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MARIPOSA

THE *CALOCHORTUS* SOCIETY NEWSLETTER

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I. ANNOUNCEMENTS

1. DUES NOTICE

Another year has come and gone, and it's renewal time! Dues will be the same this year as last, namely, $4.00 domestic and $6.00 outside the U.S.A. This year we will accept foreign currency, so long as a liberal exchange rate is used. We recommend that the currency should be sent via registered mail to insure that it will arrive safely. This MAY be an more economical way to pay from overseas; each member will have to figure relative costs.

2. Associates: In different areas of their range, many species of *Calochortus* form pairings of dry and wet, or slope and meadow species. The wet-dry pairings often occur on the Eastern Slopes of the mountains of the Pacific Coast States, including the Transverse, Sierra and Cascade Ranges. *C. palmeri* grows along stream banks or in wet meadows in the mountains of Southern California. In the dry areas of these mountains, *C. invenustus* grows, often nearby *C. palmeri*, but away from the wet areas favored by the latter species. In the Mojave Desert, seasonal streams flow down from the mountains to the West, fed by snowmelt. These streams flow thorough the ancient lake beds which originally formed the Mojave and create seasonal meadows. *C. striatus* favors these meadows, while another species, *C. kennedyi*, grows in dry areas nearby. To the north, on the eastern side of the Sierras, another species also grows in meadows formed by seasonal snowmelt. This is *C. excavatus*, a rare species from the Owen's Valley in Eastern California. In the dry areas nearby grows *C. bruneaunis*, which resembles the Utah state flower, the sego lily. Still another example is provided to the north on the Eastern sides of the Cascades, from Northeast California up to South Central Washington. In seasonally wet meadows *C. longebarbatus* grows, while in the surrounding sage deserts *C. macrocarpus* can be found. In each case, the dry species has more available habitat, and thus is more widespread. Indeed, three of the wet species mentioned above, *C. striatus*, *C. excavatus* and *C. longebarbatus*, are listed by the California Native Plant Society as threatened, while none of the dry growers is.

(II. Trips- Not enough room in this issue; will return in next edition).

III. Germination Tests--15th Installment: Potting Media

[This article is part of a continuing series on various growing trials conducted with Calochorti to gather evidence on optimum growing conditions].

In order to select the best media for pot cultivation of *Calochortus*, various media were tested comparatively to determine which are most suited to germination and growth of the various species. The tests may also provide evidence that species from different habitats and growing conditions prefer different, not similar media. All species were given exposure similar to that of their native haunts, i.e. light shade to full sun, as appropriate. Watering followed a once a week schedule during the growing season (except for *C. macrocarpus*, a desert spp., which received less).

The California spp. tested were *C. albus*, *C. tolmiei*, *C. uniflorus*, *C. catalinae*, *C. venustus*, *C. clavatus*, *C. macrocarpus*, and *C. weedii*. In addition, *C. gunnisoni*, from Colorado and three Mexican

spp., *C. venustulus*, *C. barbatus* and *C. purpureus* from Durango, Mexico were tested. As far as possible, seed collected in the wild was used, and from reliable sources. The species used were among the more common ones for their range and an attempt was made to represent all the subsections of the genus. The species were selected from diverse habitats so that germination comparisons would not be weighted in favor of local species.

The media were selected to represent the full gamut of soil and potting types from "light" (pure sand) to "heavy" (two-thirds organic) texture; from soil based (sand) to soilless (UC Davis soilless); and from inorganic (sand) to heavily organic (two-thirds humus); with similarly varied quantitative gradations, e.g. from one-third to 100% sand. The media were pasteurized to eliminate damping-off pathogens prior to sowing, at 180°F for two hours. Each California species was grown in each of five media types, yielding thirty-five combinations of species and mix.

The media used for the California species were:

1. Pure sand (#2 grade, i.e. relatively coarse).
2. Improved sand, consisting in two-thirds sand, one-sixth clay soil, and one-sixth redwood compost, thoroughly mixed (suggested by Farwig and Girard).
3. U. C. Davis mix: one-half spagnum peat moss and one-half sand by volume.
4. Two-thirds organic mix (modified from a mix suggested by C. Baccus): one-quarter sand, one-quarter redwood compost, one-quarter chopped bark, one-eighth commercial potting mix containing some sand, and one eighth spagnum peat moss.
5. U.C. Davis soilless mix: one-third vermiculite, one-third perlite and one-third spagnum peat moss.

