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VOLUME 49

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NUMBERS 1 & 2



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HERBERTIA

the journal of the **International Bulb Society**, is devoted to the botany and horticulture of geophytic/bulbous plants. Special emphases of the journal are the Amaryllidaceae and other petaloid monocot families rich in bulbous or cormous plants, but articles treating any aspects of dicotyledonous geophytes are welcomed as well.

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We thank you for your patience. If you have written to us recently and have received no reply, please write to the IBS again at the new address shown below.

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- more color in future editions of HERBERTIA;
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INTRODUCTION

The vast American continent is home to many bulbs and corms. Many of these produce showy flowers and are worthwhile additions to the garden. Some are common and even weedy. Others are rare and difficult to obtain. A few are, perhaps, extinct in their natural habitats. By focusing primarily on some American geophytes in this issue of **Herbertia**, we hope to introduce you to and make you aware of these beautiful plants. It only takes a little perseverance to obtain and grow most of them. It is hoped that these articles will motivate you to give them a try in your garden.

Cover: *Calochortus syntrophus*, photograph by Frank T. Callahan II

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A REVIEW OF THE GENUS *NOTHOSCORDUM* IN CULTIVATION

(Partially reprinted from *Garlic* 2:1)

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SAN ANTONIO TX 78232
UNITED STATES OF AMERICA

Erudite gardeners traditionally approach the subject of *Nothoscordum* with some trepidation. In modern books devoted to bulbs and their culture, *Nothoscordum inodorum* is termed an awful, frightful weed and an alarming nuisance to be avoided at all costs, and for good reason, especially if one lives in milder climates where cold hardiness is not a factor. It is a fact that *N. inodorum* can easily survive zero degrees Fahrenheit and is capable of living up to its infamy.

Seed bearing for *Nothoscordum* is essentially like *Allium*. *N. inodorum* seed is not unlike *Allium tuberosum*, in that nearly every seed will germinate. With *Allium*, the real "holy-terror-weeds" are those with numerous bulbils, such as *A. canadense* and *A. vineale*. *Nothoscordum* are not known to bear aerial bulbils, but a few compensate for this by bearing an alarming number of basal offsets that are easily dislodged at the slightest touch, contaminating the adjacent soil. The bulblets are rice-grain in size, and a mature bulb of *N. inodorum* can produce a large family that numbers from 30-100. Luckily, only a few species share this disagreeably invasive trait. Only a half dozen species are truly weeds. The rest behave themselves very nicely, and a few are really quite difficult to propagate, as they make no offsets and only a few seeds. This aside, we can enjoy the vast majority of *Nothoscordum* species without further caution. There are well over 35 species, all but one native to South America. *N. bivalve* grows in North America, Argentina, and Uruguay. *N. inodorum* is a cosmopolitan weed, having been introduced into many subtropical countries. It is a pity, too, as *N. inodorum* (syn. *N. fragrans*, *N. gracile*) is wonderfully fragrant. Indeed, the majority of *Nothoscordum* are sweetly scented, and this is one of their most endearing traits. Some species will flower both spring and fall, although most species flower only in spring. A few flower only in autumn. Others may continue flowering throughout the summer if conditions are favorable.

The extent of hardiness in *Nothoscordum* is still an unknown factor in this country. *N. bivalve* is native and can survive winters in Virginia, Ohio, Indiana, Illinois, and Oklahoma. It can easily withstand sub-zero temperatures for a period of days, perhaps weeks. *N. inodorum* may be equally cold-hardy. The late Louis Beebe Wilder had this to say on the subject regarding *N. inodorum*: "it is difficult to know just where 'north' begins from a horticultural standpoint,

but when a plant in my garden successfully withstands fifteen degrees below zero, I feel justified in calling it hardy in the north"

***Nothoscordum bivalve* and its varieties**

Nothoscordum bivalve (L.) Britton. (syn. *N. striatum* [Jacq.] Kunth) var. *bivalve* Guaglianone

N. bivalve is a most remarkable plant because it is native to both North and South America. In North America it is found throughout the southeastern states to Texas, Oklahoma, New Mexico, Arizona and southward to central Mexico; in South America it resides in Argentina and Uruguay. Favoring disturbed soils, it is commonly found along roadsides, railroad right-of-ways, vacant lots and lawns. There is very little variation in the range of this species other than intensity of the keel markings, which can vary from colorless to greenish, brownish or purplish. A "keel" in the horticultural sense is the same as in the nautical sense. If days are warm and sunny, the flowers open early in the afternoon, release their honey-like perfume, then close before sunset. Flowers are cream-white with yellowish centers and contrasting keels. They are modestly pretty when viewed at close range but usually lack the clean whiteness to make them truly showy.

As with tulips and crocus, the flowers of *N. bivalve* remain closed on wet, cold or cloudy days. Under those conditions they have little or no perceptible scent, which explains why many people are unaware of their fragrance. *N. bivalve* flowers only release their perfume on warm, sunny afternoons. Each bulb is capable of producing a succession of scapes throughout the flowering period. Larger bulbs may produce scapes with up to a dozen flowers, 2 - 6 flowers opening at any one time. Unfortunately, floral opening is somewhat staggered so that an umbel is usually composed of buds, opened flowers and developing seed capsules, creating a careless, unkempt appearance at times. Plants easily re-seed, and can mature in as little as two years. In this respect they are similar to many small *Allium* species.

Nothoscordum bivalve var. *nanum* (Grisebach) Guag.

The variety *nanum*, another Argentine form of *N. bivalve*, is found in damp soils in the provinces of Entre Rios and Corrientes along the Rio Uruguay, south of Buenos Aires. They flower here outdoors in autumn and spring. The only perceptible difference from the type form is that there are slightly fewer flowers in the umbels, and overall the plant is a bit smaller. The main difference occurs underground, as offsets are formed at the ends of numerous short rhizomes, rather than attached basally to the mother bulb. Thus, they can quickly make a small clump, as the rhizomes push outward, away from the center. They are best kept in pots to discourage this way of spreading. They are as hardy as the type form. In my greenhouse they seem to gain some size and stature, and really can't be discerned from the type, unless bulbs are knocked from their pots. Outdoors they combine well with the yellow flowered *N. montevidense*, as they flower at the same time .

In the spring of 1992 I drove from San Antonio, to Laredo, Texas to observe and collect spring-flowering bulbs, including *Allium*. *N. bivalve* was at its peak, flowering mile after mile by the zillions in the afternoon sun. I made several stops, noting that the fragrance was so heavy that the air was perfumed with the honey-like scent. After awhile it became a bit cloying. While driving I noticed a few small patches of lilac color in their midst that were somewhat similar in color to many *Allium drummondii* forms, but I have never found them in this particular area. They looked more like *Nothoscordum bivalve*. How could this be when such color forms are unknown in this species? Curiosity got the best of me, so I stopped to check. To say that I was astonished would be an understatement. Sure enough, they were *N. bivalve* in various shades of lavender, lilac, and mauve. These grew singly and in tiny colonies among myriads of the common cream-white forms. They ranged from white forms with very dark purple keels to forms heavily blushed along the keels with purple, to those having the purplish color on the inner surface, especially along the margins. The prettiest ones were solid mauve or lilac with deep purple buds. I tried to dig only the darkest ones, but unfortunately, a few of the paler forms were mixed in too, necessitating culling, which was time consuming.

Such solid-colored variants are unknown in North America, but forms with deep purple keels are not uncommon. *N. texanum* M.E. Jones was reported with "somewhat fragrant, yellowish-white flowers externally tinged with purple". These were reported from Arizona, but are most likely also from western Texas and New Mexico. I believe that *N. texanum* is merely a synonym for forms of *N. bivalve* having purplish keels. Keels of *N. bivalve* can vary from colorless to yellowish, greenish or purplish, and have little taxonomic significance. On the other hand, solid-colored forms in lilac are good candidates for varietal status, as opposed to a subspecies. I would tentatively recommend *N. bivalve* var. *lilacinum* for horticultural purposes. When replanted the darkest ones continued to push up scapes, flowering for another month without reverting to "normal" colors in spite of the heat and different soil type. Seed was harvested to see if they would breed true. As of February 1993, my collected plants are growing well, a few are finished blooming (20%) and are keeled purple or wine red.

I asked a friend in Argentina if he had ever seen similarly colored *Nothoscordum*, but he replied that he had not. However a Chilean species, *N. nidulum*, is said to be rose-colored and is misidentified as *A. roseum*. It must be very pretty, but may now be considered a *Tristagma*.

Yellow flowered *Nothoscordum* species

Several yellow flowered species occur in South America, and they are a welcome addition to a mostly white flowered genus. There are 3-4 species, depending on your authority: *N. striatellum* from Chile, *N. ostenii* from Uruguay, *N. montevidense* and *N. minarum* from Argentina, S. Brazil, and Uruguay. *N. minarum* can be considered to be a subspecies of *N. montevidense* by some authors.

Nothoscordum montevidense Beauverd ssp. *montevidense* Ravenna

This is the type form of the yellow flowered species. A variant form with broader tepals is known as ssp. *latitepalum* Guag. In 1986 I saw both the wide and narrow-tepaled forms of *N. montevidense* flowering in a pasture. I could see no difference between them aside from tepal width. I collected both forms, even though the wider-tepaled form seemed more attractive. These grew as little mites only a couple of inches high, with just 1-2 (occasionally 3) starry, yellow, fragrant flowers per umbel. They were cute but not very showy, since they were so small. The bright yellow flowers had green keels and were little more than 1/2 inch wide, somewhat like some *Hypoxis*. Foliage was narrow and nearly thread-like. Bulbs were only about 1/2 inch wide and had a few, tiny bulblets. The plants were collected in early October, spring in Argentina. When replanted in San Antonio, they continued to grow, and they flowered the following (North American) spring, a few months later. This required a minimum of adjustment, as they normally flower in autumn and again in spring anyway.

The following year *N. montevidense* ssp. *montevidense* out-did itself, bud counts jumping from 1-3 to 1-5, with an average of three flowers per umbel. Scape heights nearly doubled, as had bulb size, and bulbs produced up to five scapes in a flowering season. Foliage doubled in number of leaves, and the slender leaves now arranged themselves in a nearly rosulate pattern instead of the normal, distichous pattern of most *Nothoscordum*. They have continued to flower both spring and fall, but others report that bulbs continue to flower in summer. Flowers open on warm, sunny days and remain open until late afternoon. A few scapes can perfume an entire greenhouse. As with most *Nothoscordum*, *N. montevidense* needs maximum light to look its best, otherwise the stems become lax and lay about untidily. Grown outdoors they proved cold-hardy in our climate, but resume a smaller size and stature, as when collected. They "grow on you" in time. It is an ideal plant for pot culture.

Nothoscordum minarum Beauverd (syn. *N. montevidense* Beauverd ssp. *minarum* [Beauverd] Rav.)

This species is distinguished in being a slightly more robust plant with slightly larger bulbs and taller scapes with higher bud-count (2-10). The stem is a bit more rigid, and flowers are slightly smaller and more numerous with narrower segments. Bulbs form offsets slowly, if at all. The fragrance is exactly like that of *N. montevidense*. Offset and propagation are slow, but bulbs will sometimes simply split equally into two. Seed propagation is good, but the tiny seeds grow into very tiny plants that seem to mature slowly. The first season the leaves are simply little green hairs. This species is one of my favorites.

I have two forms of *N. minarum* and they differ quite a bit in foliage, although flowers are much the same. Both came from the state of Rio Grande do Sul, Brazil. The first form was found flowering in a neglected lawn next to a gasoline station in the town of Santa Margarida. In every respect, the plants reminded me of *N. bivalve* in Texas, save that the flowers were yellow instead

of white. Foliage was identical: narrow, flat, and dark green. Bulbs were similar too, except offsets were not present. A second form found near the city of Uruguayana had more flowers per umbel and stiffer stems; foliage was closer to that of *N. montevidense* in form and nearly rosulate. The plants rarely form offsets and are more apt to simply split into two bulbs of equal size every year or two. Both forms, when well grown, flower briefly in autumn and again in spring. They combine nicely with *N. bivalve*, as they are about the same height and size, and flower in the same time. Fragrance is similar too. I can hardly wait to see how they will look with the lilac forms of *N. bivalve*.

N. ostenii Beauverd

Very little is known about *N. ostenii*, another rare, yellow flowered species from coastal Molles, Uruguay. It is said to grow on stony hills. There are only 1-3 large, yellow flowers in the umbel, and scapes are only a few inches tall, but the effect is very showy. Individual florets are larger than those of *N. montevidense*. I was privileged to see a small pot of it in flower, but I do not recall any fragrance. The plant flowers in early spring, followed by a summer dormancy. The bulbs, which do not form offsets, are about the same size and shape as those of *N. bivalve*, but have a smooth, fawn-colored "shell". I recently acquired a few bulbs of *N. ostenii*, and am looking forward to observing them in cultivation. They are said to be easy from seed if the seed is planted immediately after ripening. They're rare in the wild, and endemic to coastal Uruguay. The original description states that it is one-flowered, but this characteristic does not appear to be constant. Generally plants in cultivation are noted to have more than one flower.

Nothoscordum versus *Ipheion*

Several *Nothoscordum* are controversial because authorities can't agree whether or not they belong in *Nothoscordum* or in the genus *Ipheion*. These *Nothoscordum* are one-flowered forms, and include three yellow-flowered species. Their flowers open in the morning and close at night, as with most *Nothoscordum*. I shall list them here as *Nothoscordum*, along with their *Ipheion* synonyms, but will omit their other synonyms. They have been transferred from one genus to another (*Milla*, *Tristagma*, *Brodiaea*, *Nothoscordum* and *Ipheion*) as each genus was redefined, and the genus *Beauverdia* was created specifically for them. It now boils down to *Ipheion* or *Nothoscordum*. Possibly another genus will be created to accommodate them, or the genus *Beauverdia* might be reinstated, as they don't seem to fit into current genera at this time. Rosa Guaglianone champions them as *Ipheion*, while Pierrefelice Ravenna regards them as *Nothoscordum*.

Of the three yellow ones mentioned, *N. dialystemon* (Guag.) Crosa (syn. *I. dialystemon* Guag.) produces basal offsets, but is also the rarest species. It should be easiest to propagate. *Nothoscordum hirtellum* (Kunth) Herter (syn. *Ipheion hirtellum* [Kunth] Traub) does not produce bulblets, but has a strong alliaceous odor. *N. felipponeii* Beauverd (syn. *I. sellowianum* [Kunth] Traub) is

the only member of this group that I have grown.

Nothoscordum felipponei Beauverd has the same sweet, honey-like scent of *N. bivalve* and *N. montevidense*. The lemon-yellow flowers are larger than those of typical *Nothoscordum* and are quite showy, like species *Crocus*. They are diurnal, in typical *Nothoscordum* fashion. Bulbs are never fully dormant, and must maintain live roots even while resting in summer. They increase very slowly by offsets, so propagation is principally by seed. Unfortunately, they are self-incompatible and need to be pollinated by a different clone in order to set viable seed. Strangely, foliage of this species is rosulate rather than distichous, but this is never mentioned in their descriptions. The mainstream members of *Nothoscordum* have distichous leaves, as do most *Ipheion*. Of the *Nothoscordum* I have seen, only *N. montevidense* approaches a rosulate stage, but this characteristic is not obvious. A pot full of *N. felipponei* in flower is a lovely sight. Unfortunately, my plants often skip a year between flowerings. One to four scapes are produced on a flowering-size bulb. Culture is very easy. Their main drawbacks are slow propagation, self-sterility, and not flowering freely on a regular basis. Otherwise they would be nearly perfect as greenhouse plants. I have yet to try them in the garden.

More *Nothoscordum*

While visiting an estancia (cattle ranch) in northeast Argentina, I was pleased to locate several *Nothoscordum* species, including *N. inodorum* ssp. *inodorum*, *N. inodorum* var. *angustinus*, and what I have tentatively identified as *N. arenarium*.

N. arenarium Hert. (Province of Corrientes, Argentina)

These plants grew under small shrubs in a pasture along with *Zephyranthes mesochloa*. The scapes were somewhat wiry with about a dozen pure white, starry, fragrant flowers on long, slender pedicels of unequal lengths. The tepals were narrow and the flowers opened in early afternoon. Foliage was long, narrow, and sprawling. Bulbs make no offsets. These flower regularly in autumn and spring and make a few seeds. It is modestly pretty, but slow to propagate vegetatively.

N. balaenense Rav.

More recently I received seed of *N. balaenense* collected at Punta Ballena, Uruguay, which is near Punta del Este, on the Atlantic coast. "Ballena" translates into "whale", and I suspect that whales are often sighted there. Germination was good and two years later a few reached maturity. There are no signs of offsets, and this may be their normal condition. This is one of the prettier species. The flowers are snowy-white, fairly large, and are very fragrant. The umbel is 9-13 flowered. Foliage is 3-3.5mm wide and 10-17cm long, channeled, and carinate. Pedicels are only about 15-20mm long, and the flowers are held tightly in compact umbels. The flowers do not seem to fully close, remaining partly open at night and early morning, fully expanding in the

afternoon. In stony and rocky places of Punta Ballena, they flower in spring.

Nothoscordum castilloi T. Howard, *sp. novum* (Howard #86-6, dubbed "the Stinker"). A formal description of *N. castilloi sp. novum* can be seen in page 93 of this journal.

I collected these plants in Brazil in spring, October 1986. They grew by a roadside in full sun, along with an unidentified species of *Calydorea* (a bulbous irid with white flowers and purple centers). The flowers were half closed in the noon sunlight, and I didn't notice a fragrance at the time of collection. The flowers had prominently marked keels. None of the bulbs had signs of offsets. I learned that in cultivation they do form offsets, but rather sparingly. They do not flower in autumn. The flowers have a somewhat disagreeable, rancid odor. The umbels have only 4-5 flowers, white with wide keels in purple, greenish-purple, or greenish. Similar to *N. inodorum* behavior, the flowers do not open until late in the afternoon and do not close until the next morning. The foliage is narrow, lax, linear, concave-convex, bluish mid-green, forming a pseudo-neck at the base.

"Stinker" (*N. castilloi* Howard #86-6) differs from *N. sellowianum* in its crepuscular habit (flowering at dusk) and in having erect, flat, oblong-subulate, contiguous filaments, forming a cylinder around the ovary, much the same as in *N. inodorum* ssp. *nocturne*. So far I can't find a *Nothoscordum* description approximating *N. sp.* Howard #86-6, and conclude that it is new to science. It belongs to the *N. inodorum* alliance, but is distinctive enough to merit separate species recognition. "Stinker" is a fine pot plant and the bright purple keels are very attractive.

***Nothoscordum inodorum* and its varieties**

N. inodorum (Solander ex Aiton) Nicholson (syn. *N. fragrans* [Vent.].Kunth, *N. fragrans* [Vent.] Kunth ssp. *inodorum* Rav., *N. gracile* [Dryander ex Aiton] Rav.)

This is one of the culprits that has given *Nothoscordum* a bad name. People are often confused because one plant bears a name that literally translates to "without an odor", when its best known synonym states that it is fragrant! Actually, both epithets speak truth, but of different parts of the same plant. Indeed the flowers are very fragrant, but the plant/foilage lacks any sort of alliaceous odor. On the other hand, the leaves impart a garlicky aftertaste if chewed. It is a pity that the plant is such a devilish weed, as the flowers' scent is much like *Dianthus* or cloves. Scapes are tall enough for cutting, although the flowers remain closed until mid-afternoon and close at night. The flowers are modestly attractive but not showy, and have a bell-shaped (infundibulate) form. The two basic flowering periods are spring and fall, but when conditions are to their liking, they may flower through much of the summer.

If one MUST grow *N. inodorum* outdoors, at least relegate them to a place devoted to wild plants, away from the ordered discipline of a flower bed. Be forewarned! These plants inspired the word "invasive". It is not merely the

rampant seed-spreading but the loathsome bulblets that form around the base of the mother bulb. These "rice-grain" bulblets are easily dislodged, falling away to forever contaminate the soil with a plague of unwanted plants. Self-sown seed is equally bad, as wherever seed goes, bulblets will soon follow.

How then does one get rid of them? Digging them out rarely works, as enough of them will remain to return in a year or two. One must simply deal with them ruthlessly. One good method is to treat the soil with a fumigant such as Vapam. This destroys any living thing in the soil down to about eight inches or so. One can sometimes stick an ice pick into the heart of a plant (or clump) and pour a small amount of Vapam into the hole. The poisonous vapors will kill the mother bulb and her villainous brood. Restraint must be used, lest other cherished plants be killed along with the weeds. One can also use a monocot weed killer such as Roundup™ or Kleenup™ if applied several weeks in succession, sprayed or dabbed on with a brush. Again, one must take great care that the poison is not accidentally applied to your wanted treasures.

Quite by accident I learned that systemic organic phosphate insecticides such as Diazinon have a deleterious effect on the weediest *Nothoscordum* species (*N. inodorum*, *N. nudicaule*, *N. angustius*, as well as innocent *N. nocturnum*), but do no harm to the others. Indeed, nearly all the other species of this genus I grow seem immune to the pesticide. Only the really BAD ones are defoliated and made ill. Unfortunately, one treatment is not enough, and they must be sprayed again and again as long as foliage is evident. But it is a harmless way of getting rid of some noxious weeds while not harming other plants. I learned this little trick when I sprayed my greenhouse plants for mealy bugs (cotton aphids), and inadvertently sprayed my potted *Nothoscordum*, too. This shocked the weedy ones into a tailspin.

The *N. inodorum* group is vulnerable to mosaic virus. While most other *Nothoscordum* species appear to be immune to the virus, those plants that are infected are at risk of infecting other virus-susceptible plants. Growing the *N. inodorum* clan from seed seems to yield virus free plants.

N. inodorum ssp. *angustius* Rav. (*N. "angustius"* of Hort.)

This is a newer form with pretty, smallish, greenish-white bells tinged with olive-tan, an appealing color combination. I know of no other *Nothoscordum* with the same olive-tan markings. The flowers are very sweetly scented. Foliage on most forms is narrower than that of ssp. *inodorum*, but otherwise similar, thus the name, *angustius*, which means "narrow". However leaves are not all that narrow. Scapes are tall and the umbels have a lower bud-count than ssp. *inodorum*. Bulbs are a bit smaller than ssp. *inodorum*, but they are inclined to make the same numerous rice-grain bulblets — a pity, as this form has much to make it endearing. I have in my collection what appears to be a more robust form of ssp. *angustius* which is even prettier with more numerous, larger flowers per umbel and wider leaves. Were it not for the excessive bulblets, it would be a favorite.

N. inodorum ssp. *nocturnum* Rav. (syn. *N. inodorum* var. *macrostemon* [Kunth] Beauverd, *N. "nocturnum"* [hort.])

The most distinctive of the *inodorum* group is *N. inodorum* ssp. *nocturnum*. The bulbs are much larger, the offsets are far fewer and larger, and they are far easier to control in the garden than are the other *N. inodorum* types. The flowers are larger, too, and open flatter to form a pinwheel. The floral segments are noticeably spatulate, and the fragrance is distinctive from the others, but very sweet. The flowers don't open until dark and close before sunrise. Finally, the filaments are broader and flat, touching one another to form a sort of "trumpet" in the center. Cold hardiness is unknown, but it makes a fine pot plant. It is easily one of my favorites, a well-behaved plant and a night-bloomer worthy of the cut-flower trade.

Nothoscordum nudicaule (Lehmann) Guag. (syn. *N. euosmum* Link et Otto.)

N. nudicaule is allied to *N. inodorum* forms but differs from them in several respects. Foliage, bulbs and the spring/autumn flowering times are similar. However, the flowers of *N. nudicaule* open before noon (remarkable for this group) into lovely, white stars keeled with wine-red lines, much like *Allium ramosum*. The flowers of this *Nothoscordum* are very sweetly scented, but, unlike other members of the alliance, the filaments are much narrower, spreading, but connate at the base. *N. nudicaule* is easily identified by its red keels. It also opens in the morning instead of in the afternoon or evening; flowers close in late afternoon. It is an attractive plant, but beware of those bulblets!

Nothoscordum sp., unidentified

While in Buenos Aires, I was fortunate enough to see a lovely, *Nothoscordum* from Uruguay in cultivation as a pot plant. The flowers were surprisingly large and showy for the genus, looking somewhat like a small "paper white" tazetta *Narcissus*. The flowers were pure white, widely open around noon. Foliage was narrowly linear. I was so excited at seeing such large, showy flowers that I forgot to sniff! I later received a few seeds, but they never germinated. I hope someday I will have another chance to grow this lovely thing, which was tall enough for cutting. I don't know if it makes offsets but suspect it does not. It is a pity that this is not a plentiful item, as it surely rates at the top alongside the yellow-flowered species and the lilac-flowered forms of *Nothoscordum bivalve*. I don't know if the giant, white-flowered form has a validly published name.

