In terms of height and number of flowers, *Cardiocrinum giganteum* var. *yunnanense* is the most impressive giant Himalayan lily.
AlthOUGH Cardiocrinum have been neglected as garden plants in recent decades, Gertrude Jekyll thought very highly of C. giganteum and published details of their cultivation in *The Garden*, later combined into a chapter in her *Lilies for English Gardens* in 1901. In the intervening years, however, they have fallen out of fashion.

In these pages Matthews (2002) gave an overview of the genus in cultivation, and subsequently Cox (2009) extolled the virtues of *C. giganteum*, particularly *C. giganteum* var. *yunnanense*, but the other species have been largely ignored.

This article will concentrate on my observations of the genus as a garden plant. It is based on my experience of cultivated plants in my National Plant Collection of *Cardiocrinum* which is held at Redhall in the Angus foothills of Scotland at an altitude of 150m and a latitude of 56°N.

**Classification**
The genus is small with only three species, two varieties and a few possible forms.

Recent advances in its taxonomy and relationships have been made via molecular work on the genus.

The technique of plant DNA barcoding can be used to establish whether a plant belongs to a particular species. The Natural History Museum in London has been good enough to sequence the *matK* gene of each selection in my National Plant Collection. The information was used in the identification of plants in cultivation as *C. cathayamum* discussed below.

Other molecular techniques have been used to investigate relationships within the genus. Li *et al.* (2011) used microsatellite markers to distinguish between *C. giganteum* var. *yunnanense* and other taxa, and Nishizawa *et al.* (2010) used the same approach to distinguish *C. cordatum* var. *cordatum* from *C. cordatum* var. *glebini*.

DNA analysis has also been used to determine relationships and divergence within the genus. The genus belongs to the *Liliaceae* family. Paterson & Givnish (2002) consider *Cardiocrinum* to be part of a closely related group, along with *Fritillaria*, *Lilium* and *Nomocharis*, that diversified in the Himalayas 12 million years ago.

However, Yang *et al.* (2017) used data from 54 populations to plot the geographical distribution and separation of four taxa. They suggest that the ancestor of *Cardiocrinum* diversified during the late Miocene around 7 million years ago in central China. The ancestor of the *C. giganteum* lineage dispersed westward to the Himalayas and southwest China, with the split between *C. giganteum* and *C. giganteum* var. *yunnanense* occurring around 4 million years ago. The genus spread westwards to Kashmir, south as far as northern Myanmar, and
eastward throughout China. Populations of the *C. catbayanum* lineage moved into southern Japan via a land bridge approximately 5 million years ago, and now extend as far north as the Kurile Islands as *C. cordatum var. glebnii*.

**Morphology**

All species share the same basic form when in their vegetative, growing stage prior to flowering. They have a somewhat hosta-like appearance with large, heart-shaped leaves which give rise to the Greek-derived name (*kardio* for heart, *krinon* for lily).

It is in their flowering year that the differences appear. At the start of the flowering year (March in Scotland) the plants begin to grow a flower stem which will be crowned with the raceme in June to August, depending on the species. In the space of four months the large, 20cm-diameter bulb of *C. giganteum* can grow a 4m stem, a growth rate of more than 3cm a day.

The genus has the capacity for self-fertilization, so even on a solitary plant a seed pod will develop for each flower, each holding about 500 seeds. Although monocarpic (dying after flowering), plants leave up to ten offsets when they die.

One point made by Cox (2009), but seldom mentioned elsewhere, is that they have a beautiful and pervasive scent. This varies with time and weather, being more noticeable after rain and in the evening but, with the right conditions, the scent of one plant can perfume an acre of garden.

**Cardiocrinum giganteum**

This species is the largest of all, growing to a height of 3–4m in the most advantageous conditions in the
Cardiocrinum giganteum var. giganteum

This variety usually does not have such dark stems as var. yunnanense, and at 2.5–3.5m is taller. It has an inflorescence of around 20 trumpet-shaped flowers. The flowers are about 16cm long and pale green, turning yellow in sunlight, with streaks of magenta in the interior base of the flower.

Cardiocrinum giganteum var. yunnanense

Some authorities do not distinguish var. yunnanense and regard it as part of a continuum within C. giganteum. However, recent DNA analysis (Li et al. 2011) has distinguished between var. giganteum and var. yunnanense. This variety is slightly shorter than var. giganteum, to 2–3m, with a more slender stem that tends to be purple, or at least has purple streaks. The number of flowers is variable.

However, the flower colour is the distinguishing feature. Songyun & Tamura (2000) state that var. yunnanense has white flowers, as opposed to greenish in var. giganteum, and I find that var. yunnanense in the collection have have a more pronounced and deeper tinge of magenta inside the trumpet that carries over to colour on the outside as well. Even though this is the most predominant colour combination for the variety, the flower colour is variable.

