viola, the largest genus of the family Violaceae, is cosmopolitan, with a predominant presence throughout the temperate regions. A significant secondary representation exists in the tropical zones of South America, Africa, Asia, and also Melanesia (Lindsay & Horwith 1999), where violas are associated with mountain systems from 600 m upwards, but exhibiting a tendency to favour higher, cooler elevations. Based on the latest informed assessment, the species total for *Viola* stands at 644 known and accepted species in 31 sections, the majority of the latter endemic to the Northern Hemisphere (Wahlert et al. 2014, Watson & Flores 2019, Marcussen et al. 2022a, 2022b).

The genus has been found to have evolved ca. 35 ma ago in what is now the southern end of temperate South America (Clausen 1929, Ballard et al. 1999, Marcussen et al. 2012, Marcussen et al. 2015). This geographical location of the branching from the rest of the family has led to the conclusion that it contains species of the most direct ancestral origins in *V. subg. Neoandinium* and two sections of *V. subg. Viola*, sect. *Leptidium* and sect. *Rosulatae*. The subgenus and one of these sections, sect. *Rosulatae*, are endemic to the subcontinent, and the other section is mainly distributed there (Watson & Flores 2012). When its unpublished but accepted species are considered, *V. subg. Neoandinium* is the largest of these taxonomic alliances (Watson & Flores 2019, Watson et al. 2021).

Reiche (1893) was the first to recognise the latter endemic South American conglomerate, and he defined it as the *Rosulatae*, but without taxonomic rank, so therefore it was invalidly published. It is confined to the western Andino-Pacific geographical zone, ranging more or less continuously from the equator down to southern Patagonia. Its taxa, known colloquially as the Andean rosulate violas, amount to at least 147 species as currently recognised by us, 111 of them published to date, together with the present species and 35 more known either as specimens or in a few instances as reliable photographs, but which are as yet undescribed (Watson & Flores 2019, Watson et al. 2021).

Apart from two regional floras (Baehni & Weibel 1941, Rossow 1988), *V. subg. Neoandinium* was ignored botanically for decades following the death in 1928 of its historical authority Wilhelm Becker of Berlin-Dahlem, with specialised study of the infrageneric alliance as a whole not resumed until the mid-1990s. When these factors are taken in conjunction with the paucity of in situ encounters with many of its taxa, the fact that despite considerable recent advances it is still poorly understood compared with *V. subg. Viola* is hardly surprising (Watson & Flores 2014b). Furthermore, as many as 40 species are currently unknown in the wild (Watson & Flores, ined.), which serves to compound the problems, as also do the

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destruction of Becker's important collection at Berlin-Dahlem during World War Two (Hiepko 1987, Haagemann & Zepernick 1993), and the difficulty of distinguishing between some taxa. Nevertheless, Marcussen et al. (2015) calculated from a partial sampling that the subgenus split from the rest of *Viola* as early as 29 ma. This revelation, together with its specialised adaptation to developing Andean uplift and more recent Mediterranean geoclimatic conditions, explains why so many of its taxa are uniquely unlike the rest of *Viola* (Watson & Flores 2012, 2013a, c).



fig. 3. Neuquén Prov., N Argentinian Patagonia. Minas Dept. - pink lined. *Viola yrameae* location is arrowed.

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Numerous undescribed species of *V.* subg. *Neoandinium* have come to the attention of its investigators in recent years. In fact, the present century has already seen 25 published (Watson et al. 2021). This revitalization is readily explicable as being due to a near dearth of study of the section for 66 years following the decease of Wilhelm Becker, during which period only two new species were made known formally (Baehni & Weibel 1941, Rossow 1993). In addition, taxa of the section frequently inhabit vast, underexplored Andean terrain of difficult access, and exist as small, cryptic populations in few or even solitary locations (Watson & Flores 2014b). These factors in turn lead to discovery of two categories of novelties. On the one hand, very distinct undescribed species are regularly encountered during the course of fieldwork in localities hitherto unvisited for their flora. On the other, chronic and continuing lack of familiarity with the section, coupled with the very close superficial similarity of numbers of its taxa, have bred a situation where misidentification is commonplace, including in print. The misidentification may only amount to confusion between one published species and another, but at times it gives rise to an undescribed species being determined as a familiar one. Such is the case of the novelty presented here.



fig. 4. General northern Patagonian habitat of *Viola yrameae*. (Photo Anita Flores)

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Several of these taxonomical errors have their origin in the otherwise important and valuable entry of *Viola* for Flora Patagónica by Rossow (1988), who was given insufficient time for preparatory investigation (M.N. Correa, R.A. Rossow pers. comms.). During an early but fruitless attempt at the beginning of 1998 to locate a possibly undescribed Rossow plant in its habitat, we collected from the same vicinity of Neuquén Province, Argentinian northern Patagonia, a small, white-flowered annual *V.* subgen. *Neoandinium* species. It had been determined by Rossow (1988) as *Viola pusilla* Hooker & Arnott (1833: 145). The latter epithet was subsequently shown to be a nom. illeg. (Marticorena & Quezada 1985), and a new name, *Viola subandina* J.M. Watson [figs. 8, 9, 11], has since been provided for it. This taxon was published as the type of the recently described *Viola* subg. *Neoandinium* sect.

Subandinium (Watson et al. 2021). *V. subandina* is a common, widespread species [fig. 10]. The principal corolla pigment can either be pink [fig. 11] or pale violet [figs. 8, 9], but also rarely white, in common with the new species herein. It is told apart from all but one related annual species principally by its distinctive floral style crest. This consists of two lateral, linear, narrow, horizontal, flange-like lobes sharply recurved from the swollen clavate head of the style [figs. 13, 14]. The lobes can vary somewhat in length from individual to individual but are always clearly present. This configuration is not found in any other similar taxon of the section except *V. araucaniae* W. Becker, a species not known in the wild, but only from the type specimen, and differing at least in its glabrous foliage.

Rossow (1988) accurately circumscribed this micromorphological floral feature of *V. subandina* in his Flora Patagónica descriptive text, but while researching we chanced to notice that the accompanying botanical drawing showed a style which entirely lacked a crest (de Bruhn 1988) [fig. 12]. One consideration was the possibility of the structure having suffered loss of the lobes for some reason. Alternatively, it might have been an atypical flower or individual plant. Fortunately, the drawing was of a collection taken in 1970 from precisely the same locality in Minas Department, northern Neuquén Province as our own 1998 gathering. Careful examination of the latter specimens revealed that no crest was present on any flowers of the several specimens. Two further records of the same new taxon are known to have been recorded from nearby, and both have also been found to share the same crest-free style morphology (M. Ferreyra, M. Sheader pers. comms.). The three sites form a triangular area of narrow distribution [figs. 5, 6] which is isolated geographically from any *V. subandina* population [fig. 10].

The ornate style crest is an extremely uncommon evolution in *Viola* other than for the majority of *V.* subgen. *Neoandinium* taxa. Only the small Near Eastern and North African group *V.* subg. *Viola* sect. *Sclerosium* with a maximum of seven species (Shahrestani et al.

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2015) possesses significant equivalents (Becker 1925). By contrast, the absence of a crest in taxa of *V.* subg. *Neoandinium* also amounts to an unusual situation, being limited to nine taxa as published hitherto. Five of those are tropical and mainly perennial, the remainder temperate and largely annual (Watson & Flores ined.).