Nothoscordum sp. #86-10 (Brazil)

Umbel with 8-12 fragrant, starchy, white flowers with faint purplish keels on lanceolate flower segments mounted on wiry stems about 10 inches (25cm) high. There are 5-6 long, narrow leaves and small bulbs forming no offsets. Bulbs produce 1-2 scapes in spring.

Additional species

The following species are unfamiliar to me, although a few may be found in cultivation.

N. andalgalense Rav. (Catamarca Province, Argentina). A new species, little is known of it, but flowers are white and somewhat similar to *N. arenarium* and *N. andicolum* Kunth (Andean Argentina, Bolivia, Chile, and Peru). Umbels with 4-5 whitish flowers, flushed purplish externally display on scapes only a few inches high. Found at about 10,000-12,000 feet elevation and said to be abundant around corn fields. Bulbs are often boiled and eaten by the natives as a home remedy for fever and anemia. Cultivated in England. Not to be confused with *N. andinum* which is a different species.

N. andinum [Poepp.] Fuentes. (syn. *Zoellnerallium andinum* [Poepp.] Crosa, *N. brevispathum* R.A. Phil.) (Chile). Crosa (1975) separates *Zoellnerallium* from *Nothoscordum* on the basis of chromosome morphology and color of the bulb coats when dry. Ravenna (1978) rejects this as the basis for a different genus. The bulb coats of this species are white in the live bulb but turn purplish in the dry state. The 3-4 flowers per umbel are white with purple keels dilated at the base. It takes alpine culture, growing after snow melts.

Nothoscordum boliviense Rav. (Bolivia). Umbels with 5-9 comparatively large, funnel-shaped, white flowers sometimes tinged purplish on outer surface. Leaves are carinate, offsets and scent not reported. — One of the nicer *Nothoscordum*.

Nothoscordum bonariense [Pers.] Beauverd (syn. *N. pulchellum* Kunth, *N. gaudichaudianum* Kunth, *N. grossibulbum* Beauverd, *N. sellowianum* Kunth) (Argentina). Umbels with 2-4 white flowers. Offsets are produced, often at the ends of lateral rhizomes. Ravenna considers *N. pulchellum* and *N. gaudichaudianum* as synonyms for this species, dismissing foliar differences. It flowers autumn to spring, scent is unreported.

N. capivarinum Rav. (Brazil). Growing in sandy soil on the banks of the Capivari River in the State of Paraná, it has umbels with 4-8 starchy, white flowers, which may be scentless or slightly fragrant with keels greenish or purplish. It's said to produce many bulblets. Leaves are broad, 4.5-9mm wide.

N. entrerianum Rav. (Argentina). Found along the Paraná River in sandy clay. Bulbs with an alliaceous odor and with few offsets. Umbels with 7-10 very fragrant, white flowers without contrasting keels.

N. exile Rav. (Brazil). Umbel with 7-10 white flowers and purple keels on 5-12 inch stems grow in stony fields at Guarapuava, State of Paraná.

N. gaudichaudianum Kunth (Argentina and Uruguay). Conflicting reports say that it's either spring or fall-flowering, bulbs with an alliaceous odor and no offsets. Scapes are only a few inches high with fragrant, whitish flowers, keeled violet. Leaves are narrowly linear. Ravenna lumps this under *N. bonariense* as a narrow-leafed form. Guaglianone says it flowers fall through winter (southern hemisphere April-June). She regards *N. grossibulbum* Beauverd as a synonym.

N. goianum Rav. (Brazil). A dwarf type with 6-8 infundibulate (bell-shaped), whitish flowers. State of Goias.

N. grossibulbum Beauverd (Uruguay). A synonym of *N. gaudichaudianum* Kunth. Flowers in autumn.

N. macrantherum O. Kuntze. (Paraguay, at Villa Florida). Umbels are 4-6 flowered, flowers white, anthers half the length of the filaments. Plants are small, 4 inches (10cm) tall.

N. mahuii Traub (Province of Santiago, Chile). Umbel with 3 flowers on 2 1/2 inch (6cm) scapes. Flowers are white, keeled with a thin purple line appear in winter and again in spring — a fine miniature for pots — scent unknown.

N. nidulum R.A. Phil. (Santiago, Chile). Bulbs clustered. Reportedly with rose-colored, flattish umbels with up to 10 flowers. Said to be common in fertile fields around Santiago, where it is called *Allium roseum* by gardeners. May belong to the genus *Tristagma*.

N. nublense Rav. (Chile, from Province of Valdivia, in fields and seashores). Umbel have 3-7 snowy white, starry flowers with purple keels. The flowers are widely funnel-shaped, often nearly rotate, and intensely white. Bulbs make offsets.

N. nudum Beauverd (Uruguay and Northeast Argentina) is a fall-flowering species that sends up leafless scapes before the foliage. Umbels have 3-6 white flowers of starry form.

N. pulchellum Kunth (Argentina and Brazil). Ravenna places this as a synonym of *N. bonariense* in spite of the broad leaves. 5-flowered umbel of starry, white flowers. Leaves longer than the scape, 3mm wide. Allied to *N. bivalve* and *N. bonariense*, but the ovary has a different form.

N. scabridulum Beauverd (Uruguay). Umbels have 2-4 flowers, whitish with yellowish keels. Bulbs are very small, to 1cm, in shaded, mossy areas.

N. serenense Rav. (Chile, in the region of Ovalle). Bulbs make many offsets.

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One of the most distinctive species, it has 3-12 large, white flowers, keeled brownish-green. The segments incurve at the tips with a cucullate-concave apex.

N. sellowianum Kunth (Uruguay). This is not the same as *Ipheion sellowianum* (Kunth) Traub. The umbels have 5-6 white flowers with flat, subulate filaments. Scapes are 8-9 inches tall (20-22.5cm). It's a poorly understood species.

Nothoscordum setaceum [Baker] Rav. (Argentina, State of Tecuman, Santa Fe, and Entre Rios). Solitary, white flowers. Guaglianone (1972) lists it as *I. setaceum* (Baker) Traub. It is one of the species whose genus placement is in dispute.

N. striatellum [Lindl.] Kunth (syn. *N. gramineum* [Sims] Beauverd) (Central and Southern Chile to Valdivia and Calbuco). One of the yellow-flowered species akin to *N. montevidense*, this one has pale yellow flowers. The true form may not be in cultivation, although it would be a welcome addition. Often confused with *N. striatum* Kunth, which is a synonym for *N. bivalve*.

N. vernum R.A. Phil. (Chile, by the seashore at Conon, in Spring). The umbel has 2-5 white flowers, yellowish at the tepal bases and with yellowish filaments and violet keels. May belong to the genus *Tristagma*.

N. vittatum [Griseb.] Rav. (syn *Ipheion vittatum* [Griseb.] Traub) (Southern Brazil, Argentina, and Uruguay). This may be the same as *N. setaceum*. Flowers are solitary, keeled violet.

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Nothoscordum bivalve



Nothoscordum montevidense



Nothoscordum ostenii



Nothoscordum felipponi



Nothoscordum vivalve v. *lilacinum*



Nothoscordum castilloi sp. nov.

A NEW SPECIES OF CALOCHORTUS (LILIACEAE-TULIPEAE) FROM SHASTA COUNTY, CALIFORNIA

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Abstract

Calochortus syntrophus, a new species from northeastern Shasta County, California is described and illustrated. Its relationships are discussed. A discussion of soils, longevities and associated species is given.

The Montgomery Creek country of Shasta County is a region of long-standing botanical explorations. Settlements began in the mid to late 1800's along with road and trail access. Considering roads, housing and power developments, it seems unusual that a showy, roadside "mariposa lily" would remain overlooked. Yet on June 12, 1993, the author discovered another new species of *Calochortus*. The site is not far from a very large, inobvious population of the newly described *Neviusia cliftonii*.

Calochortus syntrophus Callahan, *sp. nov.* (Figure 1 and Table 1.)

Calochortus superbus J. Howell affinis *Calochortus syntrophus* a qua differt: capsula gilva, carina angustiore, canali capsulae profundiore et angustiore; seminibus maius et crassius, embryo obscuro, seminibus angularibus 55° in capsulam, triens minus seminum per capsulam, 66% capsulae est usufrectae. Flos: ungue petali aureo ad aream supra glandem, trichomis glandium aurantiacis et angulatis ± usque ad apicem. Glandibus concavis ellipticis, paca trichomes longiora cingent glandem. Macula porphyrea cincta zonam auream supra glandem. Bulbis maiores et infossis profunde, foliis basalibus viridibus sub anthesi. Plantis crescentibus in habitum fasciculatum.

Bulb ovoid to 16mm width, encased within several thin, light-brown, membranous tunics, deep seated to 20cm, bulb division common. Strictly erect perennial herbs to 60cm tall, stem bulbiferous at second basal leaf axil, with mostly two basal, linear, keeled leaves — green and glaucous at anthesis, to 30+cm long x 8 - 10mm wide, cauline leaves linear 15cm long x 5mm wide subopposite becoming reduced above. Bracts subopposite and much reduced. A monochasial 1 - 5 flowered inflorescence; subumbellate flowers erect, campanulate, white; yellow petal base extending from receptacle and terminating just above the reddish brown blotch or 1/2 the petal length.

Yellow region surrounding gland fluoresces bright yellow under long wave ultraviolet light. Gland concave-elliptical in outline, invested with dense, simple, multicellular trichomes to 1mm in length, tips arching distally, and evidently nectiferous. Gland surrounded by scant, longer trichomes to 5mm long, yellow. Sepals glandless but similarly with yellow base and small reddish brown spot 8-10mm wide x 30cm long, lanceolate, attenuate, glabrous. Petals obovate, cuneate, rounded and obtuse above, margins erose, gland not depressed. Anthers and basally dilated filaments near equal in length to 8mm. Anthers white, (pollen white) parallel, basifixed, linear lanceolate, acute to oblong. Ovary 12mm long linear, not winged, tapering to a persistent trifid stigma. Stigma lobes purple crested. Capsule, dull yellow, linear, acute to 6.5cm long x 9mm wide, penniparallel venation, groove width 1mm x 0.5mm depth. Seed angle $\pm 55^\circ$, average seeds per capsule 73, 125 seeds per 0.5 grams. Seed testa colliculate, hilum region with traverse purple band, thickness 1mm x 6mm long x 4mm wide, embryo mostly obscure. Flowering period late May-June. Capsules mature July. TYPE: USA, California, Shasta County, The Cove, southeast of Roaring Creek, 40°53'24"N 121°56'45"W, T35N R1W S.14 S1/2 NW1/2, elevation: 524m, 1720 feet, June 12, 1993, F. Callahan 1125, Holotype: CAS, Isotypes K, US, MO, RSA, UC, SOC.

Calochortus syntrophus clearly belongs in Section II, the Mariposa (Ownbey 1940) which was borrowed from Purdy's Group 6, the true Mariposa Tulips (Purdy 1901). Purdy, also considered the presently accepted *Calochortus superbus* as *C. luteus* var. *oculatus* Purdy and Bailey (1900). Both plants form hybrid swarms with intensive back crossing and highly fertile seed counts. This intense production of fertile hybrids is unparalleled in the genus, with the exception in Section *Calochortus*: *C. tolmiei* x *C. uniflorus*. This latter hybrid affinity challenges Ownbey's subsection concept. Conversely, hybrids *C. superbus* x *C. splendens* yield only sterile offspring. *C. superbus* and *C. venustus* are sympatric in several range overlaps, but introgression is not evident (Farwig and Girard). However, in reviewing specimens of *C. superbus* and *C. venustus* (SOC and Callahan Seeds Herbarium) the author found material that was identical in all respects except gland characters. *C. superbus* and *C. syntrophus* exhibit entomophily, with similar vectors (beetles from the Carambycidae family) i.e., *Brachysomida lactifica* (V. Parker pers. comm.). *Calochortus syntrophus* exhibits allopatric distribution with *C. superbus*. A distance of only 0.3km separates both species, yet no evidence of introgression was observed in either population (Erwin and Callahan). *C. syntrophus* exhibits only slight color arrangements and gland plasticity, characters yielding a stable species. The fact that this population lacks compromise by introgression with *C. superbus* further engenders a strong case for species recognition.

Calochortus syntrophus shares many traits with such relatives as *C. superbus*, *C. luteus*, *C. vestae*, *C. venustus*, *C. argillosus* and *C. simulans*. The latter two species are known from very early collections (Purdy 1900 to date), yet were undetected by Ownbey as distinct taxa. The gland configuration of



Calochortus syntrophus.
Gland and petal blotch



Calochortus syntrophus.
Anthers and pollen gland



Calochortus syntrophus. Top view

Calochortus syntrophus is unique and seems closest to *C. venustus*, yet these species are separated by a gap of 225km, 158 miles. Research will be conducted to determine pollen receptivity between these two species.

Calochortus syntrophus shares many traits and geographical affinity with *C. superbus*. Specimens of *C. superbus*, collected north of Manton, in Shasta County, California gave the author the first indication of low level speciation. These specimens lacked the linations, ocellate spot and were yellow at the proximal half of the petal, although the gland was acute in shape like *C. superbus*.

Morphological data implications

A bias was employed utilizing capsules of both species having identical length and width to insure balanced seed counts. Over 200 mature capsules of each taxa were evaluated, confirming \pm uniform size differences. Capsule utilization and seed size (mass), however, seems to indicate markedly different reproductive strategies. *Calochortus syntrophus* with fewer, heavier seeds utilizes the added endosperm for deep radicle development in seedlings to insure survival of a long lived, deep seated bulb. The seeds seem to be carried by water, as plants are concentrated in swales. Deep seated and long lived bulbs are characteristics are shared by two other rare taxa: *C. tiburonensis* to 25cm depth and *C. obispoensis* to 30cm depth. *C. superbus* develops twice the seeds per capsule that are very light and are wind and water transported. This "broadcast" effect seems very adaptive in delivering seeds to a wide range of habitats. The bulbs of *C. superbus* are smaller and possibly short lived; however, recruitment rates are very high. Both taxa utilize stem bulbs in asexual reproduction. However, *C. syntrophus* exhibits a common trait of main bulb division. Considering its large range distribution, *C. superbus* clearly demonstrates an efficacious seed dispersal stratagem. The very limited range distribution of *C. syntrophus* may relate more to habitat compromise (geologic and floristic) than to recruitment strategies.

Soils

The soils of the Montgomery Creek Formation, Klamath Mountains are largely derived from Eocene non-marine sediments. "The granitic and metamorphic rocks of the Klamath Mountains formed the main source materials for the Montgomery Creek Formation," (Higinbotham 1987). The habitat of *Calochortus syntrophus* is situated on Kilarc (KID) series soils of the Montgomery Creek formation - situated between the Klamath Mountains province and the Cascade Range province. The local Kilarc soils have only limited distribution as a result of the intense overcasting of Cascadian lava and mud flows. This geologic "window" of Kilarc series soils consist of only 2 hectares (5 acres) of habitat island. The Kilarc series soils exhibit slow permeability, available water capacity of 10-20cm, sandstone at a

Table 1. Comparison of morphological data of *Calochortus syntrophus* and *C. superbus*

Character \ species	<i>C. syntrophus</i>	<i>C. superbus</i>
Capsule keel: color, width	dull yellow - brown, 0.8-0.9mm	near white - brown, 1.4mm
" groove: width x depth	1mm x 0.5mm	0.5mm x 1mm
Capsule: seed angle	55°	40°
Capsule: seeds per locule	24.3	62.3
Capsule: seeds per capsule	73	187
Seeds per 0.5 grams	125	257
Seed thickness, length, width	1mm x 6 mm x 4mm	0.5mm x 4.5mm x 2mm
% of capsule utilized	66 ±	83 ±
Embryo	obscure	visible
Capsule size: length x width (control + maximum)	6.5cm x 0.9cm (maximum)	6.5cm x 0.9cm (7cm x 0.9cm maximum)
Petals length x width (cm)	5 x 5	5 x 5
Petal coloration	white, proximal half petal yellow with distal edge of reddish brown, blotch ± equidistant from petal tip to petal base, yellow region fluorescent under long wave ultraviolet light	white, yellow, lavender, pink, rarely red; proximal petal lineolate with smaller brown oculate blotch surrounded by yellow; distal edge of blotch is 2/3 distance from petal base to petal tip.
Gland	Concave-elliptical, densely beset with orange trichomes ±1mm long, surrounded w/scant, yellow trichomes to 5 mm long; proximal edge of gland 5-8mm from petal base.	Acute 45° (similar to inverted "V"), trichomes 0.2-1mm long, brown, surrounded by scant, brown trichomes to 5 mm long; proximal edge of gland 10+mm from petal base.
Bulbs (main bulb division)	common	rare
Bulbs: width (cm)	1.6	1.0 (1.4)
Bulb depth in soil (cm)	20+	10 or less
Basal leaves	green-active	green to withering

depth of ± 1 m, a very stony surface, and a pH value of 6-6.5 (6.51 tested with Corning PS 30 pH meter). KID soils are Ultisols - mineral soils with a subsoil of illuvated clay-base, saturation of less than 35%. Family classification: clayey, montmorillonitic, mesic. Average precipitation is 190 cm (75 inches), minimum temperature is -20°C (-5°F) (USDA, SCS 1974). The KID soils parallel ultramafic soils in shared edaphic properties. Many similar relict plant populations inhabit both soils i.e., *Cupressus macnabiana*, *Pinus sabiniana* and numerous bulbous species. The soils surrounding the specific site support heavy conifer populations, especially *Pinus ponderosa* and *Pseudotsuga menziesii*. A *Quercus douglasii* ecotone island provides the restricted, habitat for *Calochortus syntrophus*. In effect, the quondam distribution of *Calochortus syntrophus* plausibly was much larger. Currently this remnant species seems "bottlenecked" in this edaphic soil cell with limited opportunity to expand its distribution base.

Longevity

Little is known in the literature concerning longevity in the genus *Calochortus*. A report by Fiedler (1987) that "*Calochortus* plants may live ten years or more" lacks evidence. In fact, three years of research concerning reproductive patterns or life history studies of *Calochortus* yields not much more than speculation. Most species require 3 to 5 years from seed to bloom (Kline, Robinette, Baccus, Farwig, Girard pers. comm.). Bulb coats are shed annually and are rarely preserved (Baccus pers. comm.). In ultramafic soils the bulb coats are occasionally preserved. Residual tunics representing 45+ years have been documented for *Calochortus coxii* Godfrey and Callahan (material beyond this dating was poorly preserved). *Calochortus coxii* blooms in approximately 5 years from seed (Kline pers. comm.). Combining this data would approximate an age of 50+ years for *Calochortus coxii*. *Calochortus syntrophus* is apparently long lived relating to bulb size, multiple tunics and perennating depth. The Kilarc series soils are not conducive to tunic preservation and bulb coat counts beyond 5 years were badly fragmented. Perpetuity is also insured by main bulb division, basal leaf bulbs and seeds. Considering potential asexual bulb production these plants may not experience senescence other than by ultimate predation. *Calochortus* are seldom long lived in cultivation when compared with wild contemporaries. Twenty years seems to be the maximum for cultivated bulbs with recorded data although the average is nearer to six years (Kline pers. comm.). Cultivation of *Calochortus* species will be addressed in this issue by Boyd Kline, a plantsman with over 50 years of field and nursery experience.

Associated species

Calochortus syntrophus grows on a small soil unit that exhibits a wealth of floristic diversity. The species grows on private properties and is intersected by Cove Road (Shasta County) and several private roads. Introduction of invasive exotics via road access was noted. Associated native taxa includes: *Quercus*

douglasii, *Q. kelloggii*, *Q. garryana* var. *breweri*, *Fraxinus dipetala*, *F. oregonum*, *Arctostaphylos patula*, *Ceanothus cuneatus*, *Odontostomum hartwegii*, *Allium amplexans*, *A. acuminatum*, *A. bolanderi* var. *mirabile*, *A. sanbornii* var. *sanbornii*, *Brodiaea elegans* ssp. *elegans*, *B. coronaria*, *Triteleia bridgesii*, *T. hyacinthina*, *Zigadenus* sp., *Fritillaria recurva*, *Calochortus tolmiei*, *C. monophyllus*, *Dodecatheon* sp., *Erythronium* sp., *Elymus multiseatus*, *Danthonia unispicata*, *D. californica* var. *americana*, *Achnatherum lemmonii*, *Poa bolanderi*, *Juncus patens*, *Lotus purshianus* var. *purshianus*, *Trifolium willdenovii*, *Penstemon azureus* var. *azureus*, *Scutellaria siphocampyloides*, *Madia exigua*, *Grindellia hirsuta* var. *hirsuta*, *Navarretia intertexta*, *Perideridia kelloggii*, *Sidalcea malvaeflora** *Sisyrinchium bellum*, *Eriophyllum lanatum*, *Mimulus guttatus*, and *Wyethia* sp. (* Taxon keys close to *malvaeflora*.) Some very early blooming species were beyond seed stage and positive identification could not be confirmed. The specific site is a *Quercus douglasii* ecotone island surrounded by conifer forest dominated by *Pinus ponderosa*, *Pseudotsuga menziesii* and limited *Pinus sabiniana*.

KEY TO MEMBERS OF THE *CALOCHORTUS VENUSTUS* COMPLEX

Petals with distal edge of blotch ca. 2/3 length from petal base to petal tip. Blotch may be absent in *C. luteus* - petal colors follow gland description.

1. gland transverse, widely lunate, yellow-yellow
orange *C. luteus*
2. gland transiently rectangular; lavender - white *C. argillosus*
3. gland acute (inverted "V"), white - yellow -
lavender-pink *C. superbus*

Petals with distal edge of blotch 3/7ths the length from petal base to petal tip.

4. gland ± quadrate, claw dark red, white - yellow
-lavender *C. simulans*

Petals with distal edge of blotch + equidistant from petal base to petal tip.

5. gland ± quadrate, 2nd paler blotch often
present -white red - lavender - yellow *C. venustus*
6. gland concave-elliptical, proximal 1/2 of petal
yellow, white *C. syntrophus*

Petals with distal edge of blotch 5/11ths length from petal edge to petal tip.

7. gland transverse ± doubly lunate, white,
lavender *C. vestae*

Calochortus syntrophus

The specific epithet is of Greek derivation: *syntrophus* ≈ thriving together, which relates to the plants' clustered growth habit, edaphic soil preference, stable morphology and allopatric distribution. It compliments the name of the genus, *Calochortus* = beautiful grass, which is masculine and of Greek origin.

Considering the very limited habitat area (only 2 hectares or 5 acres) and extremely limited population base (500 - 1000 individuals), the specific habitat area should be stabilized from further human encroachments. There is little doubt that construction of Cove Road and private roads destroyed a considerable number of plants and disturbed drainage patterns in the habitat area. Establishing populations on other eligible sites might prove effective in expanding the plants' populational base. A similar program was employed by the Nature Conservancy with *Styrax texana* with a populational base of ± 38 surviving plants. Currently the plant is thriving on several preserves in Texas.

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GROWING SOME OF CALIFORNIA'S ALLIUM SPECIES

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The most recent taxonomic treatment (McNeal) lists fifty-nine species and varieties of *Allium* native to California. They occur from sea level to more than 3000 meters in a wide array of circumstances. Many are found on extremely "poor" soils, including serpentines, volcanics, and granitic sands. Some species prefer clays, others want scree or gravel, a few grow in mountain meadows or in seeps that remain wet year-round. The amount of rainfall available varies from desert conditions to 200 cm. and more a year. It is not surprising that such a range of habitats leads to a wide diversity in the plants themselves.

We have been growing our native onions for about ten years, and currently have about 35 species under cultivation, though some of them for only a year or two. Many we have found easy to grow from seed planted in fall or early winter, even in our mild climate. The reader should bear in mind that *our* experience applies to *our* circumstances. These include an altitude of just under 100 meters and a climate ameliorated by a distance of less than 13 kilometers from the Pacific Ocean. Our worst summer hot spells rarely exceed 38°C, and most summers pass with no temperature above 35°C. By the same token, we typically have twenty or fewer nights of frost in winter, with no temperatures below -3°C. Our coldest winter in ten years (reputed to be a "hundred-year cold spell") gave us five nights in a row of -8°C and daytime temperatures that failed to rise above 5°C for the four days.

Nearly all of California's wild onions are adapted to the Mediterranean type of climate, with winter and spring moisture and dry summers. This annual pattern of wet-then-dry seasons apparently corresponds with the dormancy requirements of the bulbs. McNeal and Ownbey (1973) report an effort to break the dormancy of several native *Allium* species, by subjecting them to 4°C and once-a-week watering for eight weeks starting in July, then moving the bulbs to a greenhouse and watering "as needed." Interestingly, this group of bulbs broke ground less than two weeks earlier than a second group kept dry in the greenhouse until late November. The authors conclude: "The fact that bulbs receiving adequate summer moisture do not sprout earlier indicates that a very strong dormancy, which can be broken *only after a fairly long rest period*, prevails in these species" [emphasis added].