The variation in flower colour extends to pure white, which has been reported by several sources, and an all pink variant, which has been grown by Far Reaches Farm, Port Townsend, Washington (Dodson & Milliken 2009). Unfortunately, these colour extremes are not stable and a plant showing pure pink or white flowers one year is unlikely to have offsets that do so in the next generation. Also, seeds do not necessarily come true. Far Reaches Farm is experimenting with hand pollination of its pink-flowered plants. This is an area where work needs to be done to try to find the factors affecting flower colour in var. yunnanense, with a view to possibly stabilizing the characters. At the moment they are a random occurrence to be treasured when they appear.

Cardiocrinum cordatum

This Japanese species is often described as a smaller type of C. giganteum, but there is more to it than that. It is indeed smaller, growing to 1–2m in height, depending on the variety, but it also has a leaf distribution on the flower stem which is different from that of C. giganteum. The leaves are absent on the lower portion and tend to group in a bunch in the middle of the stem, giving rise to the description of ‘a hosta on a stick’. There are fewer flowers, 3–20, than in C. giganteum, each around 10cm in length, and the flowers show horizontal zygomorphism to a greater or
lesser degree. This is manifest in the upper inner tepal and, to a lesser extent, the two upper outer tepals, being recurved, giving rise to what has been called the ‘cordatum hump’. The species also tends to have fewer offsets, three to five, rather than five or more in *C. giganteum*.

**Cardiocrinum cordatum** var. *cordatum*

This is the smallest *Cardiocrinum*, reaching a height of 1–1.5m and only having three to eight flowers. The flowers have two colour patterns. The most common is similar to that of *C. giganteum* var. *giganteum*, with a green tinge to the flowers and very little magenta at the base, but speckles of magenta on the interior tips of the tepals. The other pattern is similar to that of *C. giganteum* var. *yunnanense*, where the flowers are white with more magenta inside and little or no speckling.

**Cardiocrinum cordatum** var. *glehnii*

This variety is regarded as a synonym of var. *cordatum* by some authorities, but it is difficult to understand why. It has a taller stem of 1.5–2m with more flowers, 10–20, and the flowers have a different form to those of var. *cordatum*. They are much shorter and ‘boxier’, being about 8cm in length. Although they exhibit the zygomorphism referred to above, it is much less well defined than with var. *cordatum*. Only one flower colour pattern has been recorded, which is green speckled with magenta at the mouth.

The clearest statement of the distinctiveness of var. *glehnii* that I am aware of is that by Kawano (2004): ‘The northern populations of *C. cordatum*, especially in Sakhalin, Kuriles, Hokkaido, and particularly on the Japan sea side of Honshu, Japan, are characterized by taller and more robust morphologies of the flowering individuals, with more numerous and larger flowers than other populations, and thus are referred to as a local variety, var. *glehnii*.

**Cardiocrinum cathayanum**

I have a problem with *C. cathayanum* in that I have not seen a genuine example. Some nurseries in the UK advertise plants with this name, but when they flower they bear no resemblance to EH Wilson’s type description, nor to the holotype material he lodged in the Kew herbarium. I have grown bulbs imported from China which also produce plants that differ from the type description. All the material referred to above I have had tested by DNA barcoding. It turned out to be *C. giganteum* and, from the colour of their flowers, *C. giganteum* var. *yunnanense*.

The only examples of *C. cathayanum* that I know of in the UK are descendents of a Kew accession obtained from University of British Columbia Botanical Garden that still grow at Royal Botanic Gardens,
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Kew. The identity of the original plant was verified by reference to Songyun & Tamura (2000) and its DNA matches that of the samples of *C. cathayanum* in BOLD, an online database. I would be more than happy if anyone can provide a verified example of *C. cathayanum*, but at the moment I do not think it is in general cultivation in the UK.

I have seen photographs of verified *C. cathayanum* which show it to be very similar to *C. cordatum* var. *cordatum*. They are both relatively small, have the same asymmetric leaf distribution on the flower stem, and have few flowers which all show the cordatum hump. While there may be differences in fine detail, the gross morphologies are such that I cannot tell the difference between the two species from photographs.

While investigating it is important for taxonomy, it does not matter in the garden: if it looks the same as *C. cordatum*, then plant *C. cordatum*.

**Garden use**

A *Cardiocrinum* does not look happy planted on its own in a herbaceous border, or surrounded by shrubs. Plant them in shade, and the darker the better, even under evergreen trees. If you are starting with a single plant then place it in a group of plants with similar leaves. Hostas are the obvious choice; after all, you will have up to three years of just leaves before it flowers. I tend to plant in groups of three or five of the same species.

The best is undoubtedly *C. giganteum* var. *yunnanense*, but this is not to say that there is no place for var. *cordatum*. In a mixed group the different flower colours will accentuate each other.

If you feel that *C. giganteum* is too big for your garden, then *C. cordatum* enjoys similar conditions and partners. However, remember that *C. cordatum* var. *glehni* flowers up to a month earlier than var. *cordatum*.

Another approach for smaller gardens is growing in pots. I have seen a small courtyard garden which featured *C. giganteum* var. *yunnanense* surrounded by hostas, all in pots.