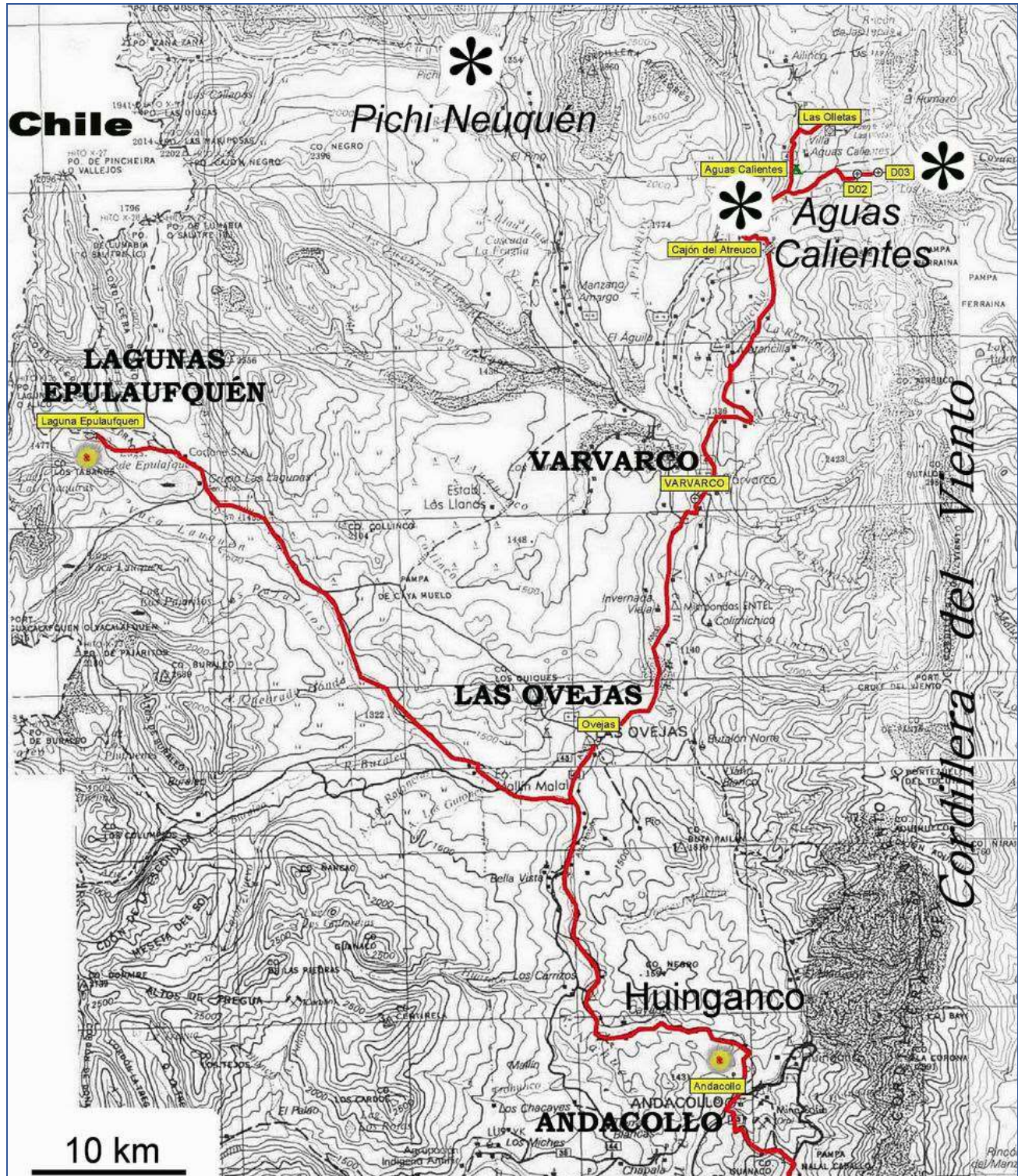


fig. 5. The three sites of *Viola yramaea* in Minas Department, Neuquén Province, Argentinian Patagonia.

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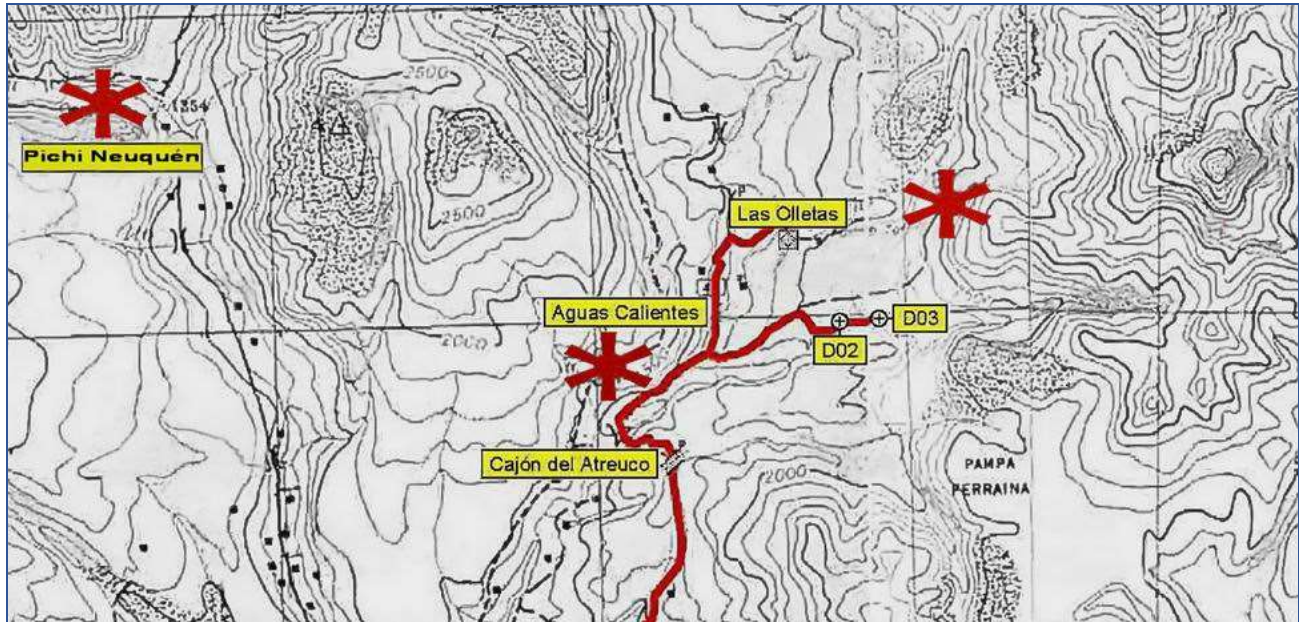


fig. 6. A close-up of the three sites where *Viola yrameae* has been found and recorded.



fig. 7. The new *Viola yrameae* (Photo Marcela Ferreyra)

The new species introduced above and described below adds a further taxon without a crest to the subgenus. As we collected and recorded it at the type site, the mutualism outlined in Watson & Flores (2013c) between its *V.* subg. *Neondinium* and the butterfly genus *Yrameae* was noted and confirmed there.

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Taxonomy

Viola yrameae J.M. Watson & A.R. Flores, sp. nov. [figs.5, 7, 12, 15].

Type: ARGENTINA. Neuquén Province, Minas Department, Pichi-Neuquén, beside the police post (puesto de Gendarmeria), 36°37'19"S 70°48'24"W, 1350 m, 10 Jan 1998, leg. A.R. Flores & J.M. Watson, F.& W. 8710! (holotype CONC. Isotypes SGO, herb. Flores & Watson).

Diagnosis: *Viola yrameae* differs from all other annual species of *V.* subg. *Neoandinium* by its morphological combination of eglandular laminas with patent-ciliate leaf margins, its white corollas, and absence of a style crest. (See also the key below.)