Our experience with growing *Allium* from seed suggests that their seeds also may have significant timing or seasonal requirements, both for dormancy and for the breaking of dormancy. We find that seeds of most California *Allium* species require at least two months and often three or four months to germinate. Seeds that are planted "too late" in the winter season often exhibit

poor germination the first spring, with better results in the second year (after a full winter's cool-wet cycle). This seems to be especially true of high-altitude species. Exceptions to this, as well as other special germination requirements, will be noted as we discuss individual species.

All of the wild onions we have grown require good light; none occurs naturally in deep shade, though some may grow on north-facing slopes or in partial shade in hot inland locations. Their native soils vary from heavy clays to scree; we will describe the natural circumstances of each species discussed. It is worth noting that the extremely poor soils where most occur serve to limit the competition they experience from fast-growing annuals.

Our local rainfall averages about 80 cm per annum and usually falls between mid-October and late March. We provide supplemental watering in dryer-than-normal years and for species that require more. Because they are adapted to Mediterranean conditions, all species need to receive water throughout their growing season, from winter through spring. Most will need summer-dry conditions to satisfy dormancy requirements, and may not do well unprotected in areas that receive heavy summer rains.

Our experience with some species is presented below.

Allium abramsii is an uncommon species from the Central Sierra Nevadas, often found growing in pockets of sand on granite slabs. It is a very pretty onion, with star-shaped rose-purple flowers in dense clusters on sprawling stems to 20cm. A member of the *fimbriatum* alliance, it was formerly classified as a variety of *fimbriatum*. It has a single terrete grey-green leaf which exceeds the scape in length and which begins to wither at bloom in late spring.

This onion is easy in cultivation, with seedlings blooming their second or third year. It likes full sun but will tolerate some shade. It will do well in almost any well drained soil with regular watering from late winter through mid-spring. Under conditions of good food and water, bulbs multiply vegetatively.

A. amplexans grows throughout California and as far north as British Columbia. It occurs most commonly in valleys, although it may also be found in meadows and ridgetops in foothill areas, usually growing in clay soils. It has a tight cluster of usually whitish, occasionally light pink flowers on an erect stem 15 to 50cm tall. Generally it has two to four leaves, shorter than its scape, which are withered at mid-spring flowering.

This is an extremely widespread and variable species. Some forms are easy in cultivation, blooming their second or third year from seed. Others may be more difficult. Most are very tolerant of sun, heat, and poor soils. This onion can be grown in almost any garden soil, given wet-winter-spring, dry-summer conditions. Most forms will multiply vegetatively, under good garden conditions.



Allium abramsii on a granite slab,
Fresno County, California, 1200 meters.



Allium amplexens, Santa Clara
County, California, 1000 meters.



A. campanulatum, in Yuba River Canyon,
Nevada County, California, 400 meters.



Allium cratericola on serpentine scree,
Lake County, California, 100 meters.



Allium crispum on serpentine clay, San
Benito County, California, 250 meters.



Allium dichlamydeum in cultivation.



A. falcifolium on serpentine scree,
Napa County, California, 300 meters.



Allium fimbriatum var. *purdyi* in
cultivation.



Allium haematochiton Santa Barbara
County, California, 900 meters.



Allium hyalinum in cultivation.



Allium platycaule, Modoc County,
California, 1600 meters.



Allium validum on a wet slope in Del
Norte County, California, 200 meters.

Allium campanulatum is a mountain species which grows in much of California and into Nevada. We have seen it as low as 400 meters in the Yuba River Canyon, and above 2500 meters at the summit of Monitor Pass. It is most commonly found on granitic soils. Its spreading, star-shaped flowers range in color from palest pink to rose-purple, arranged in a loose umbel. Most have a darker crescent at the base of each tepal. Its two or more leaves are generally about the same length as the scape, which may be up to 30cm tall, and the leaves will tend to persist in moist, shaded locations, through and beyond its bloom in late spring. Three to four months of cold stratification are needed before this species will germinate. Lower altitude forms have done best for us in our mild climate at 100 meters. Seedlings have taken from two to four years to reach blooming size. This onion is quite tolerant of a range of conditions from full sun to moderate shade, and like most of the California natives requires spring water and summer dryness. Bulbs multiply by offsets on short rhizomes.

A. cratericola, despite its name, is found on serpentine scree and granitic soils as well as volcanic outcrops. It is scattered through much of California at altitudes from 300 to 1800 meters. Its umbels of tightly packed flowers are 3 to 4cm in diameter and nestle above one or two long, broadly channeled leaves which persist past flowering in early spring. Individual flowers have erect tepals and occur in shades of pink with darker mid-veins.

This onion is difficult in cultivation. Germination is best after cold stratification, and seedlings have taken five or more years to reach blooming size. It likes full sun, sharp drainage, good spring water, and patience; a sharp gravel mulch is beneficial. Bulbs multiply slowly.

A. crispum is primarily a species of the Coast Ranges of California south of San Francisco, where it grows in conditions of remarkable heat and dryness and blooms prolifically in wetter-than-average years. After heavy rains during the winter of 1991-92, we saw many hillsides in San Benito County turned purple from its massive flowering. It prefers clay soils, especially serpentines. The inflorescence is one of the most striking among our wild onions. The large (to 5 or 6cm) dense umbel of deep red-purple flowers is carried on a stem of 10 to 30cm. The flowers are often brilliantly highlighted by crisped white edges on the three inner petals. There are generally two or three leaves, slightly shorter than the scape, which usually wither by its mid-spring bloom.

Seeds may require stratification in mild winter climates, and seedlings will often flower their second year. This species wants good sun and lots of water from late winter through mid-spring and is not particular about soil conditions. Bulbs multiply slowly.

Allium dichlamydeum grows on coastal bluffs in the northern half of California. A tight cluster of "hot pink" flowers is carried on a stem up to 30cm; it may be even taller in the garden. The three to six leaves generally persist

through bloom, which is usually late spring in inland gardens, though it will bloom over a long period from late spring to late summer in its natural habitat.

This species is an easy grower, though it may require protection from freezing in cold winter areas. Seedlings take about three years to reach blooming size and will probably do best with some shade in hot inland locations. It likes good drainage and frequent watering until just before blooming. Bulbs multiply rapidly under garden conditions.

A. falcifolium occurs in California's North Coast Ranges, where it usually grows on rocky serpentine slopes. We have seen it as high as 2100 meters and as low as 200 meters. Its umbels of usually dark red (occasionally off-white) flowers are often 5 to 6cm across and nestle above two flat, sickle-shaped grey-green leaves that persist past its mid-spring flowering.

This is a difficult species in cultivation. Seeds may require cold stratification (especially high altitude forms). Seedlings have taken four to six years to reach blooming size. It requires full sun, heavy soil with good drainage, good water through its growth period, and dry summer conditions - and, again, patience! Bulbs multiply slowly.

A. fimbriatum var. *fimbriatum* is found in rocky places, often on serpentine, in the southern two-thirds of our state and into Baja California. We have seen it as low as 200 meters in Napa and San Mateo Counties, and it occurs as high as 2700 meters. Unlike most of our wild onions, it seems to grow sparsely, rarely forming large dense populations. It has a loose cluster of tubular purple flowers with flaring tips on sprawling stems to 20cm. Its single, terrete leaf has withered by its blooming in mid-spring.

This onion has been very difficult in cultivation. Seeds may require cold stratification, and seedlings have taken three to four years to reach blooming size. It has done rather poorly for us, as we have found the bulbs to be very short-lived.

A. fimbriatum var. *purdyi* is a narrow endemic confined to serpentine clays and outcrops in the Inner North Coast Ranges, in Lake and Colusa Counties, at 300 to 600 meters. Where it does grow, however, it often occurs in very large, dense populations. It resembles var. *fimbriatum*, except that the flowers are off-white to pale pink, the entire plant is larger and more vigorous, and the bloom period tends to be somewhat later. We have encountered a population in northern Lake County that appears to be intermediate between the two varieties.

We have found *Allium fimbriatum* var. *purdyi* much easier in cultivation than *A. fimbriatum* var. *fimbriatum*. Seeds germinate readily, and seedlings have bloomed in three years. This onion likes full sun, heavy soil with good drainage, and good winter water. Bulbs appear to multiply vegetatively only rarely.

A. haematochiton occurs in the coastal mountains of the southern half of California and into Baja. We have seen it as high as 1000 meters in grassy meadows in Santa Barbara County, although it is usually found below 800 meters. Its dense umbel of white to light rose flowers, which feature a dark mid-vein on each tepal, is carried on a stem of 20cm or less. The four to six leaves are about the same length as the scape and usually wither by bloom in early spring.

Cultivation is easy. Seeds germinate rapidly under cool conditions, in four to six weeks, and seedlings may bloom in their second year from seed. This onion prefers full sun and will tolerate water well into summer, in any good garden soil. Bulbs multiply quickly to form large clumps.

A. hyalinum is a species of the Sierra Nevada foothills, up to 1500 meters, and the adjacent San Joaquin Valley. It grows at the edges of places that have running water in spring. Its moderately large loose umbels (to 5 or 6cm) of white to pink starry flowers are on stems that can grow to more than 30cm (especially in the garden). The two to four leaves are nearly the same length as the scape and are usually withering by flowering time in early spring.

This onion adapts well to the garden and may become invasive. It self-seeds readily, and seedlings often bloom their second year. It likes full sun to partial shade and generous water, and it is not particular about soil. It well tolerates some summer water. Bulbs are tiny - less than 6mm - and multiply rapidly.

A. platycaule is our personal candidate for California's prettiest onion. It occurs at altitudes of 1500 to 2500 meters in the northern Sierra Nevadas and northeast into southern Oregon and western Nevada. It has large (7cm or more) dense umbels of "hot pink" flowers with strongly exerted stamens, giving it an almost "fluffy" appearance. Inflorescences are nestled close above two flat, falcate blue-green leaves which persist past flowering in late spring or early summer.

This is another difficult species, but well worth the effort. Seeds require three to four months of cold stratification, and seedlings have taken four to five years to reach blooming size. In our experience, this species blooms poorly without sufficient winter chilling. It will take full sun, lots of water, and any well-drained soil. Bulbs multiply moderately slowly.

Allium validum is one of our wet-growing onions. It is found in high, wet mountain meadows and seeps in a number of California mountain ranges, to British Columbia, Idaho, and Nevada, from 1200 to 3400 meters. It is the tallest of our wild onions, with stems to 100cm. Umbels up to 7cm are densely packed with pink to white flowers with strongly exerted stamens. We have seen a form we could only describe as "cerise" near Sonora Pass at 2900 meters. The three to six leaves are generally a little shorter than the scape and may remain green throughout the summer. Bloom is early to mid-summer.

Seeds may require cold stratification, although lower altitude forms germinate for us without it. Germination may be slow and erratic. Often seeds planted in fall will start germination in early spring and will still be germinating at mid-summer. This species likes full sun and copious water, at least through mid-summer if not year-round.

In closing we remind the reader that where we have said a particular species is "easy" or "difficult" it is based on *our* experience in *our* climate and circumstances. Others may have experiences quite different from ours. We would be interested to hear from others regarding what works best for them in their situations.

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Editors' note: All the species mentioned in this article are available from Robinett Bulb Farms.



CALOCHORTUS: WHY NOT TRY THEM?

(Reprinted from volume 48 of the Bulletin of the American Rock Garden Society with the author's permission.)

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Why not grow *Calochortus* as well as tulips or daffodils? In dry country you won't have to worry about watering in the summer as you would have to water other bulbs. The traditional bulbs only appear in the early spring, but *Calochortus* bloom later, giving you marvelous color for months after other bulbs are gone. Here in Medford, Oregon they start to bloom in late April or May, and different species continue all the way to August. If you have a collection you will have bloom all summer long. I grow *Calochortus* in the open ground of my garden, 150 miles inland from the Pacific Ocean. Here we have no summer rains, or, at most, scattered showers which pass quickly and never saturate the ground.

I grow many species from seed. I leave the new seedlings in the seed pot for two summers. The pots of newly germinated seed are sunk to the rim in sand and are kept thoroughly shaded their first summer so that they don't get completely baked. *Calochortus* send up only one thin leaf the first year. As the summer goes on the tiny plants keel over and go dormant and you think you've lost them. Don't worry. Just give the pots complete drainage, shade them well, and don't water them much. I water seedlings slightly all year so they don't dry out completely.

Calochortus don't like pots, so after the plants have gone dormant late in their second season, I plant them out in the garden. Or right after the new leaves appear in March or April, I line them out in a row in a seed bed. They remain there until they bloom. When the first flowers appear I place a marker next to each plant to mark the spot. After they go dormant I transplant them to their permanent position in the garden.

Perhaps the most common reason given for not growing *Calochortus* is the length of time they take to go from seed to flowering plant. For most species it takes five to seven years to reach blooming size; a few bloom in three years. In my experience few of these plants increase much vegetatively in cultivation. *Calochortus luteus* and *C. venustus* are the most vigorous in this respect, while most other species remain as solitary plants.

Fully mature plants do not require any shade. We have hot summers and we grow them in full sun. During the growing season *Calochortus* can take just about as much water as you can give them, but as soon as the flower buds begin to show color it is very important not to water any more. Let them dry out completely. I used to grow *Calochortus* in pure sand with good success, but

KLING: WHY NOT TRY *CALOCHORTUS*?

then we had several summers with long periods of 100°F weather when they seemed to suffer. Now I grow them in a mixture of sand and loam with a lot of red serpentine soil added. Serpentine is a metamorphic rock, very common in the coastal ranges of Oregon and California, which has a high concentration of magnesium and other metals. Many plants find serpentine quite toxic, but most all *Calochortus* love it.

I ensure perfect drainage by layering a mixture of 4 to 5 inches of soil mix over 6 inches of pure sand. The bulbs are usually planted about 3 inches (7-8cm) deep in the soil. I like to mulch the bed with conifer needles to keep the soil somewhat cooler and to retain a little moisture in the summer months. I have many deodar cedar trees nearby which shed lots of needles. Where do *Calochortus* grow in nature? Many species grow on serpentine ridges. Many species grow in grasslands or sagebrush, with few other flowering plants in evidence.

I grow about 30 kinds of *Calochortus*. Here (below) are some of the species with which I have had success. Each one of them seems to have an internal clock that times a different period of bloom.

Cat's Ears

In this group of species the inner surface of the petal is covered with a coat of fine hairs, so they are commonly referred to as cat's ears. These species are relatively easy to grow, and would be good for beginners to try.

Calochortus tolmiei is one of the first to bloom. The flower is usually pale lavender in color, although in different areas there are many different shades. On the coast it is a deep purple. This species is closely related to *C. coeruleus*. In the mountains *C. coeruleus* is usually a pale lavender and very hairy. Both species grow in rocky areas among grasses. I have not had as much success with *C. coeruleus* as I have with *C. tolmiei*.

C. elegans is a tiny species that grows at 6,000 to 7,000 feet in well drained but heavy soil. The flowers vary from mountain top to mountain top. In the Siskiyou Mountains they tend to be pale lavender. In the Cascades I've found them in deep purple, the flower on 2 inch stems and the leaf 8 inches long.

C. monophyllus, called the "little, yellow cat's ear", is one of the first to bloom. I have found populations where the plants were only 3 inches tall, but I have also found plants as tall as 8 or 9 inches. This species usually occurs in shady places under pine and fir trees. It is found in California as far north as Mt. Lassen. The soil of its native habitat is rather heavy, but drains well. This species blooms in Medford the second week in May.

C. subalpinus is a nice, high-altitude species I've seen at McKenzie Pass outside of Bend, Oregon, at about 5,000 feet. It grows in forest duff and very loamy soils. It is rather low blooming, reaching only 8 inches or so. The flower is a soft, creamy white with a few markings inside. This species is supposed to bloom in August, but I went over to collect seed in September this year and found it still in flower.

Calochortus coxii is a very short species, from 6 to 10 inches tall, sometimes

called "upright cat's ear". The blossom is a creamy white color with very beautiful purplish markings in the throat. A Mr. Cox from Canyonville first found it, and thought it an unusual form of *C. tolmiei*, blooming very late. The botanists he consulted at the university thought that it was unremarkable, but later it was studied and published as a new species by Frank Callahan, an Oregon seedsman.

Globe Tulips or Fairy Lanterns

This group of *Calochortus* is utterly different from cat's ears. There are only five taxa in this section. They have pendulous blooms that hang down like Chinese lanterns, while the other species have flowers held upright like tulips. The entire group blooms early in the *Calochortus* season, starting in May most years. I grow all of these in the open, and they all seem to like serpentine. This group does most of its growing in the wet winter season of the Mediterranean climate, and for that reason perhaps these species seem to be more difficult to grow in areas where winters are severe. Some may be cold tender, too.

Calochortus amabilis is one of the so-called Chinese lanterns with yellow, round balls of bloom. It is usually found on yellow clay soils in deep grass along the back roads of California. It can be anywhere from 8 to 14 inches tall.

C. amoenus is similar, but usually a creamy white, although there is also a red form.

C. albus is a pure white species distinguished by the shape of the [depressed nectary] gland.

C. pulchellus has much larger flowers, twice the size of *C. amabilis*. The blossoms are a beautiful greenish yellow rather than just yellow.

Other *Calochortus*

Calochortus clavatus is a very late-blooming species, often flowering in August. It has upright, cup-shaped, deep yellow flowers with purple outer shading, and clavate, or club-shaped, hairs. Some have quite deep purple shading. I have never seen this species in the wild, but have grown it from seed.

C. bruneaunis superficially resembles *C. nuttallii* from farther east, but it has a number of consistent, minor differences in structure, and a consistently different chromosome count. [Ed. note: *C. bruneaunis* Nelson and J.F. Macbr. was formerly known as: *C. nuttallii* Torrey var. *Bruneaunis*(Nelson and J.F. Macbr.) F. Ownbey]

C. eurycarpus is from Montana and Idaho south to Nevada. It grows 12 to 18 inches tall. Its native habitat is in meadows of heavy soil. It usually has pointed petals and blossoms are a pale, silver white with dark markings at the base of the petals. It's a rather late bloomer, lasting into late July.

C. greenei grows on the tops of the Siskiyou Mountains and on the other side of the Klamath Basin. It occurs over an area of about 20 square miles. The flowers are a beautiful, reddish-lavender or sometimes purple color; the plants are from 10 to 16 inches tall. It grows in a peculiar, black, adobe clay. The bulb

can be 12 inches or more deep. I grow this species in ordinary soils. It has a wide leaf and is a rather late bloomer, especially in the wild, beginning to flower in mid-July.

C. gunnisonii grows and blooms nicely, but doesn't increase much. I've never seen it in the wild, but it grows well in cultivation if you let it dry out. My form is a greenish white, not particularly colorful. It blooms in July and August.

C. howellii grows at lower elevations than many other species, 1,300 to 2,000 feet, in various heavy soils, usually yellowish-brown clays. The bulb is not very deep. In the areas where it grows the ground often cracks during the dry summers. The flower is silver white with a black center. It blooms in late June or early July in the garden.

C. kennedyi is regarded by many as the most beautiful mariposa tulip. It grows primarily in the desert areas of Arizona and southern California. I used to think that the bright yellow *C. kennedyi* var. *munzii* grew in geographically distinct populations until I saw a large population where yellow flowers were mixed in with vermilion-orange ones. Until last year I assumed that *C. kennedyi* was quite tender, but a pot full of seedlings came through last winter's 5°F unscathed. This *Calochortus* blooms from late April to June, depending on altitude.

C. leichtlinii is another high altitude species from 8 to 12 inches tall. It grows at 5,000 to 6,000 feet on high plateaus from Modoc County, California south to Lake Tahoe. It tends to grow in rocky meadows where the soil is a pumice sand that dries out quickly. In nature it blooms as late as August and seed ripens only in September, but in the garden it blooms the second week of July. It responds to the same cultural treatment as the other species.

C. luteus is one of the elite species, an upright, golden yellow mariposa that grows a foot or so tall—however deep the grass is. I know it from the California ranges around Clear Lake. It is relatively early in the garden, blooming as soon as the first of June. In the wild it may bloom the first of May.

C. macrocarpus is the giant of the genus. It needs to be staked in the garden, since it has a huge flower that makes the long stem flop over. The beautiful lavender to purple flowers have a prominent green stripe down the center of the outside of each petal. Its very narrow sepals stand out straight from the base of the flower like a clown collar. It blooms in July.

C. nudus grows on flat sites where there's lots of moisture. In the high mountains it can be found in valleys, often near bogs. Its flowers are brilliant lavender on stems anywhere from 3 to 9 inches tall. It is completely hairless. This is found near Mt. Shasta south to El Dorado Co., California.

C. nuttallii I've never seen in the wild. It usually blooms a creamy white and has pointed petals. It is one of the most widespread species, occurring from California to Nebraska and from Canada practically to Mexico.

Calochortus nuttallii var. *aureus* is a form from southern Utah and northern Arizona sometimes classed as a species in its own right. It has flowers of a pure, deep golden yellow.

C. persistens is a rarity that only grows near Yreka, California. The flower is

such a gorgeous pink. I have to admit that it looks better in the wild than it does in captivity. In the wild it is only 6 to 8 inches tall, but in the garden it can be a foot tall and the flowers are a paler pink. It usually blooms mid-July.

C. plummerae is a late-blooming species, comes in lavender, and is rather tall. It grows in the mountains of southern California.

C. tiburonensis I grew from seed and it bloomed one year. It hasn't bloomed in the four or five years since. I hope it will bloom this coming year. It is the only species that doesn't bloom every year for me. I think it may not like the cold winters of Medford, so I cover my beds now to protect this and other tender species. The small, yellow-green flowers have many fine hairs. It comes from the Tiburon Peninsula and blooms in June.

C. umpquaensis is found near Roseburg. The U.S. Forest Service stated that it was a form of *C. howellii*, but *C. howellii* has upright seed pods, and this has pendant seed pods. The flower resembles *C. howellii*, but is much larger. The color is silver white with a very black center. Frank Callahan has found three locations now in addition to the original site, so the species is not nearly as rare as was once supposed. It is found on serpentine ridges on the east side of the coast range.

C. uniflorus grows at 1,500 feet altitude, and is very much like *C. nudus*, although the plant grows only 3 to 4 inches tall, the leaf to 8 inches long.

C. venustus blooms a week or two before *C. vestae*. It seems most common between 3,000 and 5000 feet, growing in grassland. This is unquestionably the most variable mariposa. It has a tremendous variety of colors that attract everybody — especially the crushed-strawberry reds and the purple reds. There are yellowish forms and creamy whites as well, each flower with markings that differ tremendously. It grows in sandy soils in the Sierra Nevada and the coast range.

C. vestae is like a late-blooming *C. venustus*, resembling that species strongly, although the flowers are a more uniform white, with beautiful, deep reddish-purple markings. It begins to flower in June, but can start as late as July, and I've even seen it in bloom in August.

Growing lilies has long been my main horticultural hobby. I am also very interested in fritillaries. From these two groups I have learned patience, and no longer mind waiting years for bloom. I have always admired the *Calochortus*, and as I tried them over the years I have found that they are not so difficult as their reputation might have you think. I just kept trying them and found I could succeed. Perhaps you will, too. They are certainly a beautiful part of the western flora and very worthy plants to grow in the garden.



ANOTHER LOOK AT *CALOCHORTUS*

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[Ed. note: Adapted from the November 1993 Southern California Hemerocallis & Amaryllis Society newsletter with some additions, this begins with a review of their October 16, 1993 program on California native bulbs given by Fred Smith, a long-time SCHAS & American *Calochortus* Society member and retired agriculture teacher. He has grown native Californian plants for many, many years, but he's only been seriously growing *Calochortus* for about 20 years.]

At the turn of the century Carl Purdy, a self taught horticulturist in Mendocino County, taught school, collected bulbs, had a nursery. Mr. Purdy became a successful seller of native plants and bulbs (field collected, of course). Around that time as a young, horticulture student, Fred Smith looked about for plants to hybridize and grow. Mr. Purdy became an early influence in Mr. Smith's life, shaping his love for native bulbs.

California natives grow in Mediterranean conditions: cool, moist winters and dry, hot summers (when the bulbs go dormant-deciduous). Roughly translated from the Latin, *Calochortus* means "beautiful grass" (describing the plant habit). Some of them are dubbed "Mariposas", since their flowers resembled butterflies sitting on top of stalks of grass. Since they need dry summers, you must grow them in pots or in wooden boxes so you can control the moisture. *Calochortus* are niche growers, and each species is only found here and there in specific combinations of light level, temperature, elevation and soil type. Thousands of years ago tulips and *calochortus* had a relative in common, but their paths diverged somewhat since. There are at least 60 species of *calochortus* on the west coast of the United States of America. The best ones are from California, but there are also a couple just east of the Rockies and also some up into Oregon. *Calochortus* were "discovered" before Lewis and Clark's expeditions, but Lewis and Clark were probably the first to bring them back with them to the eastern states.

