Clivia
Learning Package 1

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"If you've never experienced the joy of accomplishing more than you can imagine, plant a Clivia." — *Anon, Australia*

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Name: **Monica Conquest**
Species: *Clivia miniata*
Color: Yellow
Other traits: Green Throat;
Raiser: Kevin Walters
Breeder:
Ref: y2/2000
Country: Australia

Description: a Kevin Walters hybrid yellow that shows some green in the throat. Bred from ['Aurea' x Kewensis orange]

World renowned hybridist, Kevin Walters who passed away in 2012 was given his first Clivia by his grandmother when in primary school, was dux of his college, a founding member of the international Clivia Society in 1992 and later awarded life membership. Kevin was described as a specialist and champion of Clivias by the top Japanese Clivia breeder Yoshikazu Nakamura and was an associate of Dr Keith Hammett from New Zealand and Nick Primich from South Africa. A Clivia seed takes seven years to flower. In Kevin's own words "In 1979I made another fortuitous cross — Aurea x a Kewensis orange. The Orange had been grown from seed abducted in a handbag from Kew Gardens. This cross gave 33% yellows which were, in the main, an improvement on Aurea in size and width of petals. One had a green throat and was later named Monica Conquest'

AN INTRODUCTION TO INTERSPECIFIC HYBRIDS

Helen Marriott

Prologue

Following an introduction to interspecifics at the 21 August, 2009 meeting of the Melbourne Clivia Group (MCG), the text below was published in the club's subsequent newsletter in Oct 2009 (Vol. 2.5). As I re-read the text nine years later in 2018, I feel that the basic outline concerning interspecifics still stands today, though in the intervening years we have seen much more breeding, especially in South Africa and on a smaller scale in Japan and elsewhere, of interspecifics. As a result, many more examples could be given of outstanding plants, though most of those specifically referred to below have stood the test of time. In the interim, the breeding of new interspecific hybrids where at least one parent is an interspecific has increased substantially. Furthermore, more resources on *Clivia* have been published. The original 2009 text has not been updated with such content but basically follows the earlier paper with only minor adjustments and with several more photos added.

Introduction

In contrast to intraspecific hybrids which are hybrids between different forms of one *Clivia* species, commonly, but not exclusively *C. miniata*, **interspecific** hybrids are hybrids between different *Clivia* species (Duncan 2008 p.17). Among the various exciting prospects for the development of the genus *Clivia* in the coming years, surely one must be the further advancement of *Clivia* interspecific hybrids involving crossings of the existing species - C. *caulescens, C. gardenii, C. miniata, C. mirabilis, C. nobilis*, and *C. robusta*. To start with, I recommend a visit to some websites that contain photos of interspecific hybrids. A list is given at the end of this text, but for seeing photos of the latest hybrids one of the two email groups/forums is highly recommended as well as the gallery on the MCG website.

Clivia x *cyrtanthiflora* is the name given to the first recorded hybrid bred in Europe in the 19th century between *C. nobilis* and *C. miniata*. This hybrid (or later generations of it) seems to have arrived in Australia relatively early in the country's history of the introduction of *Clivia* and can be found in large massed displays in some Australian botanic gardens (eg Melbourne, Sydney and Adelaide) as well as in some older private gardens. It has often been incorrectly referred to as *Clivia nobilis* in the past in Australia (as well as in some other countries) and sometimes is now informally referred to as oz nobilis. With its original parentage involving *C. nobilis* (a pendulous species with a tubular flower) and *C. miniata* (the non-pendulous species with upright, trumpet-shaped flowers), this is typically a strong plant, may flower two or three times a year and deserves to be more widely grown. It is not commonly available in retail stores, at least in Victoria, and often seems to have been passed around through divisions.

In their natural habitat in South Africa, *Clivia* species that are growing in close proximity occasionally form natural hybrids. In 2006, *Clivia* x *nimbicola* was the first formally described naturally occurring hybrid, involving *C. miniata* and *C. caulescens*

(Clivia 5 pp. 78-80; Clivia 8 pp.23-27). A natural hybrid of *C. miniata* and *C. gardenii* is also pictured in Duncan (2008 p.105). While we may learn of other naturally occurring hybrids in the future, it is predominantly the interspecific hybrids that are increasing in many countries as a result of deliberate breeding efforts.