C. gunnisoni was tested in the above mixes as well except the pure sand. In addition, *C. albus* and *C. venustus* were also tested in media in which different gritty, inert materials were substituted for sand in the U.C. Davis mix. One of these was reddish lava rock (one-half crushed lava rock, one-half spagnum peat moss. This material was suggested by Jim Robinett). The other was "green fines," a gritty material related to ultramafic rock and collected, apparently, from underwater, then crushed and used horticulturally (again in a half and half mix with spagnum peat moss. This material was suggested by Chuck Baccus).

Three Mexican species were grown in the following media:

1. U.C. Davis soilless.
2. U.C. Davis mix.
3. The two-thirds organic mix (#4 above).
4. The organic mix plus an appropriate amount of horticultural lime.
5. A mix consisting of two-thirds Supersoil (a commercially available potting mix) and one-third red lava rock. The latter was added because the Mexican species often grow in volcanically active areas, e.g. the central belt of mountains across the interior. This mix was added to test whether media consisting at least in part of volcanically derived materials would aid in germination and growth for these species.

In addition, two Mexican species were tested in additional mixes:

6. The organic mix with lava rock substituted for the sand (*C. barbatus*).
7. The U.C. Davis mix with lava rock substituted for one-quarter of the sand: one-half spagnum peat moss, three-eighths sand and one-eighth lava rock (*C. barbatus* and *C. venustulus*)
8. A two-thirds commercial potting mix plus one-third sand mixture, to test whether the commercial mix would be better than the ones listed above (*C. venustulus*).

The results will be printed in the next edition of ***Mariposa***.

IV. The Horticultural History of *Calochortus*-17th Installment

[The second of two installments from C.H. Grey's *Hardy Bulbs*. Mr. Grey managed to grow over twenty species in a wetter, generally colder climate in England than th

Calochorti are used to.--Ed.]

"*howellii*..flowers in June-July. It is a scarce plant in nature, but I have found it very satisfactory in cultivation. It is a very beautiful species, whose only fault is that increase is slow.

"*kennedyi*..flowers in June-July, and is a magnificent plant. It has lived in my garden for three years, and during that time has produced one flower from over two hundred corms! I hope, however, that in its very dry, well-drained bed it is generally acclimatizing itself to our moist atmospheric conditions, and that...it will in the end give of its best. It is so brilliant as to be worth an infinity of trouble.

"*leichtlinii*..flowers in June. I have grown it for two years, and feel reasonably sure that it will prove a good garden plant in Great Britain, especially on the east coast. It sometimes behaves like a high alpine plant, and I have had perfectly healthy flowering corms with a stem not more than two inches in length.

"*luteus*..flowers in June, and is a first rate garden plant. When well established I have known it to produce five or six rather smaller lateral flowers as well as the terminal umbel.

"*lyallii*..flowers in June, and is an attractive little plant when established...

"*macrocarpus*..flowers in June-July, and is a strikingly handsome plant, easily grown and easily raised from seed. ...I look forward to growing it by the hundred.

"*monophyllus*..flowers in May, and is a charming little plant, easily grown in light sandy soil, and requiring full sun in Great Britain...Its ideal position is a sunny moraine.

"*nitidus*..the flowers are produced in June. It is a very beautiful plant, easily grown, and surprisingly scarce in cultivation. I confess to a passion for this genus, and in consequence my praise may be pitched in too high a key. I feel sure, none the less, that anyone who takes the trouble to grow its members well will be enslaved by their beauty.

"*nudus* [*minimus*--Ed.]...flowers in June-July. The flowers are smaller than those of any known member of the genus, and have the same sort of attraction, in comparison to the larger-flowered species, as those of *Lewisia pygmaea*.

"*nuttallii*..flowers in June-July, and presents no difficulties in a raised bed. It is a delightful garden plant. The colour of the flowers varies...

"*plummerae*..flowers in June, and is a very handsome plant, easily grown and easily raised from seed...

"*pulchellus*..flowers in April-May, and is a most delightful little plant, very easily grown, and very easily raised from seed...

"*purpureus*..flowers in August-September, and is quite hardy, with a little protection, anywhere in the south and west, in light, well-drained soil. It is a very striking plant, curiously like some of the Frittillarias in appearance.

"*splendens*..flowers in May-June, and is a very handsome species, quite easy to grow. I do not find that it sets seed at all readily.