HYBRIDIZING

Calochortus cultivars are time consuming to develop. They take from 3 to 7 years to go from seed to the first flowering. The bulbs are small and they don't always bloom or grow each year, so you can't always plan your crosses ahead of time. *Calochortus* bloom April to June in our nearly summery weather. California's native bulbs bloom a full 1-2 months after most southern African bulbs grown at the same site.

CULTURE

Calochortus sprout later than do many other bulbs — in early November once the weather cools and 2 inches of rain have fallen in the area. The bulbs are edible (taste like potatoes) and have few pests here. Usually only gophers, mice, cattle, sheep, grasshoppers, and suburbanite humans will attack them.

Fred Smith uses an inexpensive soil mix of about 30% clay-like garden soil, 1/3 sand (mixed particle sizes, gritty), and 1/3 organic matter. Plant the bulbs in pots to allow good drainage and summer dryness. Water them from sprouting time in November until flowering time (late spring/early summer), then taper off and stop watering at about the time the blossoms open. Once growth and bloom spurts start, it's OK to feed the plants minimal amounts of nitrogen and iron. Mr. Smith has tried bulb fertilizers and controlled release fertilizers such as Osmocote and one called "Once", but he finds them to be expensive. You can fertilize very lightly (1/3 strength) with superphosphate, gypsum (provides calcium and magnesium), lime soda/calcium lime (a calcium and sulfur mix).

PLANT SOURCES

Sources for *Calochortus* and other California native bulbs are as rare as the plants are. He's found some through ads in Pacific Horticulture, through Burkard's nursery in Pasadena and at the Theodore Payne Foundation. If you see an ad for them, go ahead and send for a catalog or some seeds. [Ed. note: Robinett Bulb Farm offers an extensive selection of bulbs and seeds. Try occasional offerings through the Rancho Santa Ana Botanic Gardens and via the International Bulb Society's seed exchange or members of the American Calochortus Society. See the reference list.] Keep in mind that species native to areas of high elevations do not grow well in the valleys.

Mr. Smith's many slides illustrated the different forms of calochortus: the upward facing, cupped flowers of the mariposa types, the pendant, closed-petalled globe types (which tend to die out on him), and the fuzzy cat's ears types. He discussed the characteristics, range, and habitat of each species.

VIEWING CALIFORNIA NATIVE BULBS IN BLOOM

California bulbs/corms are best viewed mid-April to early June. A few are in bloom as early as March, including the various *Zigadenus* species, lily relatives which are under a foot tall and possess a profusion of flowers shaped like softly rounded stars with egg yolk golden centers and petal tips of soft yellow. From late March through the month of April, our "firecracker flowers", *Dichelostemma ida-maia* bloom in bursts of rosy to red, tubular flowers with green tips and a floret shape unlike any of our other native onion family members. A prolific, musty/foul smelling, ant-pollinated native onion, *Allium haematochiton* (with dense umbels of off-white flowers striped burgundy), flowers from the beginning of March through early June.

Of note later in the season are the lovely, cup-shaped, lavender to violet

flowers of *Calochortus splendens*; the glittery centers of *Triteleia bridgesii*'s light violet flowers; and the airy, golden yellow flowered umbels of *Bloomeria crocea*, a distant, odorless onion relative sometimes called "golden stars".

From late April through early July don't miss the breathtaking array of *Brodiaea californica* varieties in opalescent, glistening shades of white, pastel pink, lavender and lilac-violet, some with undulating petal edges, all with 1-3 umbels per corm, each umbel 8 - 24 inches tall with at least 10 - 25 florets. If you were at an evening soireé among the sage scrub, grassland or chaparral, you might glimpse the dainty, white, nocturnal florets that *Chlorogalum pomeridianum* (a remote hyacinth relative) displays on its branched, 4 - 5 foot tall stalks above a basal rosette of leaves.

I could recommend a dozen more plants of interest, but you'll just have to take this as a "teaser", then visit California or grow your own plants to see the real things.



Looking for Adventure?

Are you tired of just reading about exotic bulbs in *Herbertia*?

Do you ever dream of going into a tropical forest and discovering plants you only knew from books?

Are you interested in collecting South American bulbs and plants?

Stop dreaming!

One of our IBS members has had experience in guiding tours of the forests of Ecuador.

Call or write Betsy Fuerstein

2357 Thornwood Lane

Memphis, TN 38119

USA

(901) 754-6271

SOURCES FOR FURTHER READING ON CALOCHORTUS AND OTHER CALIFORNIA NATIVE BULBS

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FRED M. SMITH

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Below is a brief list of references we recommend highly. Works aren't listed in any particular order. If you are unable to find these materials in your local or University libraries, try **Herbertia/Plant Life** back issues (information on page 3), or contact the California Native Plant Society (CNPS) [1722 J Street, Suite 17, Sacramento CA 95814, United States of America, phone: (916) 447-2677] for information on the works they sell. The CNPS is a nonprofit group which publishes **Fremontia**. They also supply and publish a number of reference and horticultural works on California natives.

- Niehaus, Theodore F. 1971. **A Biosystematic Study of the Genus *Brodiaea* (Amaryllidaceae)**. University of California publications in botany (vol. 60), Univ. of California Press. ISBN: 0-520-09390-9. A good, technical reference with a key to the species known at the time, this publication does focus on *Brodiaea* only (in the strict sense of the genus).
- Chickering, Allen, May 1938. **Growing Calochortus** (a horticultural monograph, #1 in a series). Rancho Santa Ana Botanic Garden. Contains an index, too.
- (Misc. authors) April 1975. "Propagation of plants with bulbs, tubers, corms, rhizomes and rootstocks" (very good article), "Two lilies of Modoc County" (includes *Leucocrinum montanum* and *Lilium washingtonianum*), and "Natives for your garden" (including *Dodecatheon hendersonii* and *D. clevelandii* ((Primulaceae))). **Fremontia** 3(1). California Native Plant Society.
- Keator, Glenn 1987. Brodiaeas. **Pacific Horticulture** 48(3). Pacific Horticultural Foundation. The article includes the allium/onion family genera *Brodiaea*, *Triteleia* and *Dichelostemma*.
- Farwig, Stan and Victor Girard 1981. Neglected Calochortuses. **Pacific Horticulture** 42(1). Pacific Horticultural Foundation. The article (pp. 19-28) includes many, very good photos.
- West, Robert C. 1981. The discovery of *Calochortus tiburonensis*. **Pacific Horticulture** 42(1). Pacific Horticultural Foundation.
- (Misc. authors). **Mariposa** (American Calochortus Society newsletter) IV(4),

- April 1993 and all other issues. To subscribe for v.5 (7/93 - 4/94), send a check (\$4 domestic, \$6 outside the USA) to the ACS in care of: PO Box 1128, Berkeley CA 94701-1128, United States of America.
- Schmidt, Marjorie G. 1980. **Growing California Native Plants**. University of California Press.
- Schmidt, M.G., Oct. 1976. *Calochortus*. **Pacific Horticulture** 37(4).
- Schmidt, M.G., 1963. (A reprint of her **Pacific Horticulture** v. 24(2and3) article.) **Journal of California Hort. Science**.
- Ownbey, Marion, Nov. 1940. A monograph of the genus *Calochortus*. **Annals of the Missouri Botanical Garden** 27(4).
- O'Neill, Charles J. 1989. The Genus *Calochortus*. **University of California, Irvine Arboretum Newsletter**, winter (December) 1989. Later adapted for "The Genus *Calochortus*" in **Herbertia** 46(1and2), 1990, which includes 4 photos by Charles Hardman.
- Farwig, Stan and Victor Girard, 1987. *Calochortus raichei*, a new species from California. **Herbertia** 43(1), pp. 2-9. As with other *species novum* papers, this includes much technical material, but it contains good descriptions, a history and pictures of the species.
- Herbertia/Plant Life**, especially vol. 11(1) from Jan. 1955 (w/*Dichelostemma ida-maia* on the cover), and this issue, 49(1and2) (1993), which has an article on *Calochortus syntrophus* (*sp. novum*) and on *Calochortus* culture. Other volumes have information on other species. **Herbertia** volume 12 (1945) contains info. on related South American *Brodiaea*. **Plant Life** 12 (1956) has articles on miscellaneous California plants.
- Hickman, James, ed. (various authors) 1993. **The Jepson Manual: Higher Plants of California**. University of California Press. This hardbound volume is a reference work with keys and line drawings for both monocots and dicots. The **Jepson's** familial classifications are highly "lumped together", and some of the keys are quite awkward with which to work. It remains a useful volume despite its many shortcomings. Munz, P.A. 1974. **A Flora of Southern California**. University of California Press. This and other works by Munz (**A California Flora** and its supplements) are reference works which are still valuable, especially when used in tandem with **The Jepson Manual**. This work also contains identification keys and line drawings, but "lumps" families slightly less than **Jepson**.
- Skinner, M.W. and B.M. Pavlik, eds. 1993. **California Native Plant Society Inventory of Rare and Endangered Vascular Plants of California**, 5th edition. Calif. Native Plant Society. It contains notes on "distribution, rarity, endangerment, legal status, habitat, plant growth form, blooming time and literature sources" for 1700 species, subspecies and varieties.
- Hoover, R.F. 1955. Further observations on *Brodiaea* and some related genera. **Herbertia** 11:23-23. This article includes notes on several *Brodiaea* spp., on at least 8 *Triteleia* (including several *var. nov.* and *comb. nov.*), and on *Bloomeria*, including *B. humilis sp. nov.*, and *Muilla clevelandii comb. nov.*



SOME SOURCES FOR SEEDS OR PLANTS OF CALIFORNIA NATIVES

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Plants and seeds of California native bulbs (and other native plants) are often difficult to obtain, since commercial sources are scant. Below is a non-comprehensive listing of a few nurseries, botanic gardens and other places where you can inquire about the availability of seeds and bulbs. There are others, but many are poorly publicized or have existed only a short time. All but one of the sources listed below are based in California (United States of America), and not all sell via mail. Most sources supplying seeds will ship seeds, but not necessarily plants, so please write or telephone before ordering.

All of the nurseries and gardens are worth visiting if you're in the area, especially during the peak bloom from mid-spring (March) through early summer (June). Some have limited visiting hours or seasons.

PLANT/SEED SOURCES:

International Bulb Society Seed and Bulb Exchange list, included with membership in the International Bulb Society. See page 4 of this journal for the IBS Seed Exchange address and more information. The Exchange lists seeds of rare and hard to find species of bulbous/cormous plants. Each edition features 500-1200 different species or varieties, particularly those from southern Africa, South or Central America and California.

Robinett Bulb Farm, PO Box 1306, Sebastopol CA 95473. Phone: (707) 829-2729. The Robinetts offer the most comprehensive assortment of west coast native bulbs available anywhere. A wide variety of *Calochortus*, *Allium*, *Brodiaea*, *Dichelostemma*, *Triteleia*, *Erythronium*, *Fritillaria* and *Lilium* are available as bulbs or seeds. Ask for their catalog, but be warned: you may want to order everything in it.

Rancho Santa Ana Botanic Gardens, 1500 N College Ave, Claremont CA 91711. Phone: (909) 626-7670 or (909) 625-8767. Open 8am-5pm daily except January 1, July 4, and November 24, RSABG contains 86 acres of exclusively California native flora and a small bookstore. They hold an annual plant sale each November, sometimes offering a few California native bulbs/corms (often *Allium*, *Triteleia*, *Dichelostemma*). The Gardens do not ship plants. Memberships in their foundation include subscription to a newsletter, occasional seed or plant offers or member discounts. Responses to inquiries

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(written or telephoned) are often slow.

Rancho Santa Botanic Gardens is worth visiting year-round, particularly in spring. It's well landscaped and features both flowering and foliage plants (annuals, small perennials (including bulbs)), shrubs, trees), all adapted to our Mediterranean climate's warm, dry summers. It has cultivar development and demonstration gardens, as well as plantings of species, and areas arranged by floristic communities. Wear comfortable walking shoes.

The Theodore Payne Foundation for Wildflowers and Native Plants, 10459 Tuxford Street, Sun Valley CA 91352. Phone: (818) 768-1802. Wildflower hotline: (818) 768-3533. Theodore Payne Foundation is open Tuesday through Saturday, and specializes in California natives. Their nursery carries a small range of geophytes in addition to trees, shrubs, ground covers, and herbaceous items and native grasses. They have a bookstore/gift shop, and operate a seasonal wildflower hotline for weekly tips on the best wildflower viewing locations in the state. Wholesale and membership discounts are available. Plants grown in pots (including misc. irids) are only available at the nursery (no deliveries) (see their plant list for offerings). Their seed list includes a limited supply of such California geophytic genera as *Bloomeria*, *Brodiaea*, *Calochortus*, *Chlorogalum*, *Sisyrinchium*, *Yucca*, and *Zigadenus*. Inquiries for particular species are welcomed, seed packet costs are reasonable, and Calif. native wildflower seed mixtures are also available in bulk. Seeds can be mailed. Send \$2.00 for plant and seed lists.

Tree of Life Wholesale Nursery, 33201 Ortega Highway, PO Box 736, San Juan Capistrano CA 92693. Phone: (714) 728-0685. Although largely a wholesale grower, they welcome the public on Fridays from 9:00am to 4:00pm at this nursery specializing in California native plants and seeds. Inquire about their supply of *Triteleia laxa*, as they are better known for their large selection of native shrubs and trees, which are of good quality.

University of California, Riverside (UCR) Botanic Gardens, Riverside CA 92521. Phone: (909) 787-4650. UCR holds a sale in October including many shrubs and trees and a few non-native geophytes of interest, including *Alstroemeria*, *Amacrine*, *Bulbine*, some *Iris* species, and *Manfreda maculosa*. They infrequently have *Allium*, *Iris* and other California genera.

University of California, Berkeley (UCB) Botanic Gardens, Berkeley CA 94720, and other U.C. campuses also hold plant sales. Contact individual campuses for information on seed and bulb availability. The Berkeley, Riverside and Irvine campuses of the University of California all have small collections of California native bulbs, but sell them infrequently, if at all. U.C. Berkeley sometimes issues a seed list. U.C. Irvine [(714) 856-5833] has sales (largely of southern African bulbs/corms) early each August and sometimes during a spring open house.

Santa Barbara Botanic Garden, 1212 Mission Canyon Road, Santa Barbara CA. Phone: (805) 682-4726. This site is landscaped primarily with California native trees and shrubs, but it has a lovely display of the native *Oxalis* in their woodland area, and an occasional planting of Pacific coast native iris. They do have occasional seed or plant sales, and they recently added a picnic area, so call ahead for sale dates, then take your walking shoes.

Turk Hesselund Nursery, 1255 Coast Village Road, Santa Barbara (Montecito) CA 93108. Phone: (805) 969-5871. Sometimes has *Gladiolus tristis* and other African bulbs/corms and sells Calif. native plants, though not necessarily California native bulbs.

United States of America. Phone: (818) 796-4355. Fax: (818) 585-0224. This is an established, neighborhood nursery carrying some small bulbs and unusual plants, some Calif. natives (including a few *Calochortus*, *Brodiaea* and *Bloomeria*); also carries Polly Anderson's *Amaryllis belladonna* hybrids each fall. Send for their bulb availability list at the end of September.

Various chapters of the California Native Plant Society (CNPS). Contact local arboreta/botanic gardens for meeting dates, or contact their headquarters at 1722 J Street, Suite 17, Sacramento CA 95814. Phone: (916) 447-2677. FAX: (916) 447-2727. The CNPS is also an excellent source for books and reference works on native flora, as well as their own journal, **Fremontia**. Resale/trade discounts are available on books. The state-wide organization doesn't sell plants/seeds, but several branches hold fall plant sales, including the Ventura chapter, San Diego chapter, the Los Angeles-Santa Monica Mountains Chapter, and the Orange County chapter (in Irvine). There are also chapters in central and northern California.

California Oak Foundation, 909 12th Street, Suite 125, Sacramento CA 95814, is a non-profit group dedicated to preserving and propagating Calif. native *Quercus* species. It has well-written articles on collecting, storing, and planting acorns, as well as reference sources. — OK, oaks aren't even monocots, but they make fabulous backdrops to native bulbs, take the same climate and water/soil requirements, and their leaves make excellent, loamy compost for use in potting mixes for bulbs. Local landscapers specializing in natives often plant Pacific coast/Calif. native iris and some of the *Triteleia* and *Dichelostemma* species within the driplines of oaks. I've also seen areas of natural chaparral containing patches of *Fritillaria*, *Paeonia*, *Calochortus*, and *Chlorogalum* intermixed with scrub oaks.

Matilija Nursery, 6007 Trancas Canyon Rd, Malibu CA 90265. Phone: (310) 457-3381. They are open Fridays and Saturdays 8:30am - 4:30pm or by appointment, and they carry California native plants, particularly those of the

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Santa Monica Mountains. This nursery sells native iris (species and hybrids), *Lilium pardalinum*, *Sisyrinchium californicum*, *Sisyrinchium bellum*, and *Lilium humboldtii* as plants in pots; they do not mail plants. Inquire about their catalog, which includes 180-250 species of California natives.

Siskiyou Rare Plant Nursery 2825 Cummings Rd, Medford OR 97501. They sell some bulbs and many other natives. Send for a catalog.

Native Bulbs, C.H. Baccus, 900 Boynton Ave, San Jose CA 95117. Phone: (408) 244-2923. They sell native bulbs by appointment only. They do not offer mail order service for 1993/94.

The nursery below has been recommended to me, but they may not carry bulbs.

Live Oak Nursery, PO Box 815, Knights Ferry CA 95361, offers a catalog of California native plants for \$1.00 which I haven't seen yet.



ERRATUM

Maurice Boussard, author of "The Genus *Ferraria*" in **Herbertia** 48 (1 and 2), wrote to identify the *Ferraria* shown in figure 2 on page 22 as *Ferraria divaricata*.



EARLY ILLUSTRATIONS OF *POLIANTHES TUBEROSA* L. (AGAVACEAE)

BERND ULLRICH
GIESSENER STR. 110
D-6301 POHLHEIM 1
GERMANY

The genus *Polianthes*, with the type species *Polianthes tuberosa* L. (1753), is placed today in the family *Agavaceae* (tribe *Poliantheae*) (Verhoek-Williams, 1975). A revision of the different genera of this tribe has been given by Rose (1903), but the conceptions vary from author to author. Doubtless, there are close relations to *Manfreda*, which is again related to *Agave* and treated by some authors only as a subgenus. The best known species is *M. virginica* L., which possesses the northernmost habitat within the whole genus (Smith 1957). A southern member from Guatemala was described in this journal some years ago as *M. fusca* Ravenna (1987).

Traub (1953) believed hybrids between *Polianthes*, *Prochnyanthes* and *Pseudobravo* to be possible. Indeed, Worsley (1911) reported upon a cross of *Bravo* *geminiflora* Llave and Lexarza and *Polianthes tuberosa*, which he named *P. X blissii*. This hybridizing was repeated by Luther Bundrant (Howard 1977), who further made a hybrid of *P. tuberosa* and *P. howardii* Verhoek, described as *P. X bundrantii* by Howard (1978). Verhoek-Williams (1975) reported of several successful hybridizations between different species of *Polianthes* and *Manfreda*, and Bundrant (1985) finally reported one of *P. tuberosa* with *M. maculosa* W.J.Hooker. A form long known in culture, with double-flowers was described by Moldenke (1948) as *P. tuberosa* forma *plena*.

In addition to its horticultural value, *P. tuberosa* is also grown for its commercial value. Ochoterena (1924) wrote upon the essential oils of *P. tuberosa*, which in India are an important commercial crop for the perfume industry. In recognition of the tuberose's use as a cut flower, Mukhopadhyay (1987, 1988) published in *Herbertia* some papers on growth regulation of *P. tuberosa*.

In this article I have attempted to compile a limited bibliography in which illustrations of *P. tuberosa* appear. The **Index Londinensis** (Stapf and Worsdell, 1929-41), an invaluable bibliography, cites three illustrations of *P. tuberosa* for the 18th century (Rumph 1747, Kniphof 1764, LaMarck 1797). The oldest known figures in the 'Florentine Codex' were reported in detail by Emmert Treublood (1973).

The following table lists in chronological order the early illustrations in the European literature. Only colored plates are cited for the 19th century, as well as the important account of Salisbury (1812).


ULLRICH: ILLUSTRATIONS OF *POLIANTHES TUBEROSA*

Chronological listing of early illustrations of <i>Polianthes tuberosa</i> L. appearing in European literature							
Year	Author	(*=color) Page/plate	Plant parts shown: R=Rhizome, L=Leaf, I=Inflorescence, F=Flower				Illustrations reviewed
			R	L	I	F	
<i>Name</i> under which the plant is listed							
1601	Clusius	p. 176	X	X	X	X	
<i>Hyacinthus orientalis indicus</i>							
1623	Vallet (1)	pl. 34	X	X	X	X	
<i>H. indicus tuberosa radice</i>							
1627	Anonymous	pl. 23		X	X	X	
<i>H. indicus tuberosa radice odoratissimus</i>							
1629	Parkinson	pl. 113, 1	X	X	X	X	Vallet (1623)
<i>H. indicus tuberosa radice</i>							
1629	Parkinson	pl. 113, 2	X	X	X	X	Clusius (1601)
<i>H. indicus minor tuberosa radice</i>							
1641	Swertius	pl. 14, 1	X	X	X	X	Vallet (1623)
<i>H. major indicus tuberosa radice</i>							
1641	Swertius	pl. 14, 3	X	X	X	X	Clusius (1601)
<i>H. minor indicus tuberosa radice albus</i>							
1651	Recchus (2)	p. 277	X	X	X	X	
<i>Omizochill</i>							
1680	Morison	pl. 12, 22	X	X	X	X	Clusius (1601)
<i>H. indicus tuberosa radice</i>							
1680	Morison	pl. 12, 23			X	X	
<i>H. indicus seratinus flore amplo albo odoratissimo</i>							
1701	Rudbeck	p. 39, F.4			X	X	
<i>H. indicus tuberosus flore narcissi</i>							
1714	Barrelier	pl. 1213		X	X	X	
<i>H. tuberosus albus odoratissimus autumnalis</i>							
1737	LaCourt	ad p. 409	X	X	X	X	
<i>Tuberooze</i>							
1742	Weinmann	pl. 584, a*			X	X	
<i>H. indicus tuberosus</i>							
1742	Weinmann	pl. 584, b*			X	X	
<i>H. indicus tuberosus flore pleno</i> (#)							
1747	Rumph	pl. 93	X	X	X	X	
<i>Amica nocturna</i>							
1764	Kniphof	pl. ?850*			X	X	
<i>Polianthes tuberosa</i>							
1786	Wirsing	pl. 135*	X	X	X	X	
<i>Polianthes flore pleno</i> (plate dated 1778)							
1797	LaMarck	pl. 243, a and b	X	X	X	X	
<i>Polyanthes</i>							
1805	Rousseau	pl. 6*			X	X	
<i>Polyanthes tuberosa</i> (Peint P.J. Redoute)							
1807	Redoute	pl. 147*			X	X	
<i>Polianthes tuberosa</i>							
1812	Salisbury	ad p. 41	X	X	X	X	
<i>Polianthes tuberosa</i> (very good account)							
1815	Edwards	pl. 63*	X	X	X	X	
<i>Polianthes tuberosa</i>							
1816	Sims	pl. 1817*	X	X	X	X	
<i>Polianthes tuberosa</i>							

1821	Link and Otto	pl. 24*		X	X	X	
	<i>Polyanthes gracilis</i>						
1822	Kerndl	pl. 71*	X	X	X	X	Sims (1815)
	<i>Polianthes tuberosa</i>						
1824	Redoute	pl. 3*			X	X	Redoute (1807)
	<i>Polianthes tuberosa</i>						
1824	Mordant de L.	pl. 446*			X	X	
	<i>Polyanthes tuberosa</i>						
1830	Drapiez	pl. 272*			X	X	Mordant de L. (1824)
	<i>Polyanthes tuberosa</i>						
1833	Redoute	pl. 141*			X	X	
	<i>Tubereuse</i>						
1896	Bois	pl. 273*	X	X	X	X	
	<i>Polianthes tuberosa</i>						
1897	Step	pl. 265*	X	X	X	X	Bois (1896)
	<i>Polianthes tuberosa</i>						
(1) 1608 edition not seen. # Nearly identical with Trew (s.d.); Vol. 10: pl. 10* ; vide: Ullrich (1992)							
(2) 1628 edition not seen							