These days, with the spread of *Clivia* around the world, the various *Clivia* species as well as numerous different types of interspecific hybrids are now increasing in accessibility. We can thus enjoy observing interspecific hybrids in public places as well as in our own gardens or collections, and, if we wish, also create our own hybrids.

Some attractions of interspecific hybrids

Some of the appealing features of interspecific hybrids can be summarized as follows:

- Expansion of the flowering period of *Clivia*, with the interspecifics predominantly flowering in Melbourne from June to August, and with some of them producing another flower stem during another season. *C.* x cyrtanthiflora may produce two to three flowers a year;
- Great diversity of flower form, with new flower shapes and umbels, eg, semi-pendulous flowers;
- Different leaf combinations, eg, *C. miniata* (daruma-type) x *C. nobilis*;
- New colours and new colour patterns or combinations in flowers, eg, flared green tips, different colour(s) of the inner and outer surfaces of the flowers; and,
- A hugely under-developed category of *Clivia*, thus allowing much scope for new creations.

Indeed, there is considerable potential for the development of *Clivia* with more growing and breeding of interspecific hybrids.

Types of interspecific hybrids

Koopowitz (2002 p.304) proposes a classification of the different types of primary hybrids involving crosses of two different species. He recommends group names be used to cover these hybrids, e.g., *Clivia* Minilescent Group for *C. miniata* x *C. caulescens* and so on. Although these group terms have some limited following, my impression is that the majority of *Clivia* growers or breeders continue to refer to the description of the full cross. Similarly, there is also a tendency for the natural hybrid involving *C. miniata* and *C. caulescens* to be labelled as such, and some people find use of the term C. x cyrtanthiflora also problematic, in that it referred to the original cross made in the 19th century rather than to the subsequent generations bred from it. Sometimes I follow the informal practice of Nakamura of using abbreviations on his own plant labels: MC for (*C. miniata* x *C. caulescens*), MN, MG and so on.

Yoshikazu Nakamura's *C. miniata* x *C. caulescens*

When seeds that are purchased are not specifically labelled, as in "my breeding mix" or else "interspecific hybrid", it is sometimes difficult to identify the parentage of the resultant plant(s), so in addition to the flower, other features such as the leaf and overall appearance of the plant itself, or the flowering time, may need to be considered. Even then, some plants remain indistinguishable, especially as the number of times *C. miniata* is used in the cross increases and it becomes more miniata-like in appearance. When identification is still not possible, statements such as "origin unknown" are sometimes used to accompany photos in published texts.

When an interspecific hybrid is named, sometimes the information on its background is not always readily available. Knowing that Rudo Lotter's 'Chanèl', for example, is an F2 *C. nobilis* x *C. miniata* is useful information for anyone trying to create a similar cultivar. In this regard, Ken Smith's "A checklist and register of Clivia cultivar names" becomes an indispensable reference, though not all named plants are recorded here.

General characteristics

After *C.* x *cyrtanthiflora*, the most commonly available interspecific group/category available in Australia is probably the combination of *C. miniata* and *C. gardenii*. These hybrids are likely to be fast growing, offset readily, flower in winter, and have flowers that may be semi-pendulous, slightly curved and perhaps with green tips on flared tepals. In Melbourne, these interspecifics seem to mainly flower in June and July. Bill Morris's 'Flame' is a large-flowered orange interspecific hybrid of *C. miniata* and *C. gardenii*. The late George Hellen in Queensland often used *C. gardenii* in his interspecific hybridization. Not infrequently, the tepals of the hybrids exhibit green tips, inherited from the *C. gardenii* parent, but sometimes the green colour can be diffused throughout the tip area. The yellow interspecific 'Moondrops' (see photo in Clivia 2 p.39) is one well-known example, among others, from the Wessel/Rudo Lotter family, which has specialised in interspecifics. 'Moondrops' is an F2 hybrid of *C. gardenii* x yellow *C. miniata*. The interspecific named 'Gay Delight'(Clivia 8 p.10 where it is misspelt) which was grown from Nakamura seed by Laurens Rijke was on display at our last meeting. It has an attractive multicoloured flower and is thought to be an F2 *C. miniata* x *C. gardenii* cross (not a cross with *C. caulescens* as originally claimed). Shige Sasaki has recently crossed an orange C. *miniata* with multitepals x