"*subalpinus*..flowers in April-May, and is easily grown and easily raised from seed...

"*tolmiei*..[var. maweanus] flowers in May, and is a most charming plant. It has rather a difficult reputation, and I entirely failed to grow it for more than a year on the moist wooded slopes which it frequents in its native land. But in a bed with the Mariposas it flourishes abundantly, and seeds itself almost too freely...[var. 'purdyi'] flowers in May-June...I have grown it for two years, and think that it should make a good garden plant in dry sandy soil.

"*umbellatus*..flowers in April, and is apt to be cut by spring frosts except in the south and west of Britain.

"*uniflorus*..flowers in May, and is a beautiful plant, presenting no difficulties in cultivation.

"*venustulus*..flowers from July to October, and should be grown in dry sandy soil and fir-needle peat.

"*venustus*...flowers in June-July, and is a very lovely plant, very easily grown, and very persistent in blossom. Although I grow it in a raised bed with other 'Mariposa Tulips,' I find its seedlings gradually distributing themselves in light soil throughout my garden...it is infinitely variable in its colour marking...

"*vestae*...is the only member of the genus generally cultivated in Great Britain. It will tolerate almost any soil conditions, given reasonable drainage.

"*weedii*...a beautiful plant...well worth trying in Bagshot sand or in the light soil found in Norfolk and Suffolk."

V. Conservation: Rare and Endangered Species

Only three species of *Calochortus* have received, as of this writing, official status as rare and endangered species. There are, however, other species which are endangered, rare or both. The bulbs of such species should never be dug, and seed of them should not be purchased, except perhaps from a botanical garden which has been permitted to propagate the species under law and occasionally offers the seed to growers. The plight of such species is perilous, and horticultural collecting makes it doubly so. Not only is it a violation of the law to do so, it is unethical, as some of these species are barely hanging on, and must survive wild predation by deer, rodents, etc. as it is.

The extremely rare or endangered species which are federally protected are *C. dunnii*, *C. persistens*, *C. tiburonensis*. Other endangered species include *C. coxii*, *C. umbellatus*, *C. greenei*, *C. striatus*, *C. excavatus*, *C. plummerae* and *C. hartwegi*. (*C. hartwegi* seems endangered based on an admittedly incomplete survey; many of its historic stands in Nayarit have been eliminated by the increased cultivation of corn.) Rare species may not be in immediate danger, due to remote habitats, occurrence on government lands, or land unsuitable for commercial purposes. They may still be threatened by wild predation, small populations or other factors. This list includes *C. pulchellus*, *C. raichei*, *C. westoni*, *C. umpquaensis*, *C. nitidus*, *C. simulans*, *C. panamintensis*, *C. obispoensis*, *C. vestus*, *C. fuscus**, *marcellae**, *C. nigrescens**, *C. pringlei**, *C. cernuus**, and *C. foliosus*. (*It is not clear which Mexi species should be on this list, and my evidence is admittedly incomplete. However, the species in th group are known from but a few collections, and, so far as is known, are rare species.) The species which are less rare but are threatened include *C. longebarbatus*, *C. howellii*, *C. catalinae*, and perhaps *C. palmerae*.

VI. *Calochortaceae*?

Usually in this section, we would cover a species from section *Mariposa*, which is next in the sequence, in depth. We will return to this format next issue. Instead, the break between sections *Calochortus* and *Mariposa* affords the opportunity to discuss the place of the entire genus in the larger group of plants in which botanists have classified *Calochortus*.

Beginning with Sereno Watson's *Revision of the North American Liliaceae*, in 1879, botanists have classified *Calochortus* in the Lily family. This classification is based upon its six distinct perianth segments (petals and sepals), the usual number for the Lily family; the resemblance of some species of *Calochortus* to *Frittillaria* L and *Tulipa* L, which are generally accepted as members of the Lily family; a tunicate bulb or corm resembling those of Tulips; and still other more technical criteria which are shared with one or more of the species in the various subdivisions of Liliaceae, the Lily family. This classification was accepted from Watson's time up to the most thorough treatment of the genus *Calochortus* by Prof. M. Ownbey in 1940. Although he acknowledged that the relation was "remote," he still believed that *Calochortus* was best placed in the Lily family of plants, in the tribe *Tulipeae*.