Description: Life form annual, rosulate hemicryptophyte. Rootstock axial, subfiliform, to ca 8–9 cm. Rosette 1.6–5 cm dia., solitary, loosely imbricate, adpressed to ground. Leaves to ca. 2.5 cm long when mature: stipules subbasal, 0.5–1.5 mm long, linear, acute, hyaline, proximate to margin, not divaricate above; pseudopetioles to 15 mm, narrow, margin hyaline to central vein; mature lamina 5–10 mm long × 1.5–6 mm wide, obovate, oblanceolate, linear-lanceolate or elliptical, cuneate to pseudopetiole; adaxial surface lightly alveolate-reticulate with 4 lateral veins per side, cryptic, all-brown or dull, pale green with brown tinged apex; undersurface smooth, eglandular; margin shortly pubescent–ciliate at base, becoming glabrescent towards apex, this acute. Anthesis successive. Flowers ca. 6 mm high × 5 mm wide, axial, solitary, forming up-facing ring on face of rosette, with maximum of four open simultaneously as seen. Peduncle 7–9 mm long, shorter than surrounding leaves, pilose apically; bracteoles 1.5–1.8 mm long, basal, erect, opposite to slightly alternate, linear-lanceolate, acute, margins entire to shallowly subdentate, hyaline. Sepals 3.5–4 mm long × 1 mm wide, entire, free, ovate-lanceolate, central vein pubescent, margins pubescent–ciliate, apex acute; posterior calycine appendage ca. 1–1.5 mm long × 1 mm wide, plane, acute. Corolla white, lower throat yellow with blackish violet longitudinal veins; superior petals 4–5 mm long × 1.8–2 mm wide, linear and slightly obovate, cuneate to base, apex bluntly rounded; lateral petals 4.5–6 mm long × 2–2.3 mm wide, linear-obovate, cuneate to base, apex subtruncate with rounded edges; small tuft of short white capitate hirsute indumentum at base; inferior petal 6–7 mm long × 4–6 mm wide, obcordate, margins upcurved, towards base, apex subtruncate, shallowly emarginate with rounded lobes and small obtuse mucron in sinus; spur 1 mm, cylindrical, apex retuse. Androecium and gynoecium concealed within throat; anthers 1.5 mm long × 1 mm wide, inferior pair with ca. 1 mm filiform, curved nectar spurs; connectives shorter than anthers, dull, dark orange–brown; style short, strongly

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geniculate, notably clavate; stigma porrect apical beak with papillose apex; style crest lacking. Fruit 4–5 mm, tri-valved capsule; seeds ca. 1.6–2 mm, lacrimiform, blackish brown.

Field note: Forming a small colony on bare waste stretches of relatively uncompacted soil with patches of short, low grass beside police post building just above an upper tributary streamside. No other petaloid flora observed in the immediate vicinity.

Phenology: Flowering and fruiting from November to January.

Distribution and habitat: *Viola yrameae* is a narrow endemic of Argentina and the country's Minas Department of Neuquén Province in the extreme northwest of Patagonia [figs. 1, 3, 5, 10]. Three localities have been recorded to date, with approximate extensions of 30 km east to west and 10 km north to south. [figs. 5, 6].

The overall habitat is undulating upper Patagonian steppe dissected by rivers and punctuated by scattered dormant volcanoes. The new species inhabits elevations there from 1350 m to ca, 2500 m. The predominant vegetation is bunchgrass of various species (Poaceae), but there are also stretches of biodiverse Patagonian flora. As known, the viola does not form part of such a mixed a petaloid community but grows in relative isolation among short grasses. [figs. 2, 4].

Additional material examined: ARGENTINA. Neuquén Province, Minas Department, Pichi-Neuquén, puesto de Gendarmeria, en ladera SO frente al destacamento Pichi-Neuquén, enero (January) 1970, O. Boelke et al. 13558 (BAB, SI), O. Boelke et al. 13596 (BAB). Curso inferior del Río Varvarco, Ao. Aguas Calientes, enero (January) 1970, O. Boelke et al. 14389 (BAB). A third cited location (the west foot of Volcán Domuyo), is only supported by a photograph taken by Marcela Ferreyra [fig. 7] without an accompanying herbarium specimen, but the record has been confirmed by two totally reliable sources (M. Ferreyra, M. Sheader pers. comms.).

Etymology: The plant is named for the symbiotic association of this particular species as well as the subgenus as a whole with fritillary butterflies of the monophagous genus *Yramea*.

Considered conservation status: Despite not having been formally evaluated as yet, *V. yrameae* as it stands should be categorized as critically endangered (CR) according to Red List criteria (IUCN 2012). It is only known as three populations within a maximum extent of 30 km, these together totalling well under 100 individuals. The area it occupies is a popular centre of tourism as well as being subjected to regular grazing by local stock animals.

Discussion: Annual subg. *Neoandinium* species

Published annual species of *Viola* subg. *Neoandinium* number 32 or 33 in total (Watson et al. 2021), and are distributed between Ancash Department, Peru, in high central tropical South

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America (Liesner 1993) and the northern Patagonian province of Neuquén, Argentina (Rossow 1988). The main centre of diversity is situated along the Pacific littoral and western exposures of the Andes in Chile, from Coquimbo Region to the cordilleras of Santiago (Watson & Flores 2013c).



fig. 8. Closely related *Viola subandina* for comparison. (Photo Anita Flores)



fig. 9. *Viola subandina*, showing the style crest, which is absent in *V. yrameae*.

(Photo Anita Flores)

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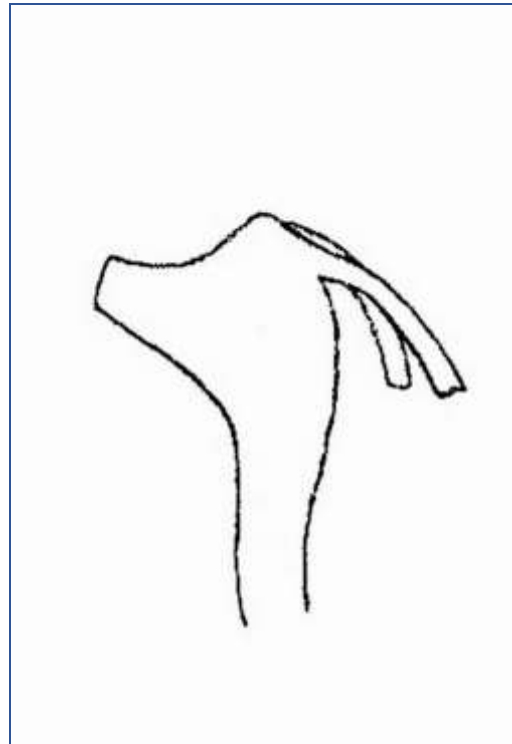
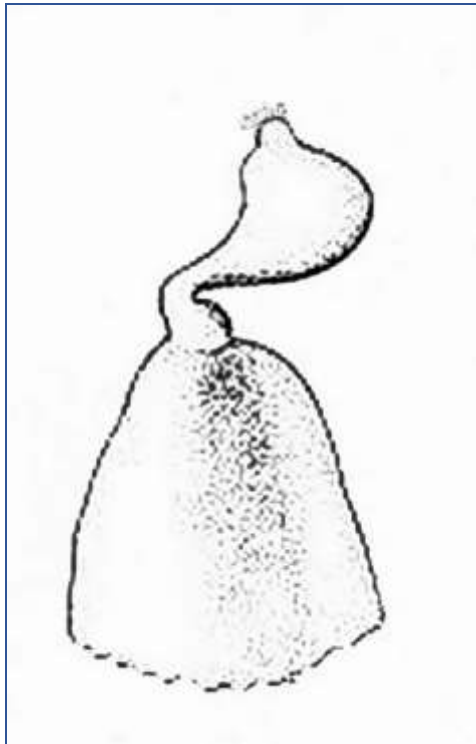


fig. 10. The separate distributions of common and widespread *Viola subandina* (green) and *V. yrameae* (blue dot).



fig. 11. A very pale form of *Viola subandina*. White forms equivalent to *V. yrameae* also exist, but rarely. (Photo John Watson)