C. 'Heleborus', an interspecific of unknown which has a slight green centre. The offspring is bronze in colour, with a green centre, and as expected in the F1, does not have multitepals but these should emerge in the F2.

Bill Morris's 'Flame'

Yoshikazu Nakamura's 'Gay Delight'

Shige Sasaki's Multitepal x 'Heleborus'

New crosses of *C. miniata* and *C. nobilis* tend to be labelled as such. Here, the leaf texture and leaf tips, as well as its floriferous characteristic seem to be strongly influenced by the *C. nobilis* parent. These hybrids also may inherit some green colouration. The plants often flower in winter and may produce a second flower in another season. 'Chanèl', mentioned above, was described by Rudo Lotter as a kind of bicolour, with the outer surface of the tepals being red and the inner surface yellow. I have heard, however, that as the flower ages this distinction is weakened.

Interspecific hybrids of *C. miniata* and *C. caulescens* typically flower in July/August in Melbourne, but also may produce flowers at other times, such as summer. At one stage Yoshikazu Nakamura (Japan) bred some extraordinary hybrids, and Laurens Rijke was fortunate in purchasing a good quantity of these seed. Inheriting the large plant form of *C. caulescens*, the interspecific hybrids may grow into largish plants themselves. Yoshikazu Nakamura's outstanding cultivar 'Day Dream' combines *C. miniata* and *C. caulescens* (see below). 'Mandala', which is featured on the cover of Duncan's (2008) publication, is also a hybrid of *C. miniata* x *C. caulescens*. 'Stanmore Moulin Rouge', another Nakamura hybrid named and owned by Nick Powell (Queensland), is produced from (*C. miniata* x *C. caulescens*) x self. Keith Hammett, in New Zealand, has also produced some excellent interspecific hybrids, including 'Golden Nugget', a cross of (*C. caulescens* x *C. miniata*) x self (see Clivia 9 p.51).

Yoshikazu Nakamura's 'Day Dream'

Nick Powell's 'Stanmore Moulin Rouge'

Following the discovery of *C. mirabilis* in 2001, the South African National Biodiversity Institute (SANBI) has actively been utilizing this new species in a range of interspecific hybrids which first flowered in 2006 (Clivia 9 pp. 47-48; Duncan 2008 p.110-111). *C. robusta* has also been used in interspecific hybrids by breeders and collectors during the last decade or more.

When we have interspecific hybrids in our collections there will be many observations that we can make. For instance, if an interspecific hybrid produces flowers at different times of the year, we may observe a change in the flower colour across the different seasons or even in different growing situations. This seems to be due to environmental factors, especially the light intensity. In my own experience, the Australian form of *C.* x *cyrthanthiflora* can flower regularly in any of the four seasons, and flowers more often than any of the other interspecific hybrid forms. In contrast to *C. miniata*, many interspecific flowers have a solid colour inside, rather than a contrasting throat colour in the basal area, as tends to be the case with orange-flowering *C. miniata*.

Breeding interspecifics

While *Clivia* can be enjoyed either as pot or garden plants, some of us will also be interested in the hybridization of interspecifics. In his introduction of interspecific hybrids, Rudo Lotter (CD or website) indicates that when colour mutations, leaf variations and other genetic variations within the six species are taken into consideration, an endless array of breeding possibilities exist. Quite commonly *C. miniata*, with its many variations, is used as the seed or mother parent and then crossed with one of the pendulous species, but it is also sometimes used at the pollen parent. Although there are some differences of opinion, it is thought that each parent contributes 50% to the genetic constitution of the offspring (eg Wessel Lotter, Clivia 2 p.34; Johan Spies, Clivia 8 p.35). While inheriting characteristics of both parents, Rudo Lotter claims that a cross between *C. gardenii* and *C. miniata* will be more pendulous looking than a cross of *C. miniata* x *C. gardenii*. Undertaking a reciprocal cross, where each parent is used as the seed or maternal parent and vice versa is the best way to investigate the differences of using the same parent as the seed or pollen parent. Less commonly, pendulous species are crossed between themselves.