In 1944, the botanist Robert F. Hoover implicitly challenged this classification by separating sections *Calochortus* and *Mariposa* into separate genera ("*Mariposa*, a Neglected Genus"). As these two taxa were no longer united at the generic level, they could only be united at a higher level: the 'tri' the subfamily or family. This was an implicit argument, then, for a new classification of *Calochortus* either a tribe, Calochorteae, or even a family, the Calochortaceae. Hoover noted that the species in section *Calochortus* resembled those in section *Mariposa* less than species of many other genera which

have become recognized as distinct, e.g. *Clarkia* and *Godetia*. Hoover pointed out that the two sections differ in their leaf shape, the characteristics of their flowers, their seeds and their normal chromosome number.

More recently, in *The Families of the Monocotyledons*, (Dahlgren, Clifford and Yeo, 1985) a group of botanists has explicitly separated these families and recognized Calochortaceae as a family distinct from the vast group comprising the Lily family.

There are at least three characters shared by the Calochorti which separate them clearly from the Lily family. The first and most important is that the haploid chromosome number of the Calochorti is never twelve, while that of the Lily family to which the Calochorti are often compared, such as tulips, is invariably twelve. Section *Calochortus* has ten or multiples thereof, section *Mariposa*, seven, eight or nine, and section *Cyclobothra* has nine. There are other members of the Lily family which vary from the twelve of the lilies proper as well, such as Trillium (five), and the Brodiaea complex. Thus genetic evidence cannot be counted alone as decisive in working out family relationships in taxonomy. Nevertheless, this genetic disparity points to a evolutionary hiatus, at the very least, between the Calochorti and the Lily family, particularly tulips, lilies and frittillaries.

Secondly, all the Calochorti have hairlike processes or trichomes on their petals, some more than others. This character reaches its extreme development in the cat's ears and some of the Cyclobothras, whose petals are entirely covered with hairs. This feature is entirely lacking in any other members of the Lily family with which I am familiar, e.g. Lily, Tulip, Frittillary, Brodiaeas, Erythroniums, Trilliums, Yucca, Alliums, etc.

Finally, Calochorti have unequal perianth segments, i.e. sepal-like outer tepals and petal-like inner ones. In most *Liliaceae* the segments are equal (again, Trilliums are another exception).

Dr. Brian Ness has pointed out that in the development of the embryo sac of the seed (in layman's terms, the pulp of the fruit), *Calochortus* has a development more akin to dicots than to other monocots. The Calochorti have a "polyganum" type embryo sac formation, while the lily family generally has a frittillaria-type. Thus the seeds of tulips, lilies, frittillaries, and many other Liliaceae often resemble one another, while those of Calochortus are distinct. In this feature, *Calochortus* may represent a link between monocots and dicots.

There are other points of difference which separate *Calochortus* from the members of the Lily family with which Watson originally tied Calochorti most closely. However, there are still other genera of this vast family which do share some of these characteristics of Calochorti, at least in part. One is the singular basal leaf. Although immature *Liliaceae* Tulips, Lilies, etc.-often begin life as a single leaf, the mature plants either lack a basal leaf (Lilies) or have multiple basal leaves (some Frittillarias). The stem of Calochorti is often branched and bracted, while most *Liliaceae* have straight, simple stems. The stem leaves in Calochorti are few and small, while those of Lilies, Tulips and many Frittillarias are large and often numerous. The stigmas of the flowers are often recurved in *Calochortus*, and the style short (Ness); in the others it is not recurved and the style is long and pronounced. Finally, the fruit or seed capsule of Calochorti is "septicidal," which means that it breaks open at natural dividing lines on the capsule. While one division or subfamily of the *Liliaceae* shares this character, according to Watson, the tulips, lilies, frittillaries and other genera which were classified in the same subfamily by Watson, do not. In other words, if Calochortus is in the larger lily family, its relation to plants within this family is more difficult to determine as it shares attributes with members form different subdivisions within the family, and is not closely tied to any of the main sub-divisions. This makes Calochorti "remote" indeed from the tulip tribe.

At a minimum, it would seem, Calochorti should be considered a distinct subfamily within Liliaceae. It is too distinct from the others to be included in the same tribe or even subfamily as tulips, lilies, etc. While the features which connect it to the Lily family may be sufficient to keep it in that taxa, its unique features deserve more recognition. Also, this would allow a place for the thorny question first posed by Hoover, whether the three subsections of Calochortus should be raised to generic status. It would be easier to treat these subdivisions of Calochorti as genera if their overall identity was nearer to the family level.