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Left: fig. 12. *Viola yrameae*. Ovary, style and stigma (lacking crest). (Flora Patagonica 5, 1988). Right: fig. 13. *Viola subandina*. Historic botanical drawing of style head and diagnostic reflexed, narrow, lateral crest lobes. (Carlos Reiche)

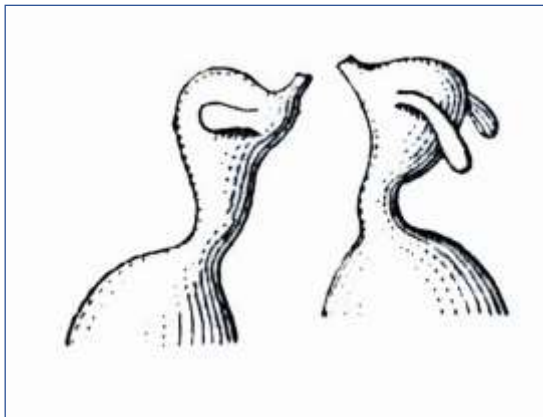
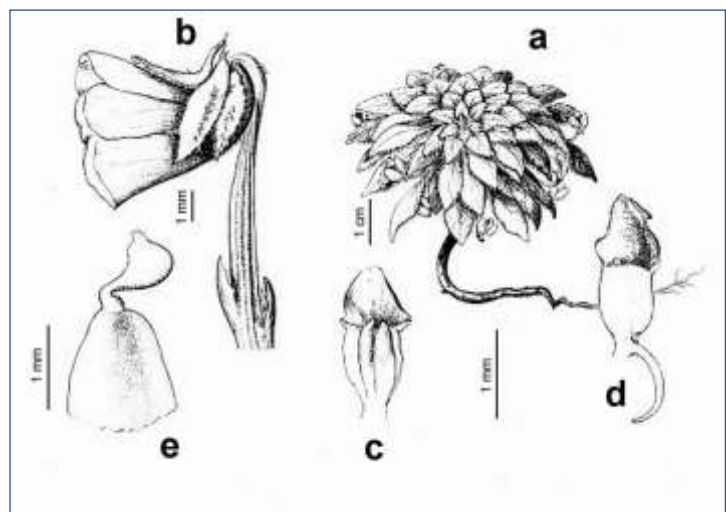


fig. 14. *Viola subandina*. Style head with lateral reflexed lobes. Two forms from different plants. (Wilhelm Becker)

fig. 15. *Viola yrameae*. (a) Plant. (b) Flower. (c & d) Apical & lateral stamens. (d) Ventral stamen with nectar spur. (e) Gynoecium showing absence of crest. (Flora Patagónica 5. 1988)



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The recently published *Viola* subg. *Neoandinium* sect. *Subandinium* (Watson et al. 2021) comprises 16 of that total, including the present novelty, as are keyed out below. Its exclusive full morphology as published is as follows: Annual rosulate herb. Lamina flexible, linear, oblanceolate or obovate, entire or shallowly long-crenulate.

Key to delineate *Viola* subg. *Neoandinium* sect. *Subandinium* and to differentiate its species.

1. Plants perennial ... Sects. *Ericoideum*, *Confertae*, *Rhizomandinium*, *Grandiflos*, *Xylobasis*, *Triflabellium*, *Inconspicuiflos*, *Sempervivum* pro max. parte, *Rosulatae* pro parte.
 - Plants annual ... 2.
2. Marginal cilia of lamina distinctly deflexed ... Sect. *Relictium*.
 - Marginal cilia horizontal or absent ... 3.
3. Lamina glabrous, fleshy, smooth-surfaced ... *V. micranthella* Wedd. [fig. 16]
 - Lamina flexible, with marked or raised venation. Margin ciliate or rarely glabrous ... 4.
4. Lamina strongly crenate or crenate-undulate ... Sect. *Rosulatae*.
 - Lamina entire or shallowly long-crenate, sect. *Subandinium* ... 5.
5. Plant short-cauline, lamina undersurface with indumentum ... *V. aurata* Phil. [fig. 17]
 - Plant subacaulous, lamina glabrous ... 6.
6. Veins of lamina face branched, reticulate, pale and clearly evident ... 7.
 - Face of of lamina insignificantly veined or without visible venation ... 9.
7. Style crest present ... 8.
 - Style crest lacking ... 18.
8. Style crest trilobed ... *V. domeikoana* Gay
 - Style crest entire ... *V. vallenarensis* W. Becker
9. Style crest lateral and apical ... *V. subandina* J.M. Watson [figs. 8, 11]
 - Style crest apical only ... 10.
10. Style crest with three free apical lobes ... *V. weberbaueri* W. Becker

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- Style crest apical-trilobed, or apical entire ... 11.
- 11. Style crest apical-trilobed ... 12.
- Style crest crest apical entire ... 13.
- 12. Lamina elliptical ... *V. auricula* Leyb.
- Lamina linear-spathulate ... *V. pusilla* Poepp. [fig. 18]
- 13. Lamina rhomboid ... 14.
- Lamina linear-spathulate ... 15.
- 14. Lamina subentire, shallowly crenate ... *V. rhombifolia* Leyb.
- Lamina markedly crenate ... *V. glechomoides* Leyb.
- 15. Corolla yellow ... *V. polypoda* Turcz. [fig. 19]
- Corolla violet or white ... 16.
- 16. Lateral petals bearded, upper margin ciliate ... *V. taltalensis* W. Becker [fig. 20]
- Corolla glabrous ... 17.
- 17. Lamina glabrous ... *V. araucaniae* W. Becker
- Lamina margin ciliate ... *V. nubigena* Leyb.
- 18. Lamina linear-spathulate ... *V. minutiflora* Phil. [fig. 21]
- Lamina elliptical or ovate ... 19.



19. Lamina undersurface glandular ... *V. pulvinata* Reiche

- Lamina eglandular ... *V. yrameae* J.M. Watson & A.R. Flores [fig. 7]

fig. 16. Annual *Viola micranthella*, Peru.

(Photo David Haselgrove)



fig. 17. Annual *Viola aurata*. Coquimbo Region, northern central Chile. (Photo John Watson)



fig. 18. Annual *Viola pusilla* Poepp., Aconcagua Province, Valparaiso Region.
(Photo Anita Flores)



fig. 19. Annual *Viola polypoda*, Atacama Region. (Photo John Watson)

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fig. 20. Annual *Viola taltalensis*, Taltal, Antofagasta Region. (Photo Anita Flores)



fig. 21. Annual *Viola minutiflora* in woodland below the Chillan volcano, Bío Bío Region.
(Photo John Watson).

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fig. 22. The southern fritillary butterfly, *Yramea cytheris* in our garden at Los Andes, Aconcagua Province, central Chile. (Photo John Watson)

fig. 23. *Viola odorata* thrives at various places in our Chilean garden at Los Andes. The leaves also feed our resident southern fritillary butterfly caterpillars. (Photo Anita Watson.)