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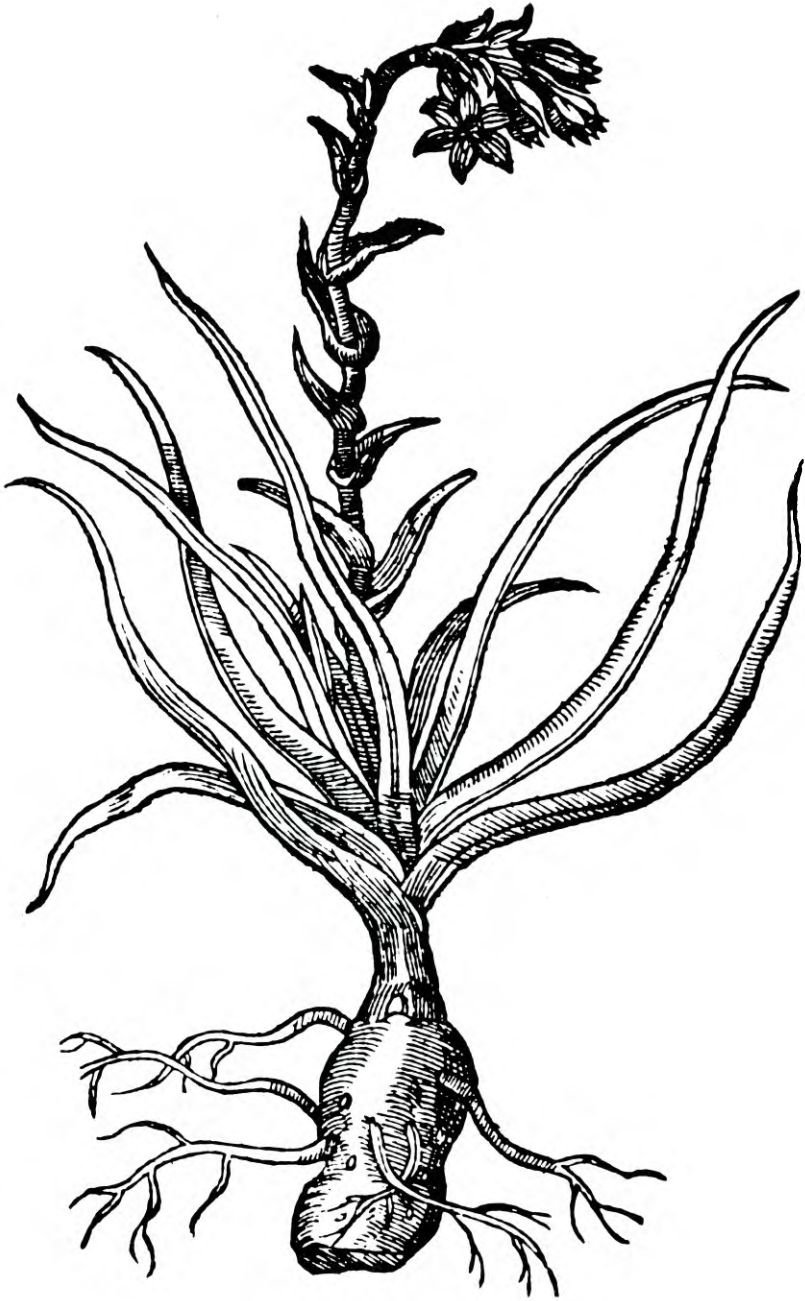


Figure 1. *Polianthes tuberosa*. Clusius (1601)



Figure 2. *Polianthes tuberosa*. Vallet (1623)



Figure 3. *Polianthes tuberosa*. Anonymous (1627)



Figure 4. *Polianthes tuberosa*. LaCourt (1737)

THE IDENTITY OF *CRINUM AMERICANUM* L. (AMARYLLIDACEAE)

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Linnaeus (1737, 1753) formulated the genus *Crinum* in *Hortus Cliffortianus*, wherein he described two plants that later became the two varieties of *C. americanum* L. listed in ***Species Plantarum***. Since its inception though, controversy has surrounded the identity of *C. americanum* L. Are there two varieties of *C. americanum* as steadfastly endorsed by Linnaeus throughout his publications? A focused discussion follows.

HISTORICAL OVERVIEW

In each edition of ***Species Plantarum***, Linnaeus (1753, 1762) cited three general references for *C. americanum*: ***Hortus Cliffortianus* 127**, ***Hortus Upsaliensis* 76**, and ***Royen Lugdunobatavo* 37**. Since the latter two references merely repeated the content of the first reference, Linnaeus (1737) developed his concept of this taxon when assembling ***Hortus Cliffortianus***. The "specific descriptions" and citations for the two *C. americanum* varieties that appeared in ***Hortus Cliffortianus***, and both editions of ***Species Plantarum*** were identical:

– - *LilioAsphodelus americanus sempervirens maximus polyanthus albus*. ***Commelin* 14.t.14**, ***Dillen* 194.t.161.f.195**.

β - *LilioAsphodelus americanus sempervirens minor albus*. ***Commelin* 15.t.15**.

Habitat in America.

These "specific descriptions" were not actually descriptive elements. Rather, they represented the nomenclature devised by Commelin (1706) for the corresponding plants listed in Linnaeus's citations. Commelin provided a separate description for each plant.

Linnaeus (1737) concluded his descriptions in ***Hortus Cliffortianus*** with an illuminating comment: "apices petalorum unco seu appendiculo instructi fuere, exacte ut in ***Comm. rar.* tab. 15. exhibentur, quotiescunque eundem florentem vidimus."** (Tips of the segments bent as if they were equipped with a small appendage, exactly as displayed in ***Commelin* 15.t.15**, however often we have seen these blooming.) Why would Linnaeus make this statement unless the segments were incorrectly portrayed in the two alpha illustrations? Indeed they differed. The floral configuration in ***Commelin* 15.t.15** (Figure 1) depicted *Crinum* subgenus *Crinum* (*Crinum* subgenus *Platyaster* Baker, 1881), whereas the umbels in the two alpha illustrations (Figures 2 and 3) characterized



Figure 1. Commelin, C.: *Plantae Rariores et Exoticae Medici Amstelodamensis*. 15.t.15. Courtesy of Missouri Botanical Garden, Saint Louis, Missouri, United States of America.

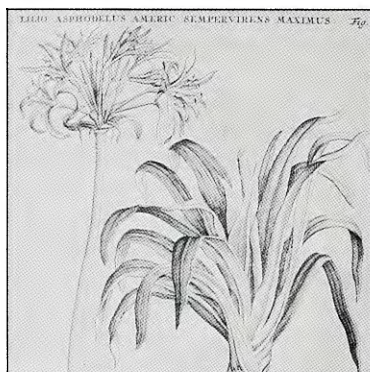


Figure 2. Commelin, C.: *Plantae Rariores et Exoticae Medici Amstelodamensis*. 14.t.14. Courtesy of Missouri Botanical Garden, St. Louis.



Figure 3. Dillen, J.J.: *Hortus Elthamensis*. 194.t.161.f.195. Courtesy of Royal Botanic Gardens, Kew, England.

Crinum subgenus Stenaster Baker (1881).

In each edition of **Species Plantarum**, Linnaeus (1753, 1762) included a general species description of *C. americanum* which paralleled his comment about segment tips in **Hortus Cliffortianus** but was less specific: "*Crinum* corollarum apicibus introrsum unguiculatis." (*Crinum* with the tips of the corollas clawed toward the inside axis.) Without the explicit comment "exactly as displayed in **Comm. rar.** tab. 15.," this descriptive element invited a subjective interpretation. Several flowers in **Commelin** 15.t.15 satisfied this criterion, but all flowers in the two alpha variety illustrations were very suspect in this depiction - the segments were curved but the segment tips were not clawed or recurved. Any conclusion was argumentative.

Casper Commelin (1706), a botanist at the Hortus Medicus Amstelodamensis, was responsible for publishing **Commelin** 15.t.15 and **Commelin** 14.t.14. In his descriptions, Commelin provided two interesting clues: 1) the bulb of **Commelin** 15.t.15 multiplied via underground stolons, whereas 2) the bulb of **Commelin** 14.t.14 never bore fruit - stolons were not mentioned. Commelin did not specify collection localities. Commelin's illustrations were engravings fashioned after watercolor paintings which the Hortus Medicus had previously commissioned. (A color reproduction of the original painting of **Commelin** 15.t.15 appears in Wijnands, 1983.)

George Clifford was also affiliated with the Hortus Medicus Amstelodamensis, and presumably many of the plants cultivated in his personal garden were also to be found at the Hortus Medicus. Were Commelin's two plants, described and illustrated at Amsterdam some 30 years prior to Linnaeus's investigation, the same two plants cultivated by Clifford? If they were indeed the same, then why did Linnaeus make the pointed remark about the floral segments in **Commelin** 15.t.15? Linnaeus had ample opportunity to examine living plants in Clifford's greenhouses since he intermittently lived at Clifford's estate during the period 1735-1738, and Linnaeus's comments implied that he actually saw two different plants. Linnaeus, it seemed, did not have a proper drawing at his disposal to depict the larger, many-flowered variety from America, so he improvised. Unfortunately, many European botanists were misled by the illustrations because they overlooked Linnaeus's comments in **Hortus Cliffortianus**.

The two illustrations cited for the alpha variety contain additional discrepancies when compared to **Commelin** 15.t.15, including: 1) horizontally oriented flowers, 2) narrow channeled segments, 3) short floral tubes, 4) pedicels, 4) a leaf column, and 5) Dillen's (1732) drawing shows the leaf column abruptly terminating into roots - a swollen underground bulb being conspicuously absent. These two illustrations correlate with *Radix toxicaria* Rumph. which Linnaeus (1762) cited under *C. asiaticum* in **Species Plantarum II**; they also agree with *C. asiaticum* L. sensu Ker-Gawl. (1807). The correct epithet is problematic, but the morphology conforms to *Crinum* subgenus *Stenaster* Baker; these plants cannot be indigenous to the Americas.

Miller (1759) was confused by Linnaeus's dubious speciation. Miller

cultivated a Panamanian bulb which he described and illustrated. Although the floral segments in Miller's illustration bore resemblance to **Commelin** 15.t.15 and his bulb produced stolons as reported by Commelin, Miller decided that his plant agreed with the morphology of the "*Crinum* with the keel shaped leaves" described by Linnaeus (1747) in **Flora Zeylanica**. I.e.: the *C. asiaticum* L. of **Species Plantarum I**. Linnaeus (1762) overlooked the obvious discrepancy involving the collection locality in Miller's account and added **Miller Dic.** t.110 to his modified citations for *C. asiaticum* L. in **Species Plantarum II**.

Linnaeus filius apparently noticed the differences between the illustrations and divided *C. americanum* L. into two species; these were posthumously published in **Hortus Kewensis I** (Aiton, 1789). Linnaeus f. retained the alpha variety as *C. americanum* and designated the beta variety as *C. erubescens*:

C. americanum L. emend. L.f. in Aiton — oblong lanceolate leaves with glabrous margins and contracted clawed tips; pedicellated flowers; floral tube short — *C. americanum* alpha of **Species Plantarum II**; **Dillen** 194.t.161.f.195. Great American *Crinum*. Habitat in South America.

C. erubescens L.f. in Aiton — lanceolate leaves with denticulated margins and elongated flattened tips, sessile flowers, floral tube long — *C. americanum* beta of **Species Plantarum II**; *Crinum* with the keeled foliage of **Miller Dic.** t.110. Small American *Crinum*. Habitat in West Indies.

According to Savage (1937), Linnaeus f. actually cited **Commelin** 14.t.14 as the principal reference for *C. americanum* in his unpublished manuscript, and, more importantly, he indicated "habitat in America?; Asia, Banks and Solander." The editor of Aiton's **Hortus Kewensis I**, Dryander, acknowledged that Linnaeus f. had shared portions of his unpublished manuscript with William Aiton prior to Linnaeus filius's untimely death in 1783. However, Dryander evidently saw fit to modify Linnaeus filius's protologue of *C. americanum*, even though Dryander professed that taxa referenced to Linnaeus f. in **Hortus Kewensis I** were "quoted" from the unpublished manuscript. How Dryander, the librarian of Sir Joseph Banks, succeeded in refashioning Linnaeus filius's description without offending his employer was a mystery, since Banks had advised Linnaeus f. that **Commelin** 14.t.14. was an Asiatic plant, not a South American plant. (Dryander also made erroneous changes to Linnaeus filius's definition of *A. ornatum* L.f. in Aiton.)

Even though Linnaeus f. encountered difficulty in placing the alpha variety in the Americas, the damage was done. Forgotten was his father's observation about floral form in **Hortus Cliffortianus**. Now there was a new species, *C. erubescens* L.f. in Aiton, typified by the beta variety of *C. americanum* L. or **Commelin** 15.t.15. Linnaeus f. may have actually examined Miller's plant since he correctly removed it from *C. asiaticum* L. and described the leaf margins as denticulated. The emended *C. americanum* description of Linnaeus f. brought out several discrepancies in the alpha variety illustrations previously discussed, plus he added that the margins were glabrous; *C.*

americanum L. emend. L.f. in Aiton was unmistakably an Asiatic plant.

Linnaeus filius's descriptions of *C. americanum* and *C. erubescens* as published in Aiton's **Hortus Kewensis I** were literally endorsed by Willdenow (1799) in **Species Plantarum Tomus II**, but Willdenow modified the citations. Willdenow included both **Commelin** 14.t.14 and **Dillen** 194.t.161.f.195 under *C. americanum* as well as full references to Linnaeus, but he repositioned **Miller Dic.** t.110 beneath *C. asiaticum*; possibly he chose to follow the original authors. Ker-Gawler (1807-1809) then published three illustrated accounts in **Botanical Magazine** which had a dramatic impact upon *C. americanum*:

1) **Bot. Mag.** t.1034, *C. americanum* (♂), few flowered West-Indian *Crinum*: The illustration displayed an American *Crinum*, and Ker-Gawler provided an appropriate description. Ker-Gawler listed **Hortus Cliffortianus** 127, **Commelin** 15.t.15, and **Species Plantarum II** in his citations. He included *C. americanum* L. emend. L.f. in Aiton, but he commented that Linnaeus f. seemed to describe *C. asiaticum*. Ker-Gawler specifically excluded

Commelin 14.t.14 and **Dillen** 194.t.161.f.195, since he suspected the illustrations belonged to "another species." Ker-Gawler remarked that **Commelin** 15.t.15 had been generally associated with *C. erubescens*.

2) **Bot. Mag.** t.1073, *C. asiaticum*, largest *Crinum*: Ker-Gawler cited many synonyms including Linnaeus's (1747) initial description of *C. asiaticum* in **Flora Zeylanica**, although Ker-Gawler's illustration and description supported *Radix toxicaria* Rumph. as the definitive type. Included among the synonyms were the *C. americanum* illustrations designated by Linnaeus for the alpha variety, **Commelin** 14.t.14 and **Dillen** 194.t.161.f.195; Ker-Gawler even commented that these illustrations belonged to *C. asiaticum* "though said to represent an American species." Unfortunately Ker-Gawler also listed **Miller Dic.** t.110 as a synonym for *C. asiaticum*.

3) **Bot. Mag.** t.1232, *C. erubescens*, blush-coloured *Crinum*: In the very brief commentary which accompanied this account, Ker-Gawler sputtered in double talk. He doubted that Linnaeus had this plant in mind as a variety of *C. americanum*, so therefore it was permissible for Linnaeus f. to separate it into a distinct species. However, the pertinent synonyms cited by Ker-Gawler included the beta variety of *C. americanum* L. and *C. erubescens* L.f. in Aiton. "Differs chiefly from *americanum* in the colour of the bloom and the cartilaginous toothed edging of the leaves." He gave the habitat as Spanish America and described the umbel as few to many flowered. Ker-Gawler did not mention **Miller Dic.** t.110 in his narrative.

Dryander's account of *C. americanum* in **Hortus Kewensis II** bespoke utter confusion. Dryander (Aiton, 1811) repeated verbatim the description of *C. americanum* L. emend. L.f. in Aiton, but he omitted any mention of Linnaeus f. Furthermore, he cited **Species Plantarum Tomus II** as the primary reference instead of **Hortus Kewensis I**, and then he included Ker-Gawler's **Bot. Mag.** 1034 in his citations - a blatant contradiction! Dryander also repeated verbatim the description of *C. erubescens* L.f. in Aiton, but again

he listed **Species Plantarum Tomus II** as the primary reference and omitted credit to Linnaeus f. Why Dryander chose not to cite Linnaeus f., **Hortus Kewensis I**, and **Miller Dic.** t.110 under *C. erubescens* was most peculiar; he also opted not to directly reference **Commelin** 15.t.15. Dryander, as editor of Aiton's **Hortus Kewensis I**, was primarily responsible for publishing *C. erubescens* L.f. in Aiton! Perhaps Dryander elected not to cite **Hortus Kewensis I** in the second edition to avoid exposing his confused and ambiguous position, and perhaps he chose to disassociate himself from Linnaeus f. as a result of the changes he introduced into Linnaeus filius's protologue of *C. americanum* L. emend. L.f. in Aiton. Savage (1937) suspected that Banks was instrumental in Dryander's exclusion of Linnaeus f. from **Hortus Kewensis II**. Whatever the reason, Dryander thoroughly discredited himself as an authority on *Crinum*.

Herbert (1820, 1821, 1837) cited Ker-Gawler's **Bot. Mag.** articles as his major references for *C. americanum* and *C. erubescens*. Herbert described *C. erubescens* as producing umbels with usually six and sometimes as many as eight flowers, while *C. americanum* made only four flowers. The latter constituted a complete reversal from Linnaeus's original classification. If the logic of Ker-Gawler and Herbert was accepted, then *C. erubescens* was a larger, many-flowered plant compared to *C. americanum*. Yet the basis for *C. erubescens* L.f. in Aiton was the "small American *Crinum*" or beta variety of *C. americanum* L., which by definition meant that *C. erubescens* had to possess both a smaller stature and umbel than *C. americanum*.

Schultes (1830) agreed with Ker-Gawler's placement of **Commelin** 14.t.14 and **Dillen** 194.t.161.f.195 under *C. asiaticum*, and Schultes returned Miller Dic. t.110 to *C. erubescens*. Kunth (1843) also cited Miller Dic. t.110 under *C. erubescens*, and he listed **Commelin** 15.t.15 as his initial reference for *C. americanum* while specifically excluding **Commelin** 14.t.14 and **Dillen** 194.t.161.f.195. Kunth placed the latter two illustrations under *C. asiaticum* with doubt.

Baker (1888) generally supported the views of Ker-Gawler and Herbert, and he apparently tried to avoid controversy by minimizing his references. For instance, Baker only cited **Species Plantarum II** and Ker-Gawler's **Bot. Mag.** t.1034 for his *C. americanum* references; he hid **Commelin** 15.t.15 in a remark under *C. commelynii* Jacq. Baker listed the habitat of *C. americanum* as the Southern United States and the habitat of *C. erubescens* as Tropical America. Baker's descriptions included broader leaves for *C. erubescens*, and he specified the umbel sizes as 4 - 12 for *C. erubescens* and 3 - 6 for *C. americanum*. Baker also described the leaf margins of *C. americanum* as smooth. (The latter is a cultivation artifact. When *C. americanum* indigenous to the Gulf Coast of the United States is grown in pots instead of semiaquatic conditions, the denticulations on the leaf margins are sometimes minute and sparse. In the wild though, the denticulations are always well developed and readily apparent.)

Baker's (1888) account prevailed as the authoritarian work for nearly a

hundred years. Then Wijnands (1983) resurrected the alpha variety of *C. americanum* L. with **Commelin** 14.t.14 as the type figure. Furthermore, Wijnands remarked that he did not agree with Linnaeus's decision to place **Commelin** 15.t.15 as the beta variety of *C. americanum*, as it represented another species. Wijnands correctly recognized the discrepancies between the illustrations cited by Linnaeus, but he apparently lacked familiarity with living specimens of the American and Asiatic species of *Crinum* and could not appreciate Linnaeus's observation of floral form in **Hortus Cliffortianus**.

DISCUSSION

The plants Linnaeus designated as *C. americanum* in **Hortus Cliffortianus** originated in the Americas. A more precise collection locality is not known. Following Linnaeus's protologue and his intent as expressed in **Hortus Cliffortianus**, we can only surmise that he saw a larger many-flowered plant and a smaller few-flowered plant, each of which bore white flowers typical of *Crinum* subgenus *Crinum*. Linnaeus's observation in **Hortus Cliffortianus** indicates that he was describing living plants, not herbarium specimens. Since Linnaeus did not cite or allude to a single herbarium specimen in either **Hortus Cliffortianus** or **Species Plantarum I**, an assumption that he intended herbarium specimens to be part of the protologue is inappropriate under Article 7 of the International Code (Greuter et al, 1988). Linnaeus's description of *C. americanum* is brief, but he does not express a difference between the two varieties other than size and umbel number. Accordingly, the guidelines set forth in Articles 7, 9, and 53 of the Code stipulate that **Commelin** 15.t.15 must be the type specimen for *C. americanum* L.

The historical evolution of *C. erubescens* L.f. in Aiton was a myriad of confusion. When originally conceived by Linnaeus f., it was described as the "small American *Crinum*" and tied to the minor or beta variety of *C. americanum* L. Yet the companion plant cited by Linnaeus f. was Miller's Panamanian specimen, a bulb offered in the commercial trade which Linnaeus f. likely examined. Croat (1978) described the variety of *C. erubescens* occurring in Panama as a huge plant with leaves measuring 1 - 2m long by up to 85mm wide and with umbels containing 4 - 12 flowers, making it probably the largest indigenous *Crinum* found in the Americas. Miller's bulb was apparently so large that Miller was influenced to classify it as *C. asiaticum*. So Linnaeus f. compounded his father's confusing illustrations by declaring the largest American *Crinum* to be the "small American *Crinum*."

There is good reason to believe that a plant similar to Miller's bulb was the original alpha variety of *C. americanum* L.; i.e.: the "great American *Crinum*" or alpha variety of *C. americanum* L. was a variety of *C. erubescens*. A cultivar of *C. erubescens* circulates in the United States under the trade name of *C. americanum* var. *robustum*. It is virtually identical to a variety of *C. erubescens* collected by Howard (1988) in the wild in Brazil (Lehmiller, 1992). Both varieties flourish in the ground under routine cultivation; they do not require semiaquatic conditions to achieve a robust state, and perhaps they grow even

larger in the wild in tidal swamps. Their physical dimensions approach Miller's plant: leaves are 0.9 - 1.1m long by 75 - 90mm wide, and umbels average 7 - 11 flowers with as many as 14 flowers observed. In contrast, *C. americanum* as found in the swamps along the Gulf Coast of the United States requires a semiaquatic environment; if cultivated in the ground or in pots even under moist conditions, it is always stunted in comparison to its wild state. Side-by-side cultivation of either variety of the aforementioned *C. erubescens* with the Gulf Coast *C. americanum* provides a striking comparison of two similar plants, except that one is much larger and many-flowered while the other is smaller and few-flowered. The latter scenario may have greeted Linnaeus in Clifford's garden.

Crinum erubescens L.f. in Aiton arose out of a misunderstanding over illustrations; since it is typified by **Commelin** 15.t.15, it is not validly published in Aiton's **Hortus Kewensis** I. *Crinum erubescens* L.f. in Ker-Gawler cannot be considered a valid publication either because not only is **Commelin** 15.t.15 cited, but Ker-Gawler fails to provide sufficient justification to separate it from *C. americanum*. Despite its common use, *C. erubescens* does not qualify as a legitimate taxon because it is a superfluous entity.


A large number of American species belonging to *Crinum* subgenus *Crinum* share common features with *C. americanum* L.: stoloniferous bulbs, arching, channeled, lanceolate leaves with denticulated margins and blunt apices, sessile flowers with long, erect tubes and perfume-like scents, dark anthers with yellow pollen, and fruits which bear long, apical projections. Hannibal (1989) identifies 33 related species which he designates as *Crinum* series Americana Hannibal. Various authors have attempted to delineate speciation among this group by citing differences in dimensions of the flowering parts and leaves. However, even within a given species, local variation in physical parameters can be sizable, and seasonal factors such as temperature, moisture, and sunlight can induce color changes in flowers and non-uniform stunting in the dimensions of the flowering parts (Lehmiller, 1987). Separation of species within this group is often impossible when herbarium mounts are compared and is highly arbitrary when living plants are examined. Actually, pleomorphism within this group is less pronounced than observed in *C. macowanii* of Africa and in *C. flaccidum* of Australia.