Wessel Lotter indicates that not all interspecifics will be attractive and he himself personally prefers those that are semi-pendulous, semi-open, gracefully curving flowers (Clivia 2, p.40). Different people, nevertheless, appreciate different flower forms and some of us like many different variations.

To maximize the potential of interspecifics, the breeding of more than one generation is necessary. Rudo Lotter, for example, argues that in a first generation cross (F1), such as crossing *C. miniata* x *C. gardenii*, the siblings will not exhibit a lot of variation. To bring out further characteristics that are recessive, the best F1 siblings are crossed between themselves (or selfed) to create the F2 generation. It is through this method that we can obtain yellow interspecifics in the second (ie F2) generation.

These days an increasing number of yellow interspecifics are available, but if we wish to breed our own, this can be achieved using a good form of yellow *C. miniata* and crossing it to one of the other species. By following Wessel Lotter's (Clivia 2, p.41) example of a step-by-step description of an interspecific hybrid involving *C. miniata* x *C. nobilis*, reproduced below, a yellow interspecific will emerge:

(1) Cross *C. miniata* (yellow) x *C. nobilis* (or any other species) =
100% F1 orange split (heterozygous for) yellow hybrids.

(2) F_1 orange split yellow hybrid x F1 orange split yellow hybrid =
25% F2 yellow hybrids
25% F2 orange hybrids
50% F2 orange split yellow hybrids.

(3) F_2 yellow hybrid x F2 yellow hybrid =
100% F2 yellow hybrids.

(Clivia 2 p.41).

In other words, a yellow interspecific hybrid can be achieved in the second generation.

Although it has been suggested that we only need to proceed to the second generation (F2) in interspecific hybridization, Keith Hammett indicates that quite often, recessive traits are not expressed until generations much later than the F2 (personal communication), so there may in fact be reason to proceed to F3 or F4 though sibling crosses or selfing.

Yoshikazu Nakamura's experience is that excellent interspecfic hybrids can be achieved already by the second generation (F2). He has often selfed his F1 interspecific hybrids, thereby bringing out many attractive features in the flowers of the F2 generation. In selecting parents to hybridize, he pays attention to small features found in the species parent that might be accentuated in the subsequent interspecific hybrid, for example a round tepal in a small pendulous flower. 'Clementina', named by Laurens Rijke, is probably the very best cultivar to emerge from Yoshikazu Nakamura's crossing of (*C. miniata* x *C. caulescens*) x self (see Clivia 7, inside cover). Note that if an F1 interspecific (or any other F1 for that matter) is subsequently used in a cross with a different parent, it becomes a new F1.

Main hybridization patterns

In his classification of interspecific hybrids, Graham Duncan (2008:101) defines primary interspecific hybrids as "first generation hybrids between different *Clivia* species". A cross of *C. miniata* x *C. gardenii*, or *C. gardenii* x C. *miniata* is thus a primary interspecific hybrid. Numerous other examples have been noted above. Given the increasing availability of these primary interspecific hybrids in recent years, these plants are now often being used in new crosses, whether it is with *C. miniata* or another combination. Graham Duncan refers to such crosses as advanced hybrids, involving hybrids between primary hybrids and species. Where three or more species are involved, Keith Hammett recommends that the term complex hybrid is an appropriate term (personal communication).