If growing in shade you will need other shade-lovers to enhance the scene. I use *Arisaema, Beesia, Jeffersonia* and *Trillium*, coupled with groundcover of vigorous *Ajuga reptans* ‘Silver Beauty’, *Arisarum proboscideum*, *Arum maculatum* mixed with *A. italicum* var. *pictum*, *Asarum europaeum*, drifts of pink and white *Colchicum*, *Fragaria vesca*, *Galium odoratum* and candelabra *Primula* such as *P. chungensis*, *P. pulverulenta* and their hybrid.

**Cultivation**

All *Cardiocrinum* have similar requirements. They do best in shade, they flourish in a rich growing medium, they must have well drained soil and they must not be disturbed outside their dormant period.

Whilst *Cardiocrinum* will grow in full sun, they do best in shade and can flourish in deep, dry shade. I have grown them under and within 1m of a *Sequoiadendron giganteum*.

They are greedy feeders. They need a hole big enough to contain the mature bulb, 30cm³ for *C. giganteum* and 20cm³ for *C. cordatum*. This should be filled with a mixture of the excavated soil, garden compost and a slow release fertilizer such as blood, fish and bone meal.

The one sure way to kill *Cardiocrinum* is for the bulb to become waterlogged. If you have a clay soil they are not for you. If a bulb is moved or even planted out when it is not dormant, there is a possibility that it will flower prematurely. I have seen *C. giganteum* flower at 45cm tall and *C. cordatum* seedlings flower in a pot at 15cm! It is best if offsets can be lifted and
replaced at the end of the year in November or December. If adverse weather means that you can not do this, they should not be touched after February.

When grown in pots they do not attain the same height as in the open ground. Some find this a benefit as *C. giganteum*, for example, will only grow to about 2m. If planting in pots you should not use the rich medium described above as it will retain too much moisture, so plant in a very well-drained compost and use a liquid feed.

One problem with the genus is that, when in full flower, they are liable to be blown over. All of the substance of what was a large bulb goes into the production of the flower stem. When this is fully developed, no bulb remains. The plant is held in the ground by a relatively small and shallow root system and exposed plants can be blown over by summer high winds. In such cases the plant can be re-erected and staked and it will continue to flower and set seed. If the growing area is liable to such winds it is better to stake them as the stem develops.

**Propagation**

*Cardiocrinum* can be propagated from the offsets left when a flowering plant dies, or from seed.

Offsets should be lifted when they are dormant in November to February and replanted. If they are left were they have formed they will grow into flowering plants, but they will be smaller than if they are given their own location with fresh compost and food. Depending on their size an offset will produce a flowering plant in three to four years.

Seeds should be gathered when the pod is ripe, which is when it becomes brown and starts to crack open. This is in November or December in Scotland. The seeds should be sown soon in a pot or tray of free-draining compost and covered with a layer of vermiculite, perlite or sharp sand to stop them being washed around when watering. Alternatively, seed can be sown in a nursery bed in shallow, 5mm-deep drills or, if you have the space, broadcast in the area where you want the mature plants. They will self-seed and, if you can afford the space, such seedlings will give rise to large, sturdy plants.

Seeds require two periods of cold to germinate, so seeds sown in November will start to germinate in the March that falls 16 months later. Phartyal *et al.* (2012) report that his process can be shortened by stratification, but only by a few months. Although germination starts after 16 months, it is usually found that further seed will germinate each spring for two years after that.

In my experience seeds have a low rate of germination (1–20%), but with around 10,000 seeds per plant this is not a significant problem.

A seedling starts with a single leaf blade and should be potted up when it produces its first true leaves, or when it goes dormant, whatever happens first. They should be grown in very well-drained compost and must not be watered once they are dormant.

It is sometimes quoted that they need seven to nine years to flower from seed. My experience with *C. giganteum* and *C. cordatum* is that some will flower within five years of sowing; three and a half years from germination.

*Cardiocrinum giganteum* dwarfs most other herbaceous plants
Availability

In the UK you should expect to pay between £7 and £10 for a medium-sized bulb that will flower in two to three years. However, bulbs with known provenance can cost £25.

However, purchasing cheaper bulbs is a buyer-beware situation. Many sellers advertise bulbs with a picture of *C. giganteum* var. *yunnanense* but a description that just states ‘*Cardiocrinum giganteum*’. Ask if the flowers are white or green. In fact, most plants offered are var. *yunnanense* and it might be difficult to find var. *giganteum*.

*C. cordatum* is less commonly available, but usually correctly described. Be even more careful if buying seed; sellers seem to attach any old photo to their advert. The worst I have seen is a seller on Australia’s eBay offering *C. giganteum* var. *yunnanense* illustrated with a picture of *C. cordatum* var. *glehnii* taken from my website!

The other point about buying seed is the quantity offered, which can be as low as five seeds to a packet. With a potential germination rate of 5% and no practical way to test this, it is possible that such a pack contains no viable seed.

Conclusion

*Cardiocrinum* are a worthwhile consideration if you have a shaded area in your garden where little else will grow, or a small area of woodland. If space allows, grow a mixture of *C. giganteum* var. *giganteum* and *C. giganteum* var. *yunnanense*. For a small space try *C. cordatum*, and if you find genuine *C. cathayanum* please let me know!

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