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fig. 24. A friend sent us seeds of this *Viola sororia* in our garden. Caterpillars of the southern fritillary butterfly are probably responsible for the perforated leaves. (Photo John Watson)

fig. 25. *Viola tricolor*, a common escape into the wild in Chile also provides 'fodder' for the fritillaries. (Photo Fialka Trekhtsvetaya via the Internet)



fig. 26. *Yramea cytheris* visiting *Viola yameae* at the type location, Pichi Neuquén, northern Patagonia, Argentina. (Photo John Watson)

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fig. 27. *Yramea cytheris* ovipositing on *Viola chamaedrys* in the subandean hills shortly above our home in central Chile. (Photo John Watson)

fig. 28. Egg cases of *Yramea cytheris* on an unidentified annual rosulate viola. (Photo Anita Flores)



fig. 29. A *Yramea cytheris* caterpillar clearly in view on a *Viola chamaedrys* it has almost completely consumed. A most unusual situation. (Photo John Watson)

The new South American violet, its butterfly, and a wider perspective of that relationship

'Species with close associations to a host species, such as parasites and phytophages, make immense contributions to biodiversity.' (Thorn et al. 2015)

During the course of our recording and collecting specimens of this *Viola* at the type site, an imago female of *Yramea cytheris* [fig. 22] was observed interacting with it. The butterfly was both pollinating and ovipositing [fig. 26], visiting numbers of plants and undisturbed by our presence. This was not an isolated phenomenon. We have frequently noted this same fritillary butterfly species behaving similarly in colonies of *Viola chamaedrys* near our home in central Chile [figs. 27, 28] (Watson & Flores 2014a), as well as another, *Yramea lathonioides*, on *Viola escarapela* [fig. 30] further north in the Elqui Valley of Coquimbo Region. On numerous occasions these and a third species which inhabits higher Andean elevations, *Yramea modesta* [fig. 31], have also been seen in the general vicinity of various sect. *Neoandinium* species, helpfully drawing our attention to the presence of these, the plants we were seeking. As an interesting relevant corollary, *Yramea cytheris* also regularly inhabits our garden at 900 m near Los Andes, Chile, where the introduced Northern Hemisphere *Viola* species *V. odorata* [fig. 23], *V. sororia* [fig. 24] and *V. tricolor* [fig. 25] grow in some quantity (Watson & Flores 2018) and clearly serve as its food plants.

The relationship between the lepidopteran tribe Argynnini, to which *Yramea* belongs, and the genus *Viola* is long-established and cosmopolitan, and is assumed to date back ca. 35 ma to the synchronous evolutionary origins of both in what is now southern South America (Marcussen et al. 2015, Simonsen 2006).

It is considered to have commenced with a broader taxonomic base when the related nymphalid butterflies of the subfamily Heliconiinae adopted the similarly related *Passiflora* and early Violaceae lineages of the Malpighiales order as specialized comestibles for their larvae. Studies of larval host plants based on the obtained phylogeny suggest that the ancestral Argynnini utilized both *Passiflora* and Violaceae (Simonsen 2006), probably on a relatively interchangeable basis to begin with. But *Passiflora* soon became the exclusive food plant of one genus of the family only, *Heliconia*, which had not only adapted to tolerate its toxins, but also absorbed and incorporated them to render itself inedible to most predators (Rothschild 1970). Likewise, most, but not all, fritillary butterflies became inflexibly monophagous *Viola* specialists, and have remained as such since (Ehrlich & Raven 1964, Arroyo Kalin et al. 1983, Simonsen 2006, Robinson et al. 2010).

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Disadvantages of monophagy are obvious enough. The resultant total dependence on one host plant means inevitably suffering equally from any and all adversities that befall it, even to the point of extinction (Braby 2005, Sims 2017). Clearly then, there must be considerable compensatory benefits which make the risk worthwhile.



fig. 30. *Yramea lathonioides* visiting the annual *Viola escarpela* in the subandean sector of Elqui Valley, the near-northern Coquimbo Region, Chile. (Photo John Watson)

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fig. 31. The restless, damned elusive and rare *Yramea modesta* captured on camera at long last beside the Andean Laguna del Maule, Maule Region, near-southern Chile. (Photo John Watson)



fig. 32. A small native moth visiting perennial *Viola congesta* in the Andes of the upper Maule Valley, Maule Region, near-southern Chile. (Photo John Watson)



fig. 33. Annual *Viola aurata* being pollinated by *Caupolicana fulvicollis*, a native Chilean bee. Lower Elqui Valley, the near-northern Coquimbo Region, Chile. (Photo Anita Flores)

fig. 34. A Chilean native soft-winged flower beetle, *Melolontha melolontha*, burying its head in *Viola aurata*. Lower Elqui Valley, the near-northern Coquimbo Region, Chile. (Photo Anita Flores)



fig. 35. A European peacock butterfly, *Aglais io*, visiting *Viola canina*. (Photo anon, courtesy of the Internet)

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fig. 36. A bee fly feeding from a pansy. Photo Sue Kelly, courtesy of the Internet)

fig. 37. A North American bumblebee species, *Bombus impatiens*, pollinating a violet. (Photo anon, courtesy of the Internet)



fig. 38. *Bombus hortorum*, the garden bumblebee feeding from a pansy. (Photo anon, courtesy of the Internet)

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Plants, on the other hand, can possess a number of possible ways of combating herbivory. Among them are toxicity of potentially edible organs (Kant et al. 2015), as in *Passiflora*. The chemistry of the relationship between that genus and *Heliconia* has been well studied (Smiley 1985). The question therefore arises as to whether a similar situation exists for fritillary butterflies. This seems highly probable, as *Viola* also synthesizes organic substances, saponins and cyclotides, which are known to act as an effective entomotoxic defence against Lepidoptera in particular (De Geyter et al. 2012).

It is certain also that the small, depressed size of many violas as well as the cryptic appearance and isolated populations of a significant number in South America causes them to be overlooked by any predators hunting for arthropods (Wiklund & Friberg 2008). But a further advantage may be inferred from this. Grazing mammalian herbivores would be unlikely to be attracted to such vegetation either, thereby avoiding the risk that eggs and caterpillars of the fritillaries are incidentally consumed or trampled, as must happen to many larvae. This particular South American symbiosis not only supports and follows the analogous hypothesis of Wiklund and Friberg (2008), but also suggests a long and stable relationship between plant and insect.

The detrimental effects of phytophagy for a plant are clearly considerable to a greater or lesser degree as well. Potential reduction or even major loss of photosynthetic surfaces [fig. 29] of corollas as attractants, and of fruits/seeds needed to maintain its reproductive capacity are all likely consequences (Kant et al. 2015). But the association under consideration here is mutual, so what benefits do their hosts get from these butterflies?

As a broad generalization it can be asserted that whether mutualistic or not, pollinator-mediated selection, whatever the agent, is one of the main factors driving adaptation and diversification in angiosperms (Maad 2000, Medel et al. 2003), as the following selected citations confirm. For example, significant short-term phenotypic selection has been described for corolla size (Campbell et al. 1997) corolla shape (Gómez et al. 2008), corolla colour (Campbell et al. 1997), nectar guides (Medel et al. 2003), stigma exertion (Conner et al. 1996), spur length (Maad 2000), and flowering period (Valverde et al. 2015).

Taking the matching aspects of violas and butterflies in particular, many of the former have a floral structure including a nectar spur, which requires a long slender proboscis to reach into for pollination to be effected incidentally. Although by no means uniquely, Lepidoptera possess this organ (Proctor et al. 1996). Murúa et al. (2010) considered as a potential pollinator any visiting insect which inserted its entire head into the floral tube of a viola. But although that included Coleoptera species, the Lepidoptera [figs. 27, 32] would

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clearly have an advantage over any others such having a significantly shorter reach as beetles [fig. 34], bees [figs. 33, 37-41] and flies, with the exception of bee flies [fig. 36].

Murúa et al. (2010) conducted an extremely thorough investigation into the pollinators of *V. portalesia*, a fairly common endemic shrubby species of southern to central lowland Chile, which rarely reaches Andean elevations. To put their study in necessary ecological perspective, two locations were monitored at 35°50'S and 35°83'S, with elevations ranging between 160-522 m. One habitat consisted of mature native forest, the other was an established pine plantation. They found the Hymenoptera (44%) and Diptera (38%) were the most important orders numerically and in terms of visits, followed by the Coleoptera (28%). Thirty different taxa were recorded in all. Lepidoptera were mentioned, but only as less numerous and frequent, with no details of identification provided.