Although *C.* x *cyrtanthiflora* is already a primary hybrid, it is now often crossed to *C. miniata* again. Given its widespread distribution in many *Clivia*-growing countries, it is not surprising to find it used in many new interspecific hybrids. The photo of Lisa Fox's attractive plant, 'Felicia', bred by John Craigie in Queensland and reproduced in the July newsletter and the current website, is yellow *C. miniata* x *C. cyrtanthiflo*ra. Kevin Walters has named another delightful cross of *C.* x *cyrtanthiflora* x orange *C. miniata* as 'Sakura'. My own crosses using *C.* x *cyrtanthiflora* are now beginning to flower and I am interested to see the amount of variation that occurs, particularly based on whether *C.* x *cyrtanthiflora* is used as the seed or pollen parent and according to the use of different *C. miniata* (or other) parents.

John Craigie's 'Felicia'

In the May 2009 MCG newsletter (Vol. 2.3), John van de Linde outlined his experiences of undertaking a reciprocal cross of [*C. miniata* x (*C. caulescens* x *C. miniata*)] x *C. miniata*. He reports obtaining a higher flower count where the interspecific was used as the maternal plant in the cross. Yoshikazu Nakamura's special cultivar 'Day Dream', mentioned above, is a hybrid of (orange *C. miniata* x yellow *C. miniata*) x (*C. caulescens* x yellow *C. miniata*) (see Clivia 8, pp.13-15; Clivia 9, pp. 49-54). In quite a lot of his hybridization, this breeder has used (orange *C. miniata* x yellow *C. miniata*) as one parent, and this also applies to his interspecific hybrids such as 'Day Dream' and others.

When backcrossed to *C. miniata*, the flowers of the interspecific hybrids are characteristically larger in size and sometimes look more *C. miniata*-like. Laurens Rijke has produced some lovely interspecifics hybrids using Yoshikazu Nakamura's orange (*C. miniata* x *C. caulescens*) x *C. miniata* 'Aurea', achieving a number of highly attractive plants from just one cross, some of which have been named, such as 'Patsy', 'Pansy', 'Primrose' and 'M. Rose', displaying a range of different flower shapes and colours. Whereas the majority of primary interspecifics or variations of them seem to flower in Melbourne during June and July, the interspecifics that are crossed back to *C. miniata* primarily flower during August, thus overlapping with the start of the main *C. miniata* flowering season itself.

Laurens Rijke's 'Pansy'

Yoshikazu Nakamura's interspecific with *C. nobilis* in its heritage

If we wish to retain the predominantly pendulous/semi-pendulous feature of an interspecific, rather than to cross it back to *C. miniata*, two hybrids of the same type could be crossed together, as in a sibling cross, for example, (*C. miniata* x *C. caulescens*) x (*C. miniata* x *C. caulescens*). Alternatively, to produce an interspecific hybrid that will carry a variety of different genes and which might flower at different times of the year, one could cross hybrids based on different species, such as (*C. gardenii* x *C. miniata*) x (*C. caulescens* x *C. nobilis*). Another way is to cross an interspecific hybrid to a single species, as in (*C. miniata* x *C. caulescens*) x *C. gardenii*.

The Queenslander mentioned above, George Hellen, sometimes backcrossed his (*C. miniata* x *C. gardenii*) to either *C. miniata* or to *C. gardenii*. The cross that I own of 'Green Imp' is of the latter type and this may explain the predominance of green in the tip and median section of the flower, since it has *C. gardenii* twice in its parentage. In 2009 Yoshikazu Nakamura backcrossed some yellow interspecifics (based on *C. miniata* and *C. gardenii*) to yellow *C. miniata* and, as expected, found all green-pigmented seedlings. He planned to cross these yellow interspecifics with (orange *C. miniata* x yellow *C. miniata*) the following year and no doubt hoped for some new and different colouration patterns in the resulting flowers.

George Hellen's 'Green Imp'

Creating our own interspecific hybrids

It is certainly not difficult to create our own interspecific hybrids. Planning the goals of the hybridization and then selecting suitable parents is a good place to start. This may involve selecting features in the parents that we wish to produce in the offspring.

Since the different species may flower at different times of the year, storing pollen in the refrigerator (or freezer) will probably be necessary, making sure that it is labelled and dated. Pollen might also be available at MCG meetings from time to time. Some people say that pollen will remain viable in the freezer for seven years; kept in the refrigerator, the pollen will certainly last for the season (or year) when it is used but probably up to three years.