The literature is cluttered by far too many species from a group of morphologically similar American *Crinum*. For example: *Crinum commelynii* Jacq. (1797) is a superfluous entity since it overtly conflicts with **Commelin** 15.t.15. Speciation among *Crinum* should be reserved for distinct morphologic dissimilarities, not differences in geographic location or in size or in ratio of the structural parts or in coloration of the flowers. Most differences that exist among the American *Crinum* are better served at subspecies classification.

C. americanum L. is an American bulb whose type specimen is represented by the illustration **Commelin** 15.t.15. *Crinum americanum* L. typifies a nearly homogeneous group of bulbs inhabiting the Americas that has been splintered into a host of reputed species; few of the latter "species" differ

sufficiently from *C. americanum* L. to warrant separate speciation. Unless a morphologic dissimilarity can be shown which substantially deviates from **Commelin** 15.t.15 and from the general description presented for *C. americanum* L., I propose that all American *Crinum* be designated as *C. americanum* L. with geographic variations addressed under subspecies classification.

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A NEW CROCUS (IRIDACEAE) FROM TURKEY

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Crocus kerndorffiorum E. Pasche, sp. nov. *C. biflorus* affinis sed cum cormo tunico membranaceo, sine annulos. Typus: Turkey, Central Taurus Mountains, E. Pasche HKEP 9010 (holotypus, K)

Cormus depressus ovoideus, 0.9-1.4cm diam.; tunica membranacea, dimidus pars divisus in fibras et lineas parallelas, nonumquam apice in collum brevi producta usque ad 6mm. *Cataphyllae* plerumque 3-4, albae. *Foliae* (4) 6.4 ± 1.3 (11) (n=31), *synanthae* sed plerumque non bene evolutae et non attingentes *florem* ad *florationem*, 0.5 - 1.5mm latae, *prasinae*, *glabrae*. *Linea alba* $1/3$ diam. *foliae*. *Flores vernaes*, 1(2), 3-8cm super terram. Ad *paginam* *interiorem* *segmenta* pallide *lilacina-caerulea*, *indistincte venosa* cum *base flava*. *Pagina exteriora* *segmentorum exteriorum ochroleuca* sed *flavescens* cum *linea angusta*, quae *caerulea* vel *violacea* est, nonumquam cum *venis subtilissimis*; *linea media* *concurrentis* cum *linea brevis* coloris *aequalis*, *radiata* de *base segmentorum brunnea-violacea*. *Faux flava*, *glabra*. *Prophyllus* *absens*. *Bractea* et *bracteola* *adsunt*, *inaequalis*, *argenteae*, *clare attingentes* *cataphyllum* *interiorem*. *Perianthii tubus* (2.5) 3.5 (4.5)cm longus super terram, *albus*, ad *basem segmentorum caeruleus-violaceus*. *Segmenta subaequalia*, *exteriora* 2.1 - 2.8cm longa, 0.7 - 0.9cm lata, *interiora* 2.1 - 2.5cm longa, 0.5 - 0.8cm lata; *forma anguste ovata* usque ad *obovata*, *obtusa* usque ad *subacuta*. *Filamenta* 5-6mm longa, *lutea*, *glabra*; *antherae* 7-9mm longae ante *dehiscencia*, *luteae* cum *marginem cano-viride* \pm *evolvente* et cum *connectivo* *sine colore* usque ad *flavescens*; *antherae* post *dehiscencia* plerumque *virides-caeruleae*, quod *color viridis-caeruleus* usque ad *viridis-canescens* *staminorum* *mutans* est, et *color lineae mediae caeruleus* vel *viridis-caeruleus* *mutatus* est, *imprime* ad *finem superiorem*. *Stylus* *divisus* in *ramos tres*, *apex leviter crispus*, plerumque *antheras attingens*, *rare antheres aequalis*. *Stylus flavus* ad *basem*, nonumquam cum *zona saturate brunnea* inter *basem* et *divisionem*. *Rami* *semper saturate rubri*. *Capsula ellipsoidea*, 1.3 - 1.7cm longa, 0.5 - 0.7cm lata, cum *arista* ad *caput loculi omnis*, *capsula maturata esse* 2-3cm super *terram*. *Semina elongata*, 4-5mm longa, 1.5 - 2mm lata, *rubra-brunnea*; *caruncula prominens*, *raphe indistincta*. *Chromosomatorum somaticorum numerus incognitus* est.

Corm ovoid, somewhat flattened at base, 9-14mm diameter; tunics membranous, half the length splitting into narrow, parallel fibers and stripes,

sometimes extended at the apex into a poorly developed neck of up to 6mm. Cataphylls are usually 3-4, papery white. Leaves (4) 6.4 ± 1.3 (11) ($n=31$), synanthous, but usually little developed and not exceeding the flower at anthesis, 0.5 - 1.5mm wide, grass-green, glabrous. White stripe one third of leaf-diameter. Flowers are vernal, 1(2), 3-8cm above ground. The inner surfaces of the segments are pale lilac blue, rarely white or deep lavender-blue, inconspicuously veined with a yellow base. The outside of the outer segments are creamy-white or yellowish with a more or less narrow, median blue or violet stripe, sometimes closely accompanied by very fine veins; the median stripe converging with short stripes of the same colour radiating from a brown-violet segment-base. Throat is yellow, glabrous. Prophyll absent. Bract and bracteole present, unequal, silvery, the bract much broader than the bracteole, clearly exceeding the inner cataphyll. Perianth tube (2.5) 3.5 (4.5)cm long above ground, white, towards the segment-base bluish-violet. Segments subequal, the outer 2.1 - 2.8cm long, 0.7-0.9cm wide, the inner 2.1 - 2.5cm long, 0.5 - 0.8cm wide; shape narrowly ovate to obovate, obtuse to subacute. Filaments 5-6mm long, deep yellow, glabrous; anthers 7-9mm long, before dehiscence yellow with a \pm developed, grey-green margin and a colorless to yellow connective; after dehiscence anthers are generally of a bluish-green appearance due to a blue-green to grey-green discoloration of stamen and a blue or turquoise discolored connective, particularly at their tops. Style divided into three branches, slightly fringed at the apex, mostly clearly exceeding, rarely equalling the anthers. Style yellow at base, sometimes having a dark-brown zone between base and division, branches always deep red. Capsule is ellipsoid or oblong, 1.3 - 2.0cm long, 0.5 - 0.7cm broad with an awn of 1-3mm at the top of each locule, 1-3cm above ground at maturity. Seeds elongate, 4-5mm long, 1.5 - 2mm broad, red-brown; caruncle prominent, raphe indistinct. $2n$ unknown.

Turkey. Central Taurus Mountains, 900-1600m, very local and thinly scattered in *Quercus*, *Juniperus* and *Pinus*, and in unconsolidated screes. Until now only known from one locality, 5 March, 1991. The type locality is illustrated in Figure/plate 1. The species is named after its discoverers, Helmut and Robert Kerndorff, *Crocus* enthusiasts who also recently increased the knowledge of the genus in Jordan and Syria.

Crocus kerndorffiorum is a spring flowering species which most probably belongs to section *Nudiscapus*, series *Biflori* (classification after Mathew 1982) if the presently available information is considered. The new species differs from *Crocus biflorus* in having a corm tunic which is membranous, splitting into many narrow parallel fibers towards the base, not into horizontal rings. Morphologically it is obviously more allied to *Crocus leichtlinii* (D. Dewar) Bowles, *C. adanensis* T. Baytop and B. Mathew, *C. aeriuss* Herbert, and *C. hartmannianus* Holmboe (Table 1). Particularly *C. leichtlinii* seems to be the closest relative considering the general appearance of the flowers,

corm tunics, number of leaves and their cross-sectional shape (Figure 2).

The most obvious differences from *C. leichtlinii* are summarized in Table 2. These differences are: fewer flowers per corm, the consistently creamy-white or yellowish outsides of the outer segments with a median blue or violet stripe, a less extended and only light yellow throat, longer filaments and shorter anthers, and often a three-colored style which clearly exceeds or rarely equals the anthers. Also the shape of the seeds of the new species is different to the one of *C. leichtlinii* and the other similar taxa (Figures 3 and 4). This, too, is valid for the microstructure of the seed-testa, which is very distinct in *C. kerndorffiorum* (Figures 3B, 3C) and clearly differs from all the other taxa compared. An important fact which additionally underlines the distinctness of the new species is the large geographic distance between all habitats of the closer allied and here compared species. Especially the localities of *C. leichtlinii*, which lie in the Mardin Diyarbakir-Ergani area, are far apart from the habitat of the new species, the Central Taurus Mountains.

While comparing *C. kerndorffiorum* and *C. leichtlinii* another interesting aspect to mention is a description for *C. leichtlinii*, cited in Mathew (1982), given by Daniel Dewar, foreman of the Herbaceous Department at Kew from 1880-1893. Bowles comments at some length on the flower colour of this species and states that "the three outer segments are yellowish externally with a band of slatey-grey up the center; the inner segments are paler with a greenish-blue spot at their bases. It has a strange, faded or washed-out appearance, being of such pale shades of yellow and grayish-lilac, with a curious tint of green throughout." Both the original description by Dewar and the comments on it by Bowles of "their" *C. leichtlinii*, of which the exact wild locality was never specified, come fairly close to some characteristic features of the new species, as can be seen from the description and also from the figures/plates. Despite the fact that the "type" of *C. leichtlinii*, "...allegedly [had] been collected in the general area of Mardin in southern Turkey," (Mathew and Baytop 1976), it might be possible that Dewar and Bowles already knew the new species as *C. leichtlinii*. This would mean, in fact, that the recent "re-collections" of *C. leichtlinii* by Baytop and Watson in the Mardin-Diyarbakir area were actually the discovery of a new species. To prove this it would be necessary to find someone who still cultivates plants of the original gathering of *C. leichtlinii*, respectively of their descendants, which is supposed to be very difficult or even impossible.

Another, more promising possibility for tracing back the uncertain identity of the "original" *C. leichtlinii* might be given through an investigation of its seed-surface microstructure (if seeds are available) or of calcium oxalate crystals in the corm tunics which were very recently discovered by Wolter (1990). Wolter found that of all crocus species investigated, only *C. leichtlinii* (plants from Ergani area north to Hazar Gölü) possesses, beside prismatic crystals, needle-like crystals transversely oriented to the longitudinal axis of the



Figure 1. Examples of flower color and shape of *C. kerndorffiorum*

Table 1. Comparison of taxonomic features of *Crocus kerndorffiorum* and morphologically allied species

species	corm tunic	cata- phylls	pro- phyll	bract	bracteole	2n
<i>C. aerius</i>	membranous, splitting at base into parallel fibers	3	absent	present	present, subequal to bract, silvery-white	22
<i>C. hartmannianus</i>	papery, splitting into many parallel fibers	3	absent	present	present, subequal to bract, brownish, speckled darker	20
<i>C. adanensis</i>	membranous, splitting into parallel fibers or stripes, occ. poorly developed rings	3-4	absent	present	present, markedly unequal to bract, silvery-white	14
<i>C. leichtlinii</i>	leathery, eggshell-like, splitting longitudinally into many triangular teeth	3-4	absent	present	present, much narrower than bract, silver-white, well exerted from cataphylls	20
<i>C. kerndorffiorum</i>	membranous, splitting into many parallel fibers or stripes, no rings	3-4	absent	present	present, much narrower than bract, silvery-white, well exerted from cataphylls	?

corm (plants collected by Baytop, ISTE 34.457, Kew). Investigations in both ways of the newly described *C. kerndorffiorum* and the original collected *C. leichtlinii* from Kew herbarium specimens could shed some more light on this problem. However, the new taxon is as shown quite distinct in many aspects, and more differences may result for instance from a cytological investigation of *C. kerndorffiorum* which could not be done in this work.

Acknowledgments

I should like to thank Helmut Kerndorff from Berlin for many important hints and discussions, for sending colour photographs and scanning electron micrographs of his collections, and for the preparation of two well-aimed journeys, the key to the finding of the new taxon. I acknowledge with thanks the kind help of my daughter, Jana, in preparing the Latin diagnosis.

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Table 2: Significant and comparatively stable differences between *Crocus kerndorffiorum* and *Crocus leichtlinii*

Parameter	<i>C. leichtlinii</i>	<i>C. kerndorffiorum</i>
corm tunic	tough, leathery with parallel, triangular teeth	membranous with narrow, parallel fibers/stripes
flowers	1 - 4	1, rarely 2
filaments	3 - 4mm long	5 - 6mm long
anthers	9 - 11mm long	7 - 9mm long
style	entirely yellow to orange, shorter than to equalling the anthers	base yellow, branches deep red, often having a dark brown zone below the division, usually exceeding the anthers
throat	bright orange, markedly extended up the segments	yellow, inconspicuous, not extended up the segments
distribution	SE Turkey	Central Taurus Mtns.



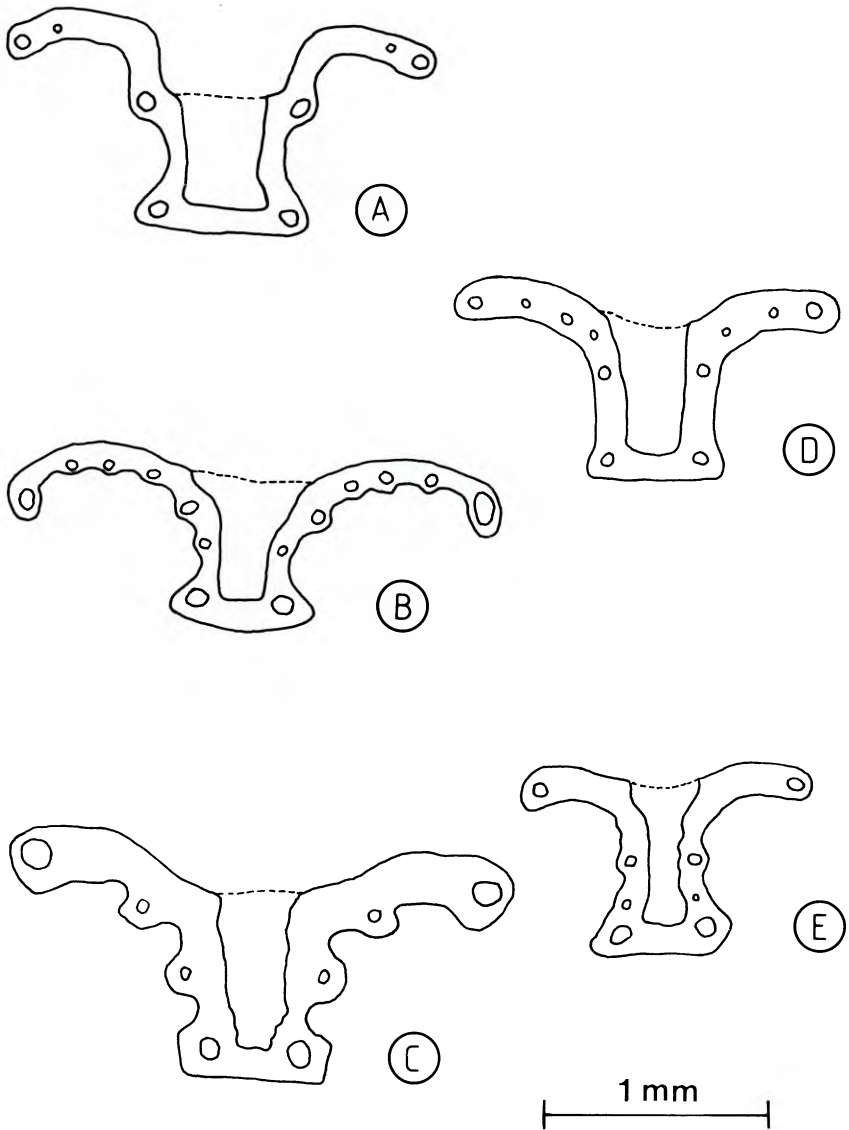


Figure 2. Cross-sectional shapes of leaves from: (A), *C. hartmannianus*; (B), *C. adanensis*; (C), *C. aerius*; (D), *C. leichtlinii*; (E), *C. kerndorffiorum*.

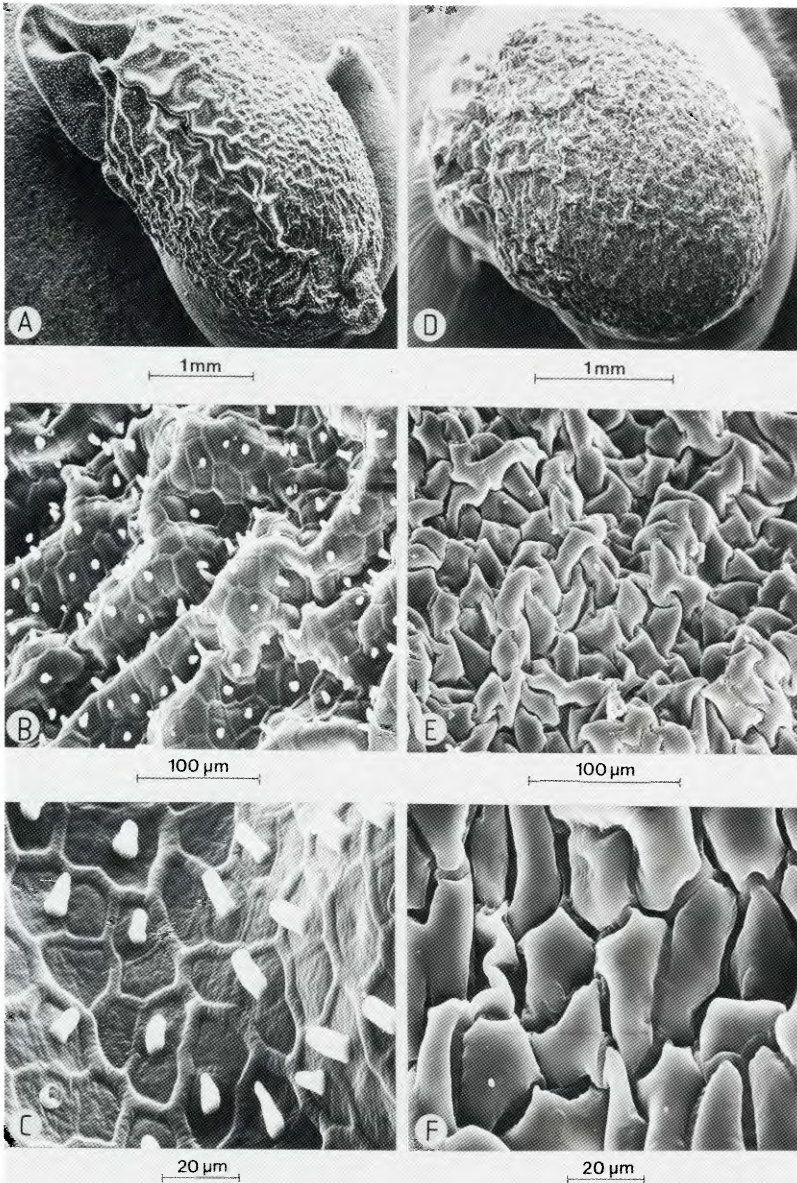


Figure 3. Scanning electron micrographs of seed and of seed surface microstructure: (A), *C. kerndorffiorum*; (D), *C. leichtlinii*; (B and C), *C. kerndorffiorum*; (E and F), *C. leichtlinii*.

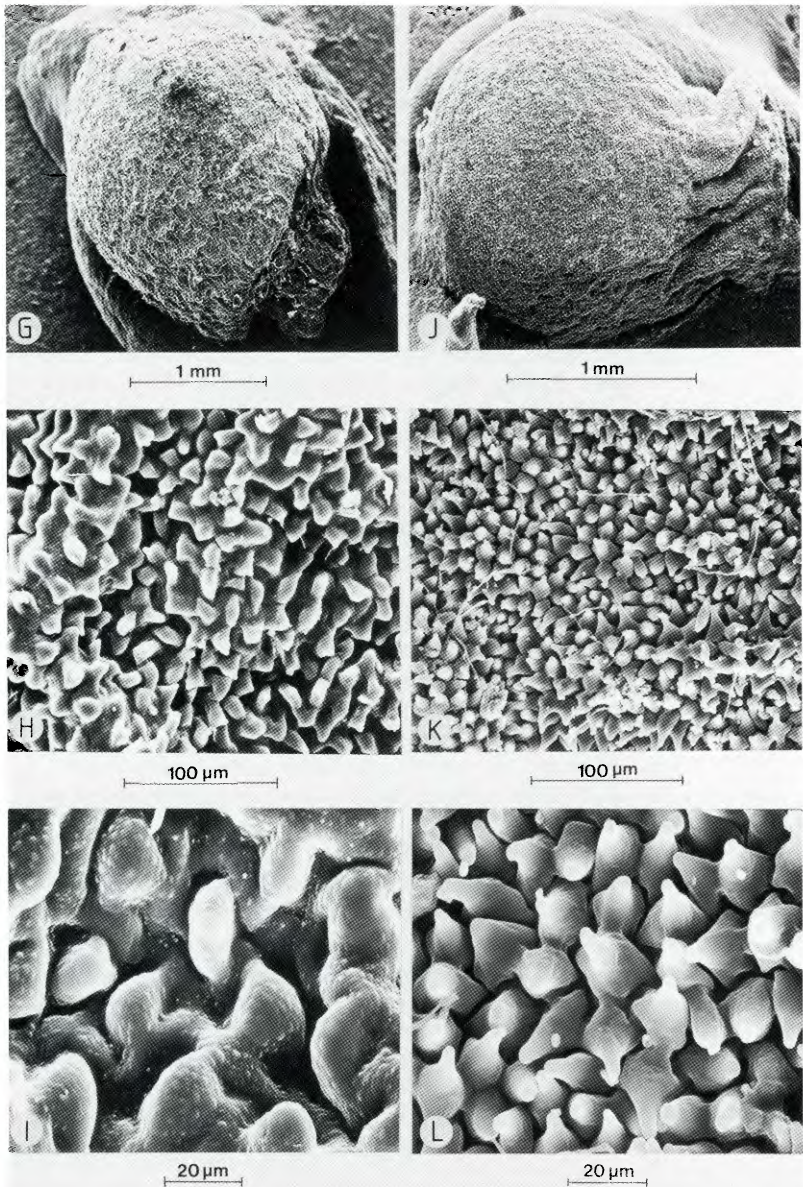


Figure 4. Scanning electron micrographs of seed and of seed surface microstructure: (G), *C. hartmannianus*; (J), *C. adanensis*; (H and I), *C. hartmannianus*; (K and L), *C. adanensis*.

TWO NEW TAXA IN TURKISH CROCUS (IRIDACEAE)

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1. *C. paschei* H. Kerndorff, sp. nov. *C. antalyensis* affinis sed plerumque pallentior, cum signis indistinctis prope basem externam segmentorum et cum zona distincta alba super faucem flavam, quae Croco antalyensi *Crocus antalyensis* abest. Typus: Turkey, Eastern Taurus Mountains, H. Kerndorff HKEP 9034 (holotypus, K).

Cormus subglobosus, (0.8) 1.2 (1.5)cm diam. Tunica membranacea, nonnumquam basis longitudine fissa; folia vaginantia 3-4, alba, acumina foliarum vaginantiarum interiorum pallide viridia. Foliae (2) 3.9 ± 1.5 (7) ($n=51$), synanthes ad florationem floribus aequantia vel flores superantia, 1.5 - 3mm latae, prasiniae, glabrae. Linea prominente alba paulo latior quam $1/3$ diam. foliae. Flores vernaes (1) 1.9 ± 1.0 (4) ($n=45$), 5-10cm super terram. Segmenta ad paginam internam pallide usque ad saturate lilacina-caerulea, rare alba vel saturate purpurea, fere non venosa, sed cum zona prominens super faucem flavam usque ad fulvam, glabram. Pagina exteriora segmentorum exteriorum argentea vel alutacea, cum punctillis pullis ad basem. Prophyllus absens. Bractea et bracteola argentea, bractea plurime latior quam bracteola, prominenter longior quam folia cataphyllae, nonnumquam contingere basem florum. Perianthii tubus 2.5 - 10cm super terram ad florationem, albus, nonnumquam lilacinus ad basem floris. Segmenta dissimilia, segmenta exteriora 2.8 - 3.8cm longa, 0.9 - 1.5cm lata; segmenta interiora 1.9 - 3.0cm longa, 0.6 - 1.2cm lata. Forma anguste ovata usque ad ovatum, obtusa usque ad subacutum. Filamenta 0.5cm longa, flava usque ad fulva, glabra; antherae 0.7 - 1.0cm longae, luteae, connectivum sine colore. Pollen luteus. Stylus divisus in ramos tres, non graviter expansus et crispus ad aciem, plerumque sine colore vel flavus sub divisione, rami saturate aurantiaci usque ad rubros. Plerumque longiores quam antherae. Capsula oblongus usque ad ellipsoideus, 0.7 - 1.2cm longa, 0.5 - 0.8cm lata. Pediculum maturum esse 0 - 2cm super terram. Semina subglobosa 3 - 4mm diam., saturate brunnea cum raphe distincta et caruncula prominens. Chromosomatorum somaticorum numerus incognitus est.