By contrast, a notable increase of psychophily (Lepidoptera pollination) at altitude and fall-off of melitophily (Hymenoptera pollination) were recorded during an intensive study in the Andes of Santiago, central Chile by Arroyo Kalin et al. (1983), where fifteen perennial and annual species of *V. subg. Neoandinium* and one of *V. subg. Viola sect. Chilenium* have been recorded at over 2000 m (Watson & Flores ined.). A similar situation is likely in areas of Patagonia subject to high winds where *Viola* species grow. Surprisingly considering their fragile morphology, butterflies, but few other insects, have been seen on the wing low over the ground during these gale force periods (pers. obs.).

The potential advantages to both organisms of co-evolving mutualism in demanding and stressful environments are manifest. The violas need to attract any potential pollinator where these are scarce, and competition is high. The butterflies benefit from evolving so the plant does inhibit the presence of their larvae (caterpillars), as well as needing to foster the fertility and fitness of its sole host plant. In that last respect, as observed by us, manifest herbivorous damage to the foliage of *Viola* taxa has been rare [fig. 29]. Argynniini caterpillars habitually feed at night (Ehrlich & Raven 1964) and we speculate they almost invariably eat lower leaves in order to avoid signalling their presence to predators.

In order to reproduce, itinerant invertebrate herbivores must first seek out host plants. The question inevitably arises as to whether the native lowland violas of *Viola subg. Viola sect. Chilenium*, *Viola subg. Viola sect. Rubellium*, *Viola subg. Viola sect. Tridens* and the mainly high tropical shrubby sect. *Viola subg. Viola sect. Leptidium*, all of which fall within the distribution range of the genus *Yrameae*, constitute its hosts in addition to subgenus *Neoandinium*. Most inhabit climatically non-stressful environments. We can find no information on this, but the adoption of three cultivated *Viola* species from the Northern

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Hemisphere [figs. 23, 24, 25] in our Chilean garden as food plants by *Y. cytheris* (Watson & Flores 2018) [fig. 22] suggests it must certainly be so.

So how do the butterflies locate their hosts? Although vision can play a major part in this process, so too can their olfactory ability, particularly when they depend on one or very few host taxa, and above all when these are in the sterile state. As individual taxa, and frequently as allied groups, plants possess distinctive vegetative chemical-compound 'fingerprint' signatures, known as green leaf volatiles or GLVs (Li et al. 2012). These are released strongly as a result of damage, such as is caused by herbivory, whereas unstressed plants emit no more than traces (Scala et al. 2013). Their purpose is at least twofold: to warn of unpalatability and to attract predators of any active herbivores present. However, this mechanism may not always work to their advantage. Certain of their arthropod adversaries may have evolved a highly developed sensitivity for detecting at considerable distance the faint innate odour of their particular food-plants and homing in on it. For instance, Anderson et al. (1995) emphasised the absolutely crucial necessity of night flying Lepidoptera to find their hosts by this means. When the plant is also in flower and emits a scent, or the corolla shows up after daylight, or both, this would be involved as well or instead, of course. Although no information is apparently available referring specifically to Argynnini fritillary butterflies being drawn to *Viola* host plants and locating them by because of foliar volatiles, information from the wider context of Lepidoptera and our personal observations in the field effectively support this speculation. In particular we have noticed that *Yramea* imagos always seem to fly in the relatively immediate vicinity of violas (Watson & Flores 2014a), and this seems to be a further evolved strategy for ensuring successful reproduction.



figs. 39, 40. Common honeybees visiting pansies. (Photos Kathy Keatley Garvey, courtesy of the Internet)





fig. 41. *Viola x josephii* being visited by the very large native bumblebee, *Bombus dahlbomii*. Paso Infernillo, Cumbres Calchaquies, Tucumán, NW Argentina. (Photo Anita Flores)

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The parallel global migration of *Viola* and Argynnini butterflies

From its origin near the tip of South America the genus *Viola* gradually advanced towards the equator and beyond, eventually crossing to the Northern Hemisphere about 16 ma. From there and then it began a rapid and explosive geographical and evolutionary expansion to almost every part of the world (Marcussen et al. 2015), frequently vectored long distances as seeds by birds, including to remote islands such as the Canaries and Hawaii (Ballard & Sytsma 2000).

That fritillary butterflies have subsequently followed the expanding distribution of the plants to almost every locality they occupy on the planet except for a few of the most inaccessible is evident from any study of their present global distribution (Simonsen et al. 2011). One has even reached Australia (Braby 2005). Equally, they too have evolved prodigiously to adapt to different environmental circumstances they have encountered.

The symbiosis between these insects and plants in the Northern Hemisphere has been virtually if not entirely eliminated by the colonization of its regions by both organisms, however. Due to various environmental and climatic factors which differ from those of their Southern Hemisphere origin, the majority of violas there flower early, before the imago butterflies have emerged. As a consequence, the relationship between them has become one-sided, with *Viola* specialist fritillaries continuing to consume the plants, but not able to pollinate them. That function is now performed exclusively by other insects, notably butterflies of other genera [fig. 35], beeﬂies [fig. 36], hoverﬂies (Syrphidae) and early-flying bees of numerous genera [figs. 37-40], (Proctor et al. 1996), as also happens to a degree in South America (Murúa et al. 1996) [figs. 33, 41]. We must therefore make clear that the mutualism described above refers only to the relationship between these organisms within their geographical area of origin, South America.

By way of an interesting incidental consequence in need of investigation, in the Northern Hemisphere the butterflies oviposit on other non-Violaceous taxa near to their food plant (Ehrich & Raven 1964), whereas in South America they may lay eggs directly on their host, at least when this is a *V.* subg. *Andinium* taxon [fig. 28].

As for the adult butterflies' comestible needs, especially when violas are not available, a wide selection of Internet images too profuse to quote in their entirety here show fritillaries worldwide predominantly visiting a variety of Asteraceae [e.g. figs. 42, 43], with various Lamiaceae a lesser preference, as well as occasional others such as Boraginaceae, Orchidaceae, Dipsaceae, Verbenaceae and Asclepiadaceae. Flower colour range as recorded was predominantly in the pink, lavender, lilac, pale blue range, with yellow much more rarely visited.



fig. 42. Female silver-washed fritillary, *Argynnis paphia*, visiting a *Centaurea*. (Photo Luri Garmash, courtesy of the Internet)



fig. 43. Female silver-washed fritillary, *Argynnis paphia*, on the composite *Lyatris spicata*. (Photo Diane Spray, courtesy of the Internet)

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Epilogue

To return finally to profile the *Yramea* fritillary butterflies, which inspired the epithet given to the new *Viola* herein, it contains just the following six species: *Y. cytheris* [figs. 22, 26, 27], *Y. inca* [fig. 44], *Y. lathonioides* [fig. 30], *Y. lynx*, *Y. modesta* [fig. 31], and *Y. sobrina*. The genus is found only throughout the high Andes and also at lower elevations in the southern temperate region of South America. It remains somewhat of a biogeographic enigma, but recent phylogenetic work promises to shed light on the evolutionary history of its group (Simonsen et al. 2011).



fig. 44. The recently described *Yramea inca*, an endemic of Peru. (Photo Ezequiel Bustos, courtesy of the Internet)

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Note: Considering the importance of the mutualism and herbivory of these butterflies and the violas, we originally submitted the manuscript to Phytotaxa as this subject is not well represented hitherto in the relevant literature. That journal has the largest worldwide readership of any plant taxonomic publication as well as being the companion of Zootaxa, the equivalent for animate organisms, so seemed the most appropriate. When returned from reviewing, however, far too many modifications were required in order to adapt it to Phytotaxa's formal layout. We are no longer young and vigorous enough to have the drive to take that on, besides which there is much still to do in the time remaining to us. At our ages our basic concern is to describe new taxa so they are accepted by the formal botanical authority, IPNI (the International Plant Names Index) according to its regulations, as has happened for the many new plants we have already published in the IRG and other journals. We must, however, acknowledge with our sincerest appreciation the meticulously thorough and painstaking work done by the Phytotaxa reviewers with a 'no stone unturned' approach, much of which, including corrections, has been incorporated herein and has appreciably improved this presentation.