Interspecific hybrids with variegation are still relatively unusual, so using a variegated *C. miniata* would be a good choice for those who like variegates. Crossing interspecifics that we already own back with *C. miniata* or with another species is also worthwhile. In other words, there are seemingly endless possibilities. It goes without saying that we should keep full records of our crosses.

Variegated interspecific of *C. miniata* x *C. gardenii*

Current and new directions in breeding

It is interesting to speak with breeders about their current work in interspecific hybridization or to view photos of some of the outcomes. We can also examine some of the seed lists that are put out by *Clivia* growers from around the world to see examples of the crosses that they are currently making. At the forum held in New Zealand in October 2008, Jim Shields suggested that the most interesting developments in *Clivia* will come from among the serious backyard hybridizer. Although he made this remark in general, it is not hard to envisage that growing and breeding interspecific hybrids is one area where creativity – or sometimes luck? – may have a role. In any case, we can continue to be stimulated by seeing some of the fantastic new crosses arising from hybridization that is being done locally, nationally and internationally.

Websites (as of 2009) to view photos of interspecific hybrids:

MCG: (http://www.melbourneccliviagroup.org.au/gallery.html)
Rudo Lotter: http://www.rudosclivias.co.za/ (see under Clivia showcase)
Shige Sasaki: http://members.jcom.home.ne.jp/clivia.3/ (see under My collection: Interspecific hybrids; Nakamura collection: Interspecific hybrid)

Other internet resources:
Yahoo Clivia Enthusiast group: tech.groups.yahoo.com/group/clivia-enthusiasts/
The Clivia Forum: www.cliviaforum.co.za

My thanks to Keith Hammett for advising on an earlier draft of this text.

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Marriott, H. (Clivia 9) *Clivia* caulescens and its hybrids. (pp.49-54)

Rourke, J. (Clivia 5) Natural interspecific hybrids in *Clivia*. (pp. 78-80)

Spies, J. (Clivia 8) Genetic aspects of *Clivia* breeding. (pp.31-38)

Truter, J.T. et al. (Clivia 8) *Clivia* x nimbicola – a stunning beauty from the Bearded Man. (pp. 23-27)

INTRODUCTION TO POLYPLOIDY IN CLIVIA BREEDING

Aart van Voorst

Summary

miniata embryos were treated with colchicine *in vitro*. Tetraploid and mixoploid plants were regenerated. Crosses yielded tetraploid and triploid plants. Possibilities for polyploids in *Clivia* breeding are discussed.

Introduction

Clivia miniata hybrids are old, but loved pot plants in our homes in Northern Europe. I had one blooming for several years. Then Gordon McNeil raised my special interest in *Clivia* when I came across his article: Hybridising *Clivia* in Herbertia (McNeil, 1985). He wrote about his acquisition of the Gladys Blackbird collection. And what interested me most, was his claim of having material of intergeneretic crosses. *Clivia* crossed with *Hippeastrum*, *Eucharis grandiflora* and *Agapanthus*. That such crosses would be possible amazed me and I was tempted to repeat such unbelievable combinations.

In my professional life I had gained much experience with embryoculture of *Alstroemeria* and *Lilium*, so I thought that if such crosses were possible under normal conditions in South Africa they also must be possible in Europe with the aid of laboratory methods. Well, I learned that it was not as simple as that, especially because those crosses do not exist (yet) in reality. The plantlets I got from the crosses proved to be selfings in the end. I still want to try crosses like that, but much more research should be done to see if certain combinations have a chance of success.

With my first so-called hybrids I did some research on propagation *in vitro*. And here again I learned that *Clivia* is not as easy as other Amaryllidaceae in *in vitro* culture. I could propagate the plantlets by dividing them into two and when I was lucky both parts formed a new plant. I also raised a plant from callus but it took about one year so a fast propagation method didn't come easily and my other work absorbed me at that time.