Corm subglobose, (0.8) 1.2 (1.5)cm in diameter. Tunics papery, occasionally splitting lengthwise at base. Cataphylls 3-4, white, tips of the inner sometimes slightly green. Leaves (2) 3.9 ± 1.5 (7) ($n=51$), synanthous, equalling or overtopping the flower at anthesis, 1.5 - 3mm wide, grass-green, glabrous.

White stripe prominent, good one third of leaf diameter. Flowers vernal, (1) 1.9 ± 1.0 (4), ($n=45$), with a distinct 'waist', cup-shell like in full sun, 5 - 10cm above ground. The inner surfaces of the segments are pale to deep lilac-blue, rarely white or deep-purple, usually without veining but with a distinct white zone above the pale to deep yellow and glabrous throat. The exterior of the outer segments are silvery or buff-colored, dark speckled at base. Prophyll absent. Bract and bracteole present, silvery white, bract much broader than bracteole, clearly overtopping the cataphylls, sometimes reaching the base of the flower. Perianth tube 2.5 - 10cm above ground at anthesis, white, occasionally lilac towards flower base. Segments unequal, the outer 2.8 - 3.8cm long, 0.9 - 1.5cm wide, the inner 1.9 - 3.0cm long, 0.6 - 1.2cm wide. Shape narrowly ovate to ovate, obtuse to subacute. Filaments 0.5cm long, pale to deep yellow, glabrous; anthers 0.7 - 1.0cm long, yellow, connective colourless. Pollen yellow. Style divided into three branches, slightly expanded and fringed at the apex, usually colourless or pale yellow below the division, branches deep orange to red, clearly exceeding very rarely equaling the anthers. Capsule oblong to ellipsoid, 0.7 - 1.2cm long, 0.5 - 0.8cm wide. Pedicel 0 - 2cm above ground at maturity. Seeds subglobose, 3 - 4mm in diameter, fresh, bright red-brown, later dark brown with a distinct raphe and a prominent caruncle. $2n$ unknown.

Type: Taurus Mountains of Turkey, 700 - 1400m. *Crocus paschei* grows in mixed *Quercus*, *Fagus*, *Juniperus* and *Pinus* together with *Styrax officinalis*, *Cornus mas* and *Ruscus aculeatus*; also in macchie and light shrub-land, as well as in adjacent fields. Until now it was only known from few localities in the same area and was/is locally abundant (Figure 1). 7 March, 1991. The species is named after Erich Pasche, a keen gardener well known among "bulb specialists", one who devotes himself to the horticulture of "bulbous" plants, particularly of crocuses.

Crocus paschei is a spring flowering species which belongs, from the general appearance of the flower (Figures 1A, 1B) the papery corm tunic, the number, width and colour of leaves as well as their T-shaped cross-section without significant ribs in the grooves underside and the colliculate seed-surface microstructure (Figures 4C and 4D), to the section *Nudiscapus*, series *flavi* (classification after Mathew 1982). Within this series *C. paschei* seems to be closer allied to *C. antalyensis* Mathew, *C. flavus* Weston, *C. olivieri* Gay, and to *C. hyemalis* Boiss. With *C. antalyensis* it shares the flower colour, but it is usually paler, having only inconspicuous speckles on the exterior near the segment base, and a distinct white zone above the yellow throat which is missing in *C. antalyensis*.

In *C. hyemalis* the corm tunic is similar (no neck of old cataphylls as in *C. flavus* and *C. antalyensis*), also the colour of the leaves, the shape, dimension and colour of seeds, and the seed-surface microstructure (Figures 4C-4L, all from the main body of the seed). Compared to *C. paschei* (Figures 4C, 4D) the one of *C. hyemalis* (Figure 3E,) has flatter, more irregular "collicules" which are more tightly packed together. It also has doubled, short, rounded papillae



Figure 1A. *Crocus paschei* at the type locality



Figure 1B. *Crocus paschei* in cultivation



Figure 1C. Habitat of *Crocus paschei*



Figure 2. Examples of flower color and shape of *Crocus biflorus* ssp. *albo-coronatus*

(on almost each "collicule") which are very poorly developed in *C. paschei*.

The other species have different seed surfaces. *C. olivieri* has collicules completely without papillae (Figures 4G, 4H), whereas the ones of the closely allied *C. flavus* ssp. *flavus* (Figures 4I, 4 J) and *C. antalyensis* (Figures 4K, 4L) have scattered rounded spines (more scattered in *C. antalyensis*) on almost flat 'collicules' which more precisely should be named "honeycombs".

Similarities with *C. flavus* are leaf-color, leaf-width, cross-sectional shape and dimension of leaves (figure 3A, 3B) and the three-branched style. Furthermore, *C. olivieri* also has a similar corm tunic and a cross-sectional shape of leaves although being twice as broad (Figure 3D). Finally, *C. paschei* is not only morphologically distinct but also geographically distinct because the habitats of all the compared species are separated by far distances. Cytological studies of the new species which could not be done in this investigation probably will show further differences to its allies.

2. *Crocus biflorus* ssp. *albo-coronatus* H. Kerndorff, ssp. nov., ssp. *nubigenae*, ssp. *pseudonubigenae* et ssp. *artvinensae* affinis sed cum corona alba, circumdanti faucem luteum; pauciores foliae, quae paulo latiores sunt.

Typus: Turkey, Central Taurus Mountains, H. Kerndorff HKEP 9009 (holotypus, K)

Cormus depressus globosus, ca. 0.8-1.5cm diam.; tunica coriacea, apice in collo brevi setosoque, nonnumquam longitudine fissa; annulos formans in base, folia (3) 3.2 ± 1.2 (5) ($n=14$), synantha, glabra, ad florantionem vix visa, vel floribus aequantia vel flores superantia, prasina, 1.5-2.0mm lata, cum jugis claris in valleculis in pagina subiacendi. Linea prominente alba, ca. $1/3$ diam. foliae. Flores vernaes, 2(3). Segmenta ad paginam anteriorem media usque ad saturate violacea, cum zona \pm prominente alba, striata cum venis violaceis super base saturate flava. Pagina exteriora segmentorum exteriorum ochroleuca, prominente striata cum 3(-5) lineis striatis fuscis usque ad violacea. Pars exterior segmentorum interiorum violacea-caerulea cum base saturate fusca usque ad violacea. Faux lutea, glabra. Prophyllus absens. Bractea et bracteola argentea, inter exicantem subfusca. Bractea conspicua, contingenta vel impendenta basem perianthii tubi. Perianthii tubus 1-3cm florendi super terram, albus, ad basem segmentorum striate fuscus-violaceus. Segmenta \pm aequalia, 2-2.5cm longa, 0.4-0.6cm lata, anguste ovoidea, subacuminata usque ad acuminata. Filamenta 0.5-0.7cm longa, flava usque ad fulva, glabra; antherae 0.9-1.1cm longae, luteae, sine colore vel cum connectivo flavo. Pollen luteus. Stylus aurantiacus usque ad saturate rubrum, rami stigmatici 3, non graviter ampli vel crispis, breviores vel nonnumquam aequae longi ac antherae. Pediculum maturum esse usque ad 2cm super terram. Capsula ovoidea usque ad ellipsoidea, ca. 1cm longa et 0.5cm lata. Semina subglobosa, 3-4mm diam., incarnatus usque ad pallide fuscam, raphe indistincta, caruncula prominens.

Chromosomatorum somaticorum numerus incognitus est.

Corm flattened globose, ca. 0.8-1.5cm in diameter. Tunics coriaceous, with a short bristly neck, occasionally splitting lengthways, forming rings at base. Cataphylls 3-4, papery white, drying intensively brownish. Leaves (3) 3.2 ± 1.2 (5), ($n=14$), synanthous, but varying from only the tips showing to equalling or exceeding the flowers, grass-green, 1.5-2.0mm wide with two prominent ribs in the grooves on the lower surface, glabrous. White stripe prominent, approximately one third of leaf diameter. Flowers vernal, 2(3) without a prominent "waist", open flat in full sun. The inner surfaces of the segments are mid- to deep violet having a more or less distinct white zone, streaked with few lilac veins above the dark yellow base. The outside of the outer segments cream-colored, heavily striped with 3 (-5) dark brown to violet stripes. The outside of the inner segments is light violet with a dark brown to violet base. Throat yellow, glabrous. Prophyll absent. Bract and bracteole present, silvery white, drying brownish; the bract conspicuous, reaching or overtopping the base of the flower. Perianth tube is 1-3cm above ground at anthesis, white, towards the segment-base striped brown-violet. Segments are more or less equal, 2-2.5cm long, 0.4 - 0.6cm wide, narrowly ovate, subacute to acute. Filaments are 5-7mm long, pale to dark yellow, glabrous; anthers are 9-11mm long, yellow, with a colorless or pale yellow connective; pollen is yellow. Style is orange to deep red, divided into 3 branches, not markedly expanded or frilled, clearly shorter than or sometimes equalling the anthers. Pedicel from just above to 2cm above ground level at maturity. Capsule is ovoid to ellipsoid approximately 1cm long and 0.5cm wide. Seeds are subglobose 3-4mm in diameter beige to light brown tinged pinkish with an indistinct raphe and a prominent caruncle. $2n$ unknown.

Type: Turkey. Central Taurus mountains, 1000-1200m, very local and thinly scattered in rocky outcrops between shrubs or light *Pinus* and *Juniperus* woodland, until now only known from one locality. The taxon is named *albo-coronatus* according to its distinct white corona surrounding the yellow throat (Figure 2).

The *Crocus biflorus* complex may taxonomically be the most difficult of the genus. Mathew (1982) recognized 14 subspecies of which 10 can be found in Turkey, 5 of them being endemic. With the newly described subspecies *albo-coronatus*, another apparently endemic taxon can be added to the already great diversity of this aggregate.

Three subspecies, *Crocus biflorus* ssp. *nubigena* (Herbert) B. Mathew, *C. biflorus* ssp. *pseudonubigena* B. Mathew, and *C. biflorus* ssp. *artvinensis* (Philippov) B. Mathew, seem to have more affinities with *C. biflorus* ssp. *albo-coronatus* than the other ones although its most distinctive feature, a white corona surrounding the yellow throat, is found only in the new taxon (Figure 2). The cataphylls, the bract and the bracteole are silvery white while the plant is in active growth, but they become intensively brown towards the beginning of dormancy, similar to *C. biflorus* subspecies *artvinensis*. The leaves are with 3-4 in number less numerous than in the other compared subspecies which

usually have (4) 5-8 leaves. Also the leaf-diameter is a little wider measuring 1.5-2mm instead of 0.5-1mm. All the above subspecies have one or more ribs in the grooves of the underside of the leaves, *C. biflorus* ssp. *albo-coronatus* constantly has two (figure 3F). The filaments of the allied subspecies are not very different, being yellow and 3-4 (5)mm long in *C. biflorus* ssp. *pseudonubigena*, 4-8mm long in *C. biflorus* ssp. *nubigena* or 5-7mm in *C. biflorus* ssp. *albo-coronatus* (not known in *artvinensis*?). The anther color in both *C. biflorus* ssp. *albo-coronatus* and ssp. *artvinensis* is yellow, in *C. biflorus* ssp. *nubigena* and *C. biflorus* ssp. *pseudonubigena* it is usually blackish-maroon to blackish, respectively. The style, too, is different: in ssp. *nubigena* and ssp. *artvinensis* it is usually exceeding or sometimes equalling the anthers, in ssp. *pseudonubigena* and in ssp. *albo-coronatus* it is clearly shorter or rarely equalling the anthers.

While *C. biflorus* ssp. *albo-coronatus* and ssp. *artvinensis* have mid- to deep violet and lilac to violet segments inside, respectively, segment colors are more variable in ssp. *nubigena* and ssp. *pseudonubigena*, being white or lilac. Only *C. biflorus* ssp. *artvinensis* has one median stripe on the exterior of the outer segments, all others have more or less conspicuous, usually 3-5, dark purple or brownish-violet stripes, in *C. biflorus* ssp. *albo-coronatus* on a buff or creamy-yellow coloured exterior.

Distinct are also shape, measurement and colour of seeds, the formation of the caruncle and the seed-surface microstructure (seeds of ssp. *artvinensis* were not available for this investigation). In ssp. *albo-coronatus* the seeds are subglobose, 3-4mm in diameter, beige with a rosy tint, having a prominent caruncle (Figures 5A, 5B). *C. biflorus* ssp. *pseudonubigena* has subglobose to elongate seeds, 2.5-3mm long with a very prominent caruncle, light yellow-brown. Seeds of ssp. *nubigena* are elongate, 3.5-4.5mm long and velvety dark violet-brown (aubergine) with an inconspicuous caruncle.

The seed-surface microstructures of *C. biflorus* ssp. *albo-coronatus* (Figures 5C, 5D), ssp. *nubigena* (plate 5E) and ssp. *pseudonubigena* (plate 5F) are distinct in their formation although all of them being colliculate. The collicules of ssp. *albo-coronatus* are tightly packed together, sparsely having more or less hooked spines, especially on the caruncle (Figures 5B, 5C, 5D). *C. biflorus* ssp. *nubigena* has hillock-like collicules which are usually well separated from each other, allusively papillate. The collicules of ssp. *pseudonubigena* are similar to the ones of ssp. *albo-coronatus* but with very weakly outlined papillae and without spines (Figure 5F). Depressed collicules result from shrinking processes in the course of preparation.

In general, *C. biflorus* ssp. *artvinensis* seems to be the closest ally, although it is difficult to say more about its relationship to ssp. *albo-coronatus* on a broader basis at the present time because ssp. *artvinensis* is still a little known plant. However, the new subspecies of *C. biflorus* is not only morphologically distinct, but also distinct in respect to the large geographical distances which lie between its only known habitat in the Central Taurus and the habitats of ssp. *artvinensis* (NE-Turkey), ssp. *pseudonubigena* (SE-Turkey)

and ssp. *nubigena* (W-Turkey and Aegean islands).

Plants with bulbs, corms and tubers are very popular in horticulture, and the demand exceeds what nurseries can grow. The result is extensive digging from the wild almost without limits for the majority of species (Mathew and Baytop 1984). As a result in Turkey species like *Sternbergia candida*, *Iris pamphylica* or in the case of crocuses, *Crocus baytopiorum*, *C. karduchorum*, *C. abantesis* and *C. adanensis* are threatened. Generally the rarer species are more threatened because their restricted habitat can be damaged quickly, a situation which is made even more acute for plants that are difficult to cultivate and can only be renewed by continuous collecting.

All this depletion by over-collecting makes it necessary for scientists to critically assess their position when they publish the discovery of new species. From a scientific view point it is sufficient to note a fairly wide, but geographically defined, area, as well as information about altitude, plant communities, flowering time and so on, instead of the exact type locality. To safeguard the rare species, we suggest that the exact locality be stored at the botanic garden at which the herbarium material is deposited, and only authorized persons have access to it.

Acknowledgments

I should like to thank my father for his enthusiastic help in the cultivation of crocuses and his company in journeys which led to the discovery of the new taxa. I am very grateful to Erich Pasche for fruitful hints and discussions and his daughter Jana for preparing the Latin descriptions. I acknowledge with thanks the assistance of Klaus Lobig (scanning electron micrographs) and Monika Jung (drawings).

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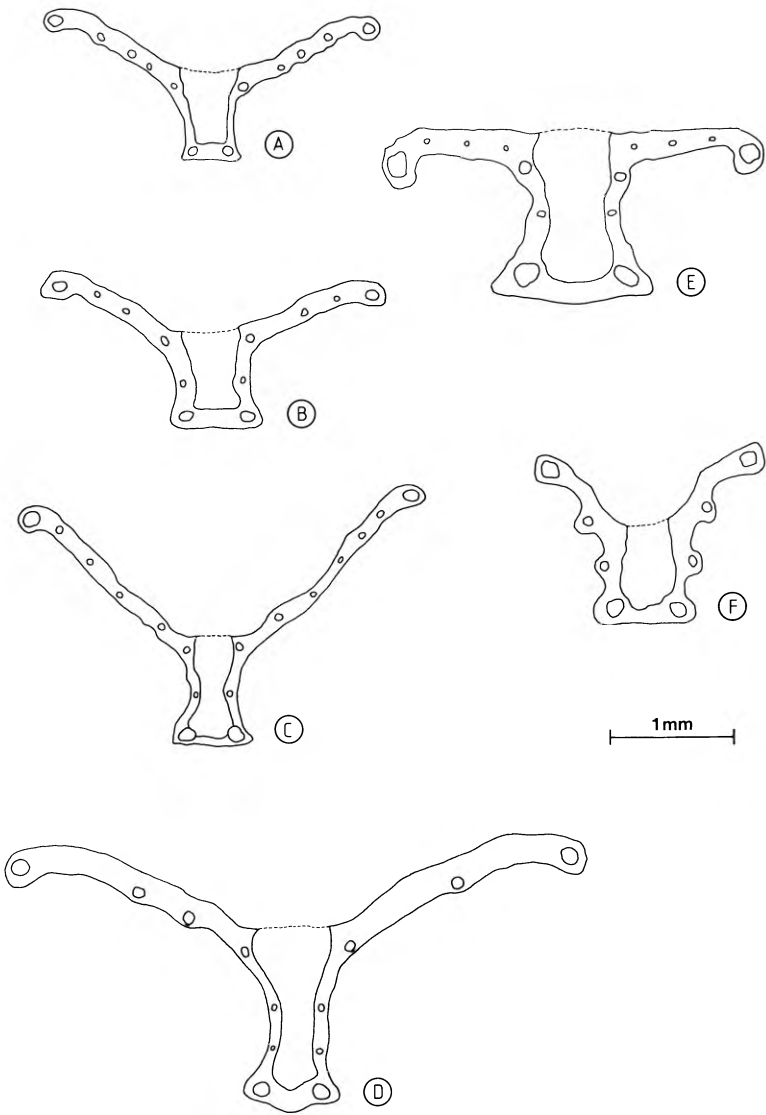


Figure 3. Cross-sectional shapes of leaves from: (A), *C. flavus* subsp. *dissectus*; (B), *C. paschei*; (C), *C. antalyensis*; (D), *C. olivieri*; (E), *C. hyemalis*; (F), *C. biflorus* subsp. *albo-coronatus*.

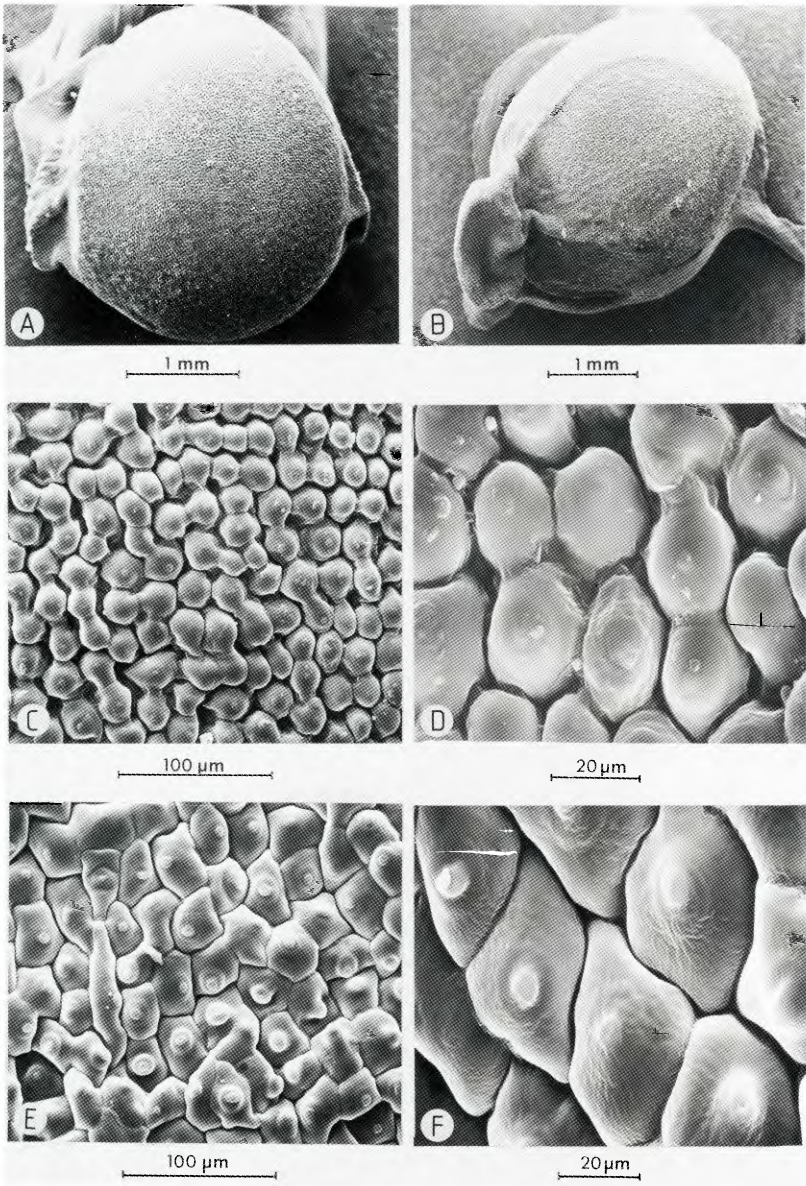


Figure 4. Scanning electron microscopy and seed surface microstructure. (A and B), seeds of *C. paschei*; (C and D), *C. paschei*; (E and F), *C. hyemalis*.

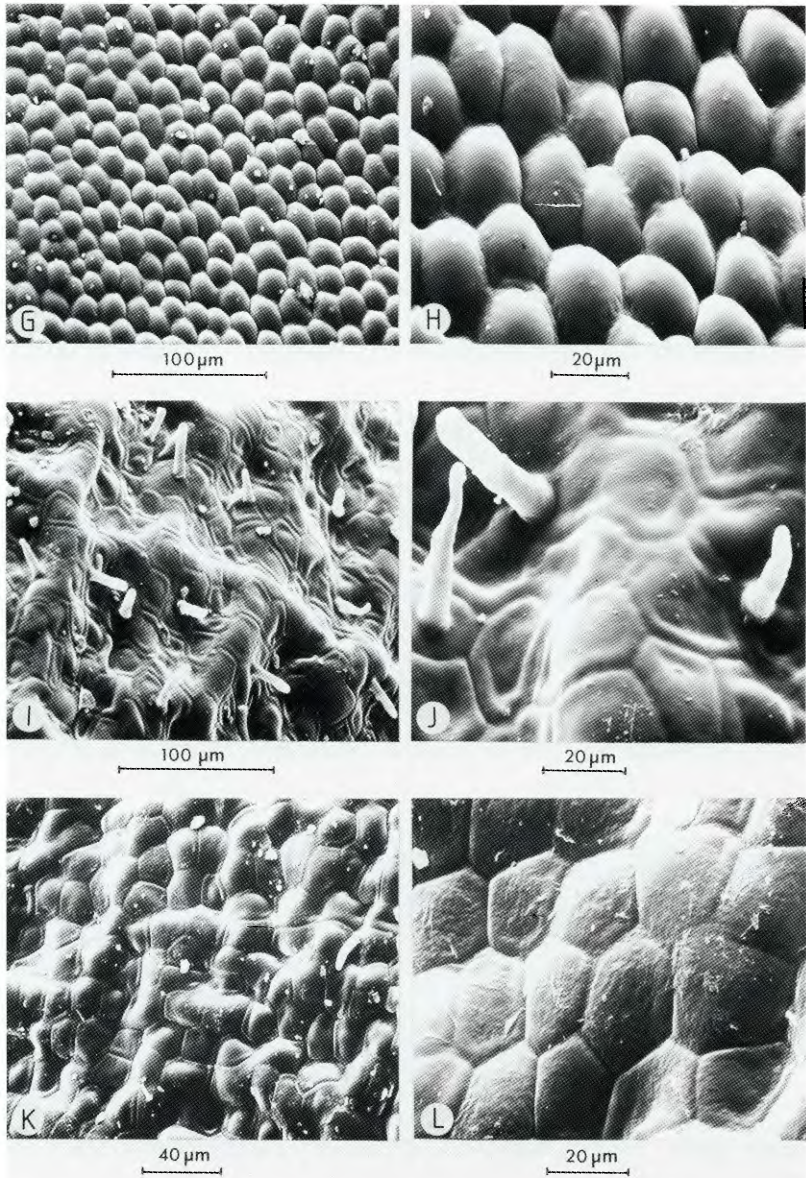


Figure 4. (continued). Seed surface microstructure by scanning electron microscopy. (G and H), *C. olivieri*; (I and J), *C. flavus* subsp. *flavus*; (K and L), *C. antalyensis*.