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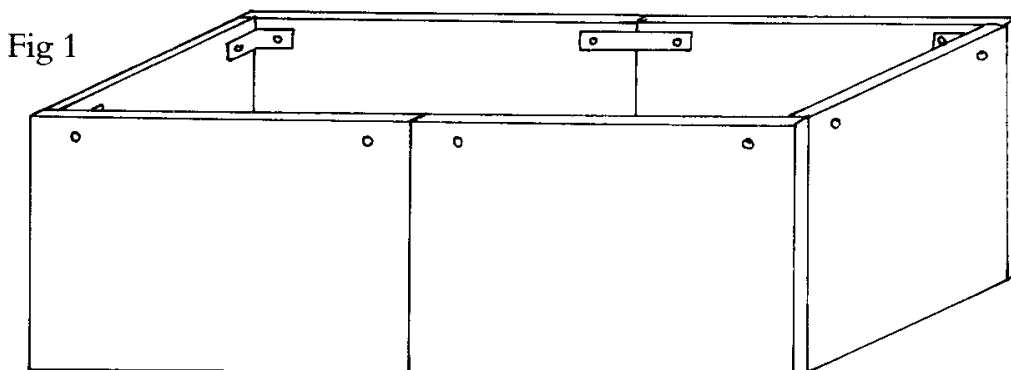
--- From The Rock Garden ---

This little article is a “Blast from the Past” – republished from the print journals of the SRGC, # 87 (pages 231 to 234) of January 1991 and includes a later update when the planting was refreshed.

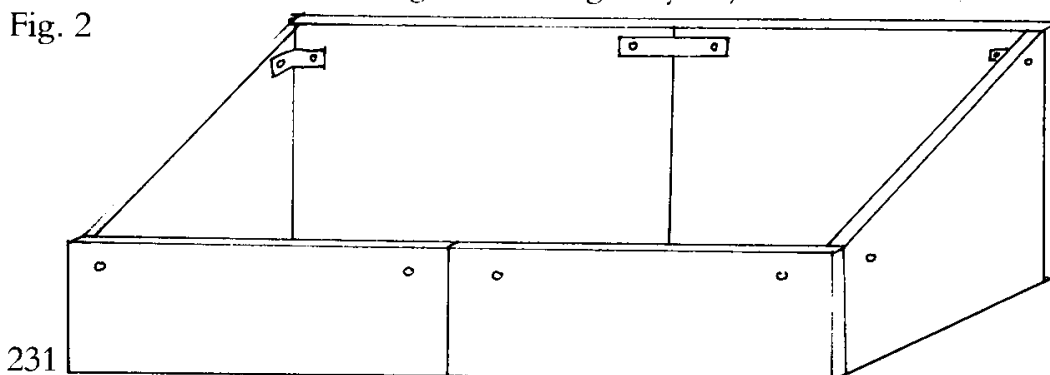
RAISED BEDS by J. Ian and Margaret Young

Some years ago we were fortunate to be able to increase the size of our garden. In planning our garden extension, we were keen to include some raised beds. These were to be quite close to the house, where we were laying a terrace of 90 x 60cm concrete paving slabs. As we had no source of natural stone suitable, we decided to build the beds from the same slabs. The slabs were to be set on their long edge to form a bed two slabs long, by one wide, giving a bed 180 x 90cm, x 60cm high.

Holes were drilled in the slabs, near the corners, using a masonry drill, allowing a steel angle bracket to be bolted on. The two slabs forming the long edge were also drilled and a straight strap of steel was bolted on the inside to secure them. (Fig. 1). The bottom edge of the bed was held in place by being set into the surrounding slabs of the terrace. If such a bed were to be free-standing, the slabs would be drilled and bracketed at the foot as well, for stability.



We have also used this system to build a plunge-frame by using two 90 x 60cm slabs for the back; two 90 x 30cm slabs for the front; and cutting two 90 x 60cm slabs diagonally, with a stone cutting saw, to form the sides. (Fig. 2). (If you prefer, the local builders' merchant who supplies the slabs should be able to arrange the cutting for you.)



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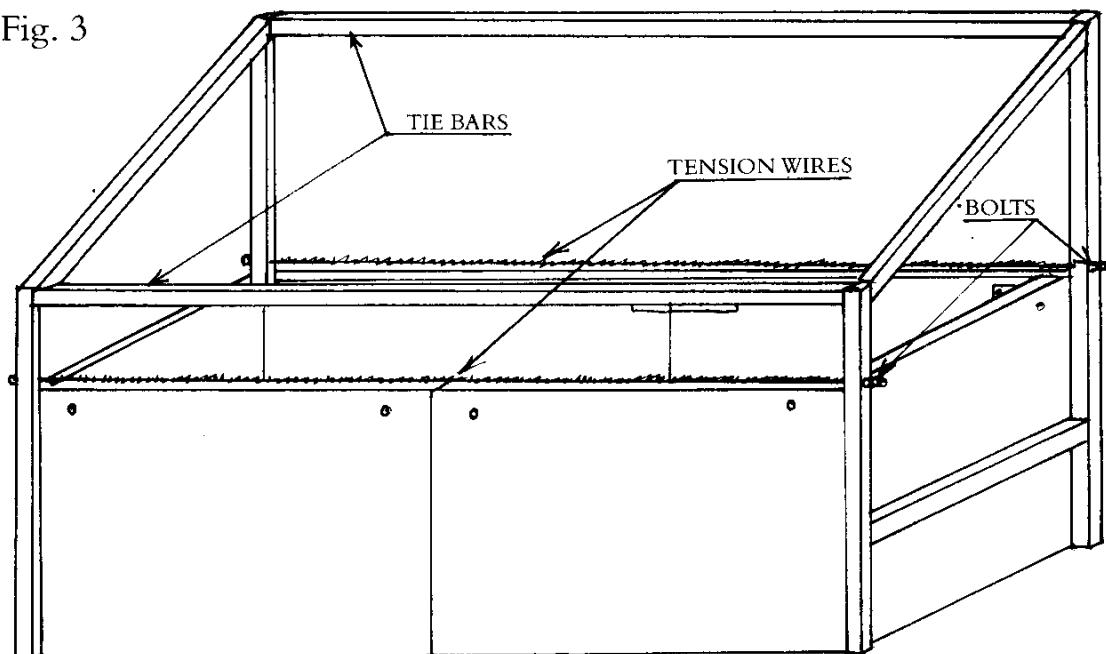
Our raised beds and frames were 180 x 90cm but they could be built to any multiple of the slabs.

With about 20cm of sand in the base of the frame and dutch-light type frames made to cover the top, we have found this frame successful for growing a large range of plants.

Now back to those raised beds. As our garden is free-draining, no special care had to be taken to ensure that the beds did not become baths! Nonetheless, we took the opportunity to dispose of any rubble and broken pots in the bottom of the beds. Next in were old stacked turves and the contents of our compost heaps, to provide a rich moisture retentive layer of humus. The final 30cm were a mix of equal parts of peat; shredded, composted turves; and ¼" granite chips. After planting up the beds, a 6-9cm dressing of the granite chips was applied. (Now our own shredded and composted hedge trimmings and prunings are replacing most of the peat content in our more recent projects.)

We have devised a system to cover the raised beds which is very quick and easy to erect. (Fig. 3). We use this method to cover two of our four slab beds from late September to April. The system consists of two sloping wooden gable frames that fit the short ends of the bed; these are 120cm high at the back and 90cm at the front. Wooden tie bars hold these together at the top, while tension wires, positioned just over 60cm from the ground and tightened by a bolt, anchor the structure firmly to the bed. Corrugated plastic or glass fibre sheeting, secured to a wooden frame, fits into the top between the gable end where it is held in place by steel pins through the tie bars.