One day I got another *Clivia miniata* plant from a neighbor and I crossed it with my specimen. I was experimenting with methods of doubling the chromosome number in *Alstroemeria* and I considered the possibility of doubling the chromosome number in *Clivia* using the seeds from that cross.

Polyploids in horticulture

Polyploidy occurs naturally in many plant species. Cultivars of numerous horticultural crops are polyploids. The origin of these polyploids has for many years been a matter of discussion: are they the result of doubling of somatic chromosomes (the chromosomes normally present in every cell of the plant) or are they originated by the addition of an extra set of chromosomes through unreduced gametes (gametes: the sex cells that have normally half the chromosome number of the parent)? The latter explanation is nowadays generally accepted (Harlan and DeWet, 1975; Ramanna, 1992).

The positive aspects of polyploidy result in a selective advantage of polyploid plants when they occur by chance in the progenies of horticultural crops. The increased chromosome number results in most plant species in larger cell sizes and larger plant parts. Bigger flowers, stronger stems and other superior characteristics may appear. This makes up for the slower growth rate and the lower seed set and bud count that usually accompany these desired traits in the first generations of polyploids.

Breeders were not aware of their plants' polyploid status and in many cases it took years before more polyploids appeared. In a crop like *Narcissus* it took more than 100 years before the majority of hybrids consisted of tetraploids (Brandham, 1995 see figure 1). Kamemoto (1950) found another example of unintentional selection for polyploids. He thought it would be interesting to check the chromosome numbers of prize-winning hybrids in competitive orchid flower shows. Many of them proved to be triploids or tetraploids, which had appeared spontaneously in the breeding stocks of the prize winners. Evidently, these polyploids showed wanted characteristics.

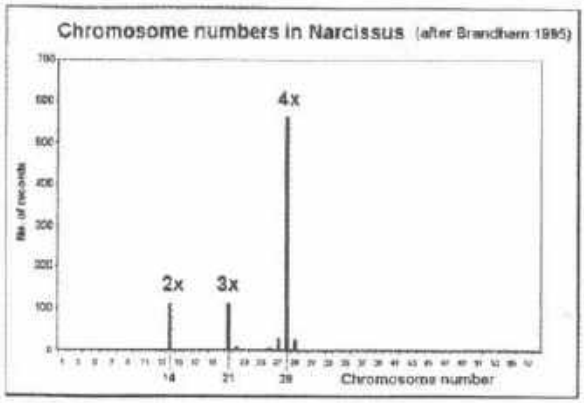

Figure 1.

Chemicals like colchicine and oryzaline were discovered that disturb the normal mitosis of plant cells and result in cells with a doubled chromosome number (Hancock, 1997). In many plant species man in the course of the last century has doubled the chromosome number with the aid of these chemicals.

Doubling the chromosome number can also restore the fertility of interspecific hybrids and this has been used in horticultural breeding programs for example with *Lilium* (van Tuyl *et al.* 2000)

In *Freesia* the first polyploid cultivar appeared in 1911 (Goemans, 1980). Here again we see an example of a crop where the first polyploids occurred spontaneously, but when the origin of their superior characteristics was recognized they were used in guided programs. To improve fertility tetraploid cultivars were selected and intercrossed with the help of natural pollinators (Sparnaaij, 1979). Later new diploid breeding lines were made tetraploid with colchicine and the same technique of intercrossing using bees was used. Today all major cultivars for cut-flower culture in *Freesia* are tetraploid.

Polyploidy in *Clivia*

The genus *Clivia* is small and consists of only six species if we include the not officially named 'Swamp *Clivia*' (Ran et al, 2001) and the newly discovered *Clivia mirabilis* (Rourke, 2002).

All *Clivia* species are diploid with a chromosome number of 22 (Ran *et al.* 2001 *figure* 2.) There are two literature references where a tetraploid number (4x = 44) is given for Clivia nobilis, both from Sato (1938, 1942). Other authors have not confirmed these chromosome numbers.

The first manmade polyploid clivias were reported by Niu *et al.* (1986). They treated seed and seedlings with colchicine. What has become of the results is not known. Doubling the chromosome number