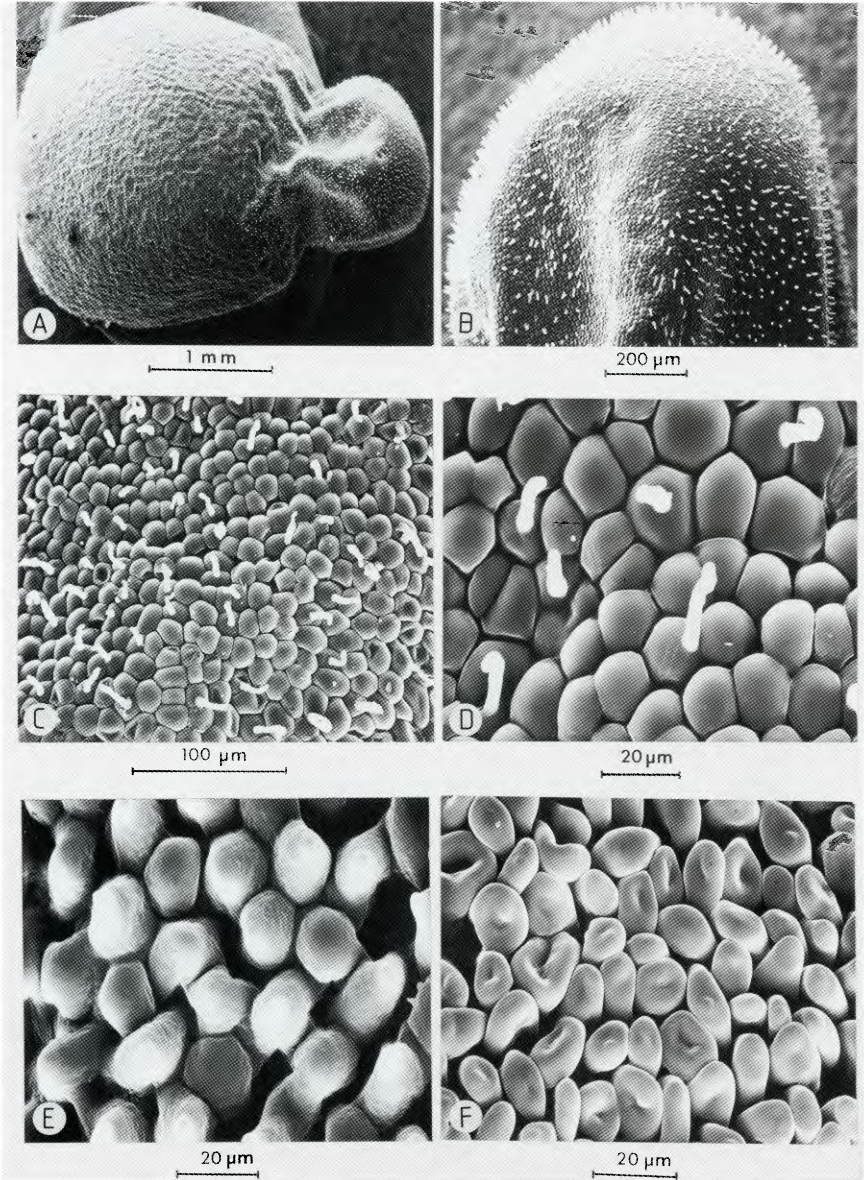


Figure 5. Scanning electron microscopy of seed surface microstructure. Seed (A) and caruncle (B) of *C. biflorus* subsp. *albo-coronatus*; (C and D), *C. biflorus* subsp. *albo-coronatus*; (E), *C. biflorus* subsp. *nubigena*; (F), *C. biflorus* subsp. *pseudonubigena*.

***MILLA* AND ITS ALLIES, A BRIEF OVERVIEW**

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The genus *Milla* and its close allies, *Behria*, *Bessera*, *Petronymphe* and *Dandya*, form a discrete group of cormous plants within the onion family, the Alliaceae. They have a distribution centered in western Mexico with a northern limit in southern Arizona and a southern limit in Guatemala (Moore 1953). They are a "sister group" of the *Brodiaea* complex, which is centered in California and includes *Androstephium*, *Bloomeria*, *Brodiaea*, *Dichelostemma*, *Muilla*, *Triteleia* and *Triteleiopsis*. They differ by having corms with membranous tunics of minute, parallel fibers, often silky in appearance and to the touch (vs. tunics mostly coarsely fibrous-reticulate), and a stalked ovary which is fused with or adnate to the perianth tube (vs. ovary sessile or with stalk not fused nor adnate to the perianth tube). These two groups fall into two distinct climatic zones as a result of their different geographic distributions, with the *Milla* group in summer rainfall regions and the *Brodiaea* group in winter rainfall areas. The plants behave accordingly in cultivation.

During a three week period in the summer of 1984, I had the good fortune to accompany Dr. Thad Howard of San Antonio, Texas, on a trip in search of bulbous plants in western Mexico which included all five genera at hand except *Behria*. Dr. Howard has traveled throughout Mexico for over three decades and has introduced many species to horticulture. His excursions have yielded many novelties, often very exciting from both a botanical and horticultural perspective. This trip did not turn up anything new, but it was remarkable in that we found virtually every taxon we sought.

One of our very first stops was prompted by the sight of brilliant white stars waving on thin stalks in well-grazed cattle fields south of Parral in the state of Durango. The stars were *Milla biflora*, and the flowers were notably variable in size, from about 4 to 6 cm across, and with a delightful, sweet fragrance approaching that of certain jasmines. With their very long (6-18cm (-22cm)) perianth tubes, these flowers are, doubtless, dependent on visits from specifically adapted moths. They do not waste precious energy opening and closing or shutting down the perfume factory during off-hours. The tepals are midstriped green on the back in a manner reminiscent of *Ornithogalum* and in common with all other Millas. *Milla biflora* is an upper elevation species, usually common where it occurs, and it spans the geographic range of extremes of the alliance - from southern Arizona, New Mexico and the Big Bend area of Texas to northern Guatemala, and to the east along Mexico's Sierra Madre Oriental — though it does not extend as far west as other members. Fall-flowering material from within the range of the species in the

United States and adjacent Mexico may represent a distinct, undescribed taxon, and the same is true of Guatemalan specimens assigned under *Milla biflora*, which may well entail more than one species (Howard 1970). The specific epithet is somewhat misleading, since an umbel may bear one to twelve flowers and normally more than two flowers are present (Howard 1970).

Milla may be divided more or less between nocturnal-blooming and diurnal-blooming species. There is also a division within the genus between those with closely attached cormlets produced at the base of the mother corm and those with cormlets terminating at the end of lateral "runners" or stolons. The latter character of habit shows up only as one moves into southern Mexico (Puebla, Morelos and south). Both means of corm formation are found in the nocturnal-flowered species, while the former, more solitary habit corresponds to diurnal bloomers. These correlations are not always consistent among the different species, though they do seem to hold up within a given species.

There are five further species described in *Milla* besides *M. biflora*, all of them poorly known to most botanists and horticulturists alike except for the well-named *M. magnifica*. This latter species grows in the state of Guerrero at middle elevations among rocks in the vicinity of Taxco and Iguala. Without flowers or an inflorescence the plant could easily be mistaken for an onion as the long leaves are terete, fistulous (hollow) and even glaucous, though the crushed foliage lacks any onion smell, as is true for all cormous members of the onion family. A plant may produce one umbel of up to 30 white and green-striped flowers, each flower being long-tubed and lasting 2 to 3 days. They are sweetly fragrant at night and usually close during the day unless the weather is overcast and cool. *Milla magnifica* is easily cultivated by giving full sun, fairly rich, well-drained soil and a cool, dry rest in winter. It is a surprisingly cold-hardy species and can tolerate temperatures in the teens (°F) when dormant in the garden (Howard, pers. comm.). Propagation of this very garden-worthy, striking species is by seed and by offsets, which occur on short stolons, in contrast with the solitary corms of *M. biflora*.

The remaining four species of *Milla* have pink, "blue" (always a claim to be wary of!) or white flowers. One of them, *M. rosea*, is an autumn flowering species, in contrast with most of the other species, which have a summer blooming habit. The introduction or re-introduction of these interesting plants to horticulture awaits the efforts of future intrepid plant explorers. According to Dr. Howard there are at least a handful of additional, undescribed species of *Milla* awaiting further study (Howard 1970). Since at least one of the undescribed species, as well as some of the named species, are rather localized in their distribution, and all of the species appear to be allopatric, it is very likely that still others remain to be discovered in Mexico's upland areas.

As we crossed the central mountains of Mexico and headed southwest, our thoughts turned to *Bessera elegans*, whose flowers must be among the most exquisite of all in nature. We first found the plants along a microwave tower road about forty miles south of Mazatlán, where they were growing, as usual, in rocky soil with a well-drained slope aspect. At these latitudes and at such low

elevations, July and August are sultry and humid and the summer climate matches the vivid green landscape. It's my idea of wonderful weather, but, more importantly, it is the only time of year to collect these or other bulbous plants with any ease, as most have their flowers out and you can see them readily while traveling at 50 to 60 miles per hour. Especially *Bessera*! Most commonly encountered are various red-colored forms of the species, some dull, others bright, all variable, especially in the patterning on the inside of the tepal segments. The coloring of the outside of the perianth, varying from pink, lavender and orange to various shades of red (one pure white form is known), is more or less solid and showy enough to attract attention. But when one uprights one of the delicate, nodding flowers there is often a dazzling display of brightly colored lines against a pure, glistening white background surrounding the androecium, which contrasts markedly by having near-black anthers and blue pollen. A majestic, bright violet-purple form which is larger in all aspects occurs in the state of Colima, though there is marginal safety in parking on the narrow mountain road where it grows. At one locality in Sinaloa we found a small population of plants with both violet and red flowers but none with intermediate tones. Harold Moore (1953) made formal note, though he did not name them, of three distinct groups within *Bessera elegans*, each occurring within the overall range of the species but having comment-worthy discreteness in morphological characters. As was the case then, further collections and field work, as well as cytological studies, are much needed to determine whether *B. elegans* comprises only one polymorphic entity or several distinctive races that merit formal designation. Horticulturally *B. elegans* poses no great difficulties, but the plants are tropical and physically delicate and, hence, require careful attention in the garden if planted out. Because they demand excellent drainage, they are best grown in containers, especially where winters are anything but mild and dry.

In the Cape region of Baja California Sur resides the monotypic *Behria*, a close ally of *Bessera* which differs in having a perianth tube several times longer than the segments (vs. shorter than or equaling the segments) and the filaments shortly united at the base to form a shallow cup (vs. united for about half their length by membranous connective tissue). It is also closely allied to *Dandya*, which has a perianth tube even shorter than in *Bessera* and filaments united at the base to form a shallow cup. While the leaves of *Bessera* are fistulous, those of *Behria tenuiflora* are apparently solid and the narrowly tubular flowers, 18-30mm long, are "scarlet or orange-red with yellow nerves, yellow in folds of throat and sometimes the lobes violet-margined" (Moore 1953). It is a summer growing species and, regrettably, is almost non-existent in cultivation at present.

One of the most obscure genera of all bulbous or cormous plants is *Dandya*, with three species in central-western Mexico (Moore 1953, Lenz 1971). The type species is *D. purpusii*, originally collected by Purpus in the Sierra de la Paila in the state of Coahuila, a low mountain range visible from modern highways but not accessible by road. Its rediscovery has been attempted by

Dr. Howard several times without success, but two further species, *D. thadhowardii* and *D. hannibalii*, were found on two separate expeditions of his in areas quite disjunct from the locality of the original species. We re-collected both of these in 1984 in areas which on first appearance would not seem likely to carry many bulbs at all and where cattle have had the run of the place for many decades. The landscape where both species occur is one of rocky, rolling hills with small, thorny legume trees, large cereoid cacti and various *Bursera* species, the latter often with seductively smooth trunks looking as though they were lacquered over the green cambium layer. Both of the *Dandya* have very narrow, grassy leaves and rather shallow-seated corms, with a flower stalk 20-40cm tall bearing flowers which close at night. In *D. hannibalii*, which grows in the state of Michoacán, the flowers are upright, lavender-blue and fragrant, with a rotate perianth closely suggesting *Muilla maritima*, a Californian species with green and white flowers. In fact the type species, *D. purpusii*, was originally described under *Muilla*. This latter genus is possibly one of the archetypal members of the Californian group of cormous Alliaceae, while *Dandya*, with its relatively simple floral structure, perhaps represents what the progenitor of the Mexican alliance might have looked like. The other species we located, *D. thadhowardii*, is only known from the state of Guerrero, and it has shooting-star (*Dodecatheon*)-like heads of white, nodding flowers which are slightly fragrant. As with the previous species, the plant in flower could be mistaken at first glance for an odd *Triteleia* or *Brodiaea*, except for the remarkable "bird-cage" androecium where the anthers are closely connate around the style. None of the three *Dandya* species is known to be in cultivation today. It is worth noting here that the genus *Diphalangium* would today probably be placed within *Dandya* (or vice-versa) had its original description not been so poor and the type material not destroyed during World War II. It is currently considered an incompletely known genus and is not likely to ever be classified precisely.

The last member of the *Milla* alliance we located is also the most tropical, even though *Milla* occurs much further south. *Petronympe decora*, the "Decorous Rock-nymph", grows in steep rocky terrain north of Acapulco where it shares the scene with *Peperomias*, *Achimenes*, *Bomarea* and assorted orchids, as well as sleepy boa constrictors. The latter didn't seem to mind me pulling myself up a cliff-face to his or her perch and climbing quickly overhead (minus a few heartbeats). We saw growing directly out of the mortar on an old stone bridge one plant with flowers at perfect anthesis, but the few accessible plants we were able to locate were quite small. This locality has been decimated within the last twenty years, apparently by collectors who knew what they were after. There most likely were other nearby populations, but the rugged topography and dense vegetation were enough to deter us from any serious scouting at the time. Since the Chilpancingo-Acapulco road is one of the few that crosses the Sierra Madre Occidental from the coast to the interior in the very large area extending from Colima in the west to Oaxaca in the east, other localities, and most likely additional related taxa, are probably to be

found in presently inaccessible areas.

The bright green leaves of *Petronymphe decora* are interesting in that they are triquetrous, or three-sided, and the pendent, chartreuse flowers held on very thin pedicels possess an elegant beauty in their slender trumpet shape. As in *Bessera*, the anthers are a striking contrast in deep blue-violet. An excellent black and white photograph of this enchanting plant can be found in **Exotica** (various editions). *Petronymphe* is not known to the author to be in cultivation at present, but anyone growing it is kindly urged to make efforts to propagate and distribute it through the IBS or other means. In cultivation it should be treated much as *Bessera*, but given a more shady position and regarded as even more tender.

A few final notes on cultivation — With respect to propagation, all of the species discussed have proved self-fertile. Next to crossing different clones together, this is the best method to generate more plants with the possibility of inducing or revealing genetic traits for adaptation to cultivation. The seedlings can be expected to flower in their third or fourth year. All generate offsets and such increases can be supplemented by scoring the base of the corm a week or so before planting so that cormlets will form at the wounds and give separable plantlets the next year.

The characteristics of corm tunics are particularly useful in taxonomy since tunics of each taxon have their own distinctive traits. Unfortunately, few of the *Milla* alliance have been studied well enough so that tunic characteristics are known to the species level. It is unfortunate that many herbarium specimens of bulbous and cormous plants are without tunics, and determinations of such material are usually based almost solely on floral characters.

I would like to thank Dr. Thad Howard for his generous loan of color slides and for his companionship in the field. Students of Mexican bulbs are indebted to Dr. Howard for his extensive travels in that country, and for his careful observations and herbarium collections as well as introductions of living material. I am happy to include myself as one of the more fortunate of those students.

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Figure 1. *Bessera elegans*, purple



Figure 2. *Dandya thadhowardii*



Figure 3. *Bessera elegans*, white



Figure 4. *Milla rosea*

***NOTHOSCORDUM CASTILLOI* T. M. HOWARD, SP.
NOV.
A NEW NOTHOSCORDUM SPECIES FROM RIO GRANDE DO SUL,
BRAZIL.**

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Nothoscordum castilloi T. M. Howard, sp. nov.

Nothoscordum inodorum (Soland. ex Ait.) Nicholson ssp. *nocturnum* Ravenna affinis sed foliis plus angustius, basi vaginis formam pseudocaulis aeriis, umbella pauciflora, filamentis leviter incurvus, odoris putidus. Florens vernalis.

Plant up to 35 cm high. Bulb ovoid, solitary, or rarely with 1-2 bulblets, 1.5 cm high, 1 cm in diameter, with brown membranous coats. Leaves 6-8 at anthesis, dull green, narrowly linear, acute, to ca. 35 cm long, ca. 2 mm wide, channeled, sub-carinate to carinate, flaccid, spreading, sheathing basally, forming an aerial pseudostem, ca. 10-35 mm high. Scapes 1-2 per bulb, to ca. 35 cm long. Inflorescence 4-5 flowered. Spathe valves two, subequal, ca. 12 mm long, joined at the base, clasping, membranous, lanceolate, marcescent. Pedicels to ca. 35 mm long. Flowers crepuscular-nocturnal, widely funnel-shaped to nearly rotate, ca. 12 mm long, ca. 14 mm across, white, with foetid odor, each segment with a broad purplish keel 1-2 mm wide. Tepals subequal, elliptic-lanceolate, acute, ca. 12 mm long, basally connate for 2 mm, the outer segments ca. 5 mm broad, the inner ca. 4 mm broad. Filaments broadly flattened throughout, slightly incurved distally, oblong-subulate, subequal, contiguous, white, ca. 6 mm long, ca. 3 mm wide; Anthers oblong, subreniform, ca. 1.3 mm long, pollen yellow. Ovary ca. 4 mm long, ca. 3 mm wide; Style ca. 3.5 mm long; stigma capitate. Capsule obovoid. Seeds numerous, black, shining. Type: Howard # 86-6 (MO). Brazil, State of Rio Grande Do Sul, east of the city of Uruguaiana. Grassy pastures, and roadsides, spring, in full sun, sympatric with a white-flowered *Calydorea* species (Iridaceae); apparently quite rare. October 6, 1986.

In its floral morphology, the new species appears to be closest to the subgenus *Platyscordum* Ravenna, because of the crepuscular-nocturnal habit and the broad, flattened, incurved filaments. Unlike them, the new species is of shorter stature, with unpleasantly scented flowers in spring from solitary bulbs forming an aerial pseudo-stem below the narrow leaves. In cultivation, with optimum culture, the bulbs will form a few basal offsets. The aerial

pseudostem and rancid odor of the flowers are unusual for known members of the genus, as is the night flowering habit, with the flowers remaining closed until evening. The unusually wide (1-2 mm) purple keels make this a rather attractive plant. Named in honor of Alberto Castillo, a fellow bulb enthusiast and resident of Buenos Aires, who was present when it was discovered.

See page 19 for an illustration of this species.



ZEPHYRANTHES LEUCANTHA T. M. HOWARD, SP. NOV.

A NEW WHITE-FLOWERED RAIN LILY SPECIES FROM EAST-CENTRAL MEXICO.

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Z. leucantha T. M. Howard sp. nov. *Z. katherinei*, *Z. verecunda*, *Z. erubescens*, et *Z. lindleyana* affinis sed differt a *Z. katherinei* in perianthio albo, grandis, stylus longioribus, stigmatibus plus trifido, excedens antheris, foliis plus viridis pallido; a *Z. verecunda*, *Z. erubescens*, et *Z. lindleyana* in tubo longioribus; a *Z. verecunda* in pedicelo longioribus; a *Z. erubescens* in habitatio montibus.

Description: bulb ovoid, solitary, ca. 2 cm diam., ca. 2 cm long, neck 1.5 cm long, with dark brown tunics; leaves 2-4, erect, linear, 27-31 cm long, ca. 3.5 mm wide, concavoconvex, medium-green, reddish-brown in lower 1/4; scape 1730 cm long, reddish-brown in lower quarter; spathe reddish-green, bifid, split in upper third, ca. 3 cm long; pedicel 1.5 - 4 cm long; perianth 4.5 - 7.3 cm long, including tube; tube green, 1.5 - 2.3 cm long; tepals broadly elliptic, white, greenish at base, suberect-spreading, mucronate, 3-5 cm long, 1-1.5 cm wide, aging pinkish at apex abaxially; stamens 1/3rd length of perianth; filaments white, suberect, slightly spreading, 1.2 - 2 cm long; anthers versatile, extrorse-arcuate, 1 cm long; pollen orange-yellow; style exceeding filaments; stigma deeply trifid with lobes 1-2 mm long; ovary ca 4 mm long; seeds flat, black, D-shaped, shrinking and wrinkling when dry. Mexico, state of Hidalgo, Sierra de Zimapan, Ca. 10 mi south of Jacala, along Mexico 85, inside rock fence on west side of road in pastures or gravely slopes. May to July. Howard # 91-08. M0. Holotype.

Discussion: *Z. leucantha* is sympatric with yellow-flowered (unpublished), pink or red-flowered (unpublished), and yellow-and-red flowered forms of the *Z. katherinei* complex, for several kilometers south of Jacala. The type form for *Z. katherinei* was based on yellow-and-red-flowered natural hybrids, intermediate between red, pink, and yellow-flowered forms of

a complex that appears to be a single species. Additional collections of living material are ca. 1 mile south of Jacala, on the east side of road in a sloping, scrubby, rocky pasture, flowering from May to July.

The flowers of *Z. leucantha* are of average size for the genus (3-6 cm diameter), but a colony of several hundred was found in full bloom ten miles south of Jacala, with flowers up to ten cm broad, creating an impressive display. Flowers of fresh specimens are purest white with a slight greenness in the throat. As might be expected in large *Zephyranthes* colonies, there are variations in size and form within this population. This taxon is known only from 1 to 10 miles south of Jacala and may be endemic to this region. The leaves are a lighter green than those of *Z. katherinei* and the longer style and more deeply cleft stigma, plus the larger, snowy-white flowers distinguish it from red or pink-flowered, yellow-flowered, and bicolored yellow-and-red-flowered forms of *Z. katherinei* found in the area. Unlike forms of *Z. katherinei*, *Z. leucantha* grows in pure colonies in scrub situations. The name *leucantha* is taken from the Greek "leuko" = white, and "anthos" = flower. This lovely new taxon is apparently safe from the intrusion of agriculture and livestock at this time, thanks to the rocky, scrubby environment that it inhabits.

Literature Review

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SWAP COLUMN

Exchanging plants and seeds is one of the most satisfying of all the benefits which come to gardeners. Many friendships have blossomed along with the plants and seeds exchanged. To promote such plant and seed exchanges, a page in each future edition of HERBERTIA will be devoted to a swap column. Subscribers are first referred to the International Bulb Society Seed Exchange, which has many exciting species and hybrids. A complete list is available upon request. Please see page 4 for more information. However, if after checking the IBS seed exchange list you are still unable to locate certain bulbs or plants, send in your request addressed to:

Swap Column, Editor, International Bulb Society
5 Sand Oaks
Laguna Niguel, CA 92677
USA

The IBS Seed Exchange has received requests for the following items: *Androstegium coeruleum*, *Kelissa brasiliensis*, *Fosteriana oaxacana*, *Griffinia* spp., *Hippeastrum* spp., *Onira unguiculata*, *Paramongaia weberbauerii*, *Petronymphe decora*, *Rauhia* spp., *Tecophilaea cyanocrocus*, *Tigridia galanthioides*, *Worsleya rayneri*, *Tropaeolum azureum*, *Lachenalia sargeantii* and any species from the tribe Gilliesieae.

If you would like to donate any of these, you can send seed, bulbs or corms, anytime of the year, to: Charles Gorenstein, IBS Seed Exchange, 5 Sand Oaks, Laguna Niguel CA 92677, United States of America.

Luis D. Arriagada, a Chilean botanist, would like to exchange or sell bulbs and corms from his extensive Chilean collection. You can request his list by writing to: Sr. Luis D. Arriagada, Casilla 8261, Viña del Mar, Chile.

E. Lassanyi, 640 Santa Maria Road, Arcadia CA 91007-2625, United States of America, is looking for plants of the *Hemerocallis* cultivar 'Starburst', and seeks sources for *Worsleya rayneri* (seeds or bulblets).

War in Armenia, a republic of the former Soviet Union, produced a shortage of heating oil which led to the complete freezing of the glass houses at the Botanical Gardens. The International Bulb Society has been asked to help replace their collection of bulbs. If you have any excess bulbs, corms or tubers that you would like to donate, please send them by air mail to: Marietta Asatrian, Institutum Botanicum Academie Scientarium, Republic Armeniae, 375063 Ezevan, Aran-63.