Fig. 3



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These covers stop the worst of the winter rain from saturating the resting plants, but wind-blown rain and snow can cover the beds and provide sufficient winter moisture. The covers also allow the early flowering plants, some of which can be in flower in late January, some protection from the worst of the frosts.

Some settlement occurs in the beds but this allows us to top-dress them annually, usually in late autumn, with more granite chips. These are worked well in around the plants. Some plants have to be eased up to avoid burying them with the gravel mulch: others, such as *Raoulia australis*, like to be completely buried for the winter, coming through with renewed vigour in the spring. We have noticed this plant steadily moving across one of the covered beds in a north westerly direction. Is it looking for fresh soil? We dug out and replaced the soil in its original site to see if we can encourage it to reverse its migration before it overtakes a *Saxifraga oppositifolia*. The saxifraga also likes a gravel mulch and does well in the raised bed where we can enjoy its very early flowers at a more convenient height. We find this plant does much better if it is dead-headed to prevent seeding.

Androsaces also enjoy life in the raised beds, especially the *A. sarmentosa* forms which are rapidly taking over half a bed. They have such good foliage, with a magnificent display of flowers in the spring, then in autumn *Cyclamen hederifolium* comes through their rosettes, so we are content to let them spread, rescuing any plants they are overgrowing. Another plant that has spread is *Leucogenes leontopodium*. Fully 1m across, it has swamped many a less vigorous plant in its path, but when it rewards us with over 500 long-lasting flowers in early summer (Fig. 61, p223) and such magnificent silver foliage all year, who could resist it? We thought we might plant *Leucogenes grandiceps* in the other half of the bed to make a North Island and South Island, New Zealand bed!

Anchusa caespitosa grows strongly, obviously appreciating the deep root run. To those who insist it should be grown “in the character of its native habitat” this plant, forming a dome some 20cm high by about 60cm across, with its spiky foliage liberally sprinkled with the brilliant blue flowers, must seem exceedingly vulgar! It seems that we are quite unable to grow it “in character”, but we’re really enjoying our fat monstrosity!

In early July we take cuttings from this *Anchusa caespitosa*, reducing it to about half its size, though about six weeks later, you would not know any difference. These cuttings, grown on and repotted regularly, make good show plants the following spring.

A *Lewisia tweedyi* seedling, planted in the corner of a bed in July, flowered from the following February right through to August. It was a very good large flowered form, and seed and cuttings were taken from it before we decided that we must try to move it because its large leaves were damaging

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some nearby cushion plants. Alas, it did not survive the move, but its offspring thrive. It was this experience that persuaded us to take a more relaxed attitude to the question of large specimen plants taking more than their fair share of space. We now try to rescue the smaller plants in good time, or failing that, we just think ourselves fortunate to have so many happy plants!

Dionysia aretioides has survived in one of the covered beds for two years now, flowering in spring, though it does not do as well as those in the alpine house. The dwarf aquilegias, *A. saximontana* and *A. bertolonii*, do well and it is a pleasure to be able to study them at close quarters. We have just raised enough seedlings of *A. jonesii* to try a few out in one of these beds and hope for flowers.

Many of the dwarf narcissus, such as *N. bulbocodioides*, *N. romieuxii* and *N. scaberulus*, are happy in the beds, where the covers allow their early flowers to be enjoyed without wintry weather spoiling them as soon as they open.

Rhodohypoxis baurii thrives in these beds, increasing well and flowering cheerily from May until the first frosts in late September or early October. Recent plantings of townsendias, eriogonums, physarias and other American species have been very encouraging. We are tempted to make a new bed especially for the Rocky Mountain alpins.

Azorella trifurcata, planted close to the side, hugs the edge of the slab and is now making its way down the outside. *Hypericum reptans* trails over another edge, providing flowers from July until winter sets in. *Rhododendron keleticum* 'Rock's Form' covers itself with its large, rich mauve-pink, flat-faced flowers and is happily intertwining with *Celmisia bellidioides* whose white daisy flowers contrast well (Fig. 62, p223). Both obviously enjoy the conditions provided by life in an uncovered raised bed.

The beds receive an autumn feed of bone meal and a spring feed of Vitax Q4. This, with the top dressing of chips, is all the maintenance required, apart from the occasional removal of plants in imminent danger of swamping! We have found very little difficulty with weeds, which are in any case very easily removed. Basically, the only watering we have to do is to ensure that new plantings do not dry out before their roots become established. We enthusiastically recommend this method of building raised beds, but should you wish to try them for yourself, we urge you not to make our mistake: be sure to make any paths between the beds wide enough to allow the passage of a loaded wheel-barrow, or, like us, you will have to make some rather convoluted journeys to bypass them!

[Pages 231-234 from TRG #87]

ED: As time went on, we discovered that the full covers were not needed with our fast draining planting mix and we no longer use them.

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We had been threatening to re-work our slab beds for some time as they were looking either tired or overgrown and it was Zdenek Zvolanek's excellent article on Crevice gardens in the [January 2003 'Rock Garden'](#) that pushed us into action.



Crevice gardens



We borrowed a small truck and bought a load of stone, each one hand picked, from a local quarry.

MY and rocks

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The next job was to dig out the beds and rescue any plants worth saving.

Then the fun of selecting and placing the rocks so that they were both pleasing to the eye and offered suitable planting positions for plants.

Raised bed construction



As described before, all the beds are approx. 190cms long by 90cms wide and made from concrete paving slabs placed on their edge and bolted together using metal strips.



In Bed 1 we had the crevices running across the short side at a slight angle, so they were not parallel to any side. We used most of the large stones that we had and arranged them so they would sit high above the concrete slab walls. We set the stones at the back and far end, higher, so that it would slope gently both from front to back and from side to side.

This gave us plenty of vertical crevice ideal for planting a wide range of alpines along the back and also a few along the front edge.

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Meconopsis delavayi

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In Bed 2 we used the large flat stones set on their edge. This time the crevices ran the length of the long side of the bed, again just off the square.



The stones were set highest at the far end so that the best view was facing you from the path side.



Bed 2 western end.

Again, some prime vertical planting sites have been created at the far end as well as all the long crevices on the top surface.

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Crevice planting



Bed 2 front



By the time we got to bed 3 we had used up most of the best stone that we had bought from the quarry so we reused the stones from the previous incarnations that we had just dismantled.

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The stone does not rise up so far above the edge of the slabs but still provides plenty of crevices to plant up.

Lychnis alpina



There are a few plants that we did not want to disturb at the moment in Bed 4 so we gave it a partial make-over instead of a complete renewal.

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Small covers made from perspex and weld-mesh provide shelter from the worst of the winter wet for some of the plants more used to being under a blanket of snow all winter.

All the plants have done well so far and only time will tell how successful we will be in establishing some of the cushion plants that we used to grow in the alpine house before they were squeezed out by our growing collection of bulbs. Early results are encouraging.



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Saxifraga stolitzkae

We are sowing seed of many cushion plants directly into the crevices in the hope that they will establish better in that way, than they would being raised in a pot, then squeezed into a narrow crevice. We are pleased with the overall effect and look forward to seeing how the plants will fair in future.



Early photo of the redone beds....



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Photos of the raised beds, over different seasons and years ---- these beds give us great pleasure- and the plants a good home – and we hope you will also be tempted to make some!

J. I. Y. and M.Y.



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The white spots here are not snow or hail – they are from falling Sorbus petals!



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In some images, you can see that Ian's "pet dandelion" needs a haircut!



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J. Ian Young by the raised beds.



In our first article, mention was made of a *Leucogenes leontopodium* doing well – often making as many as 500 flowers a year ... this scan is from an old slide when the plant had nearly 1700 flowers on it! Make a raised bed – it's fun and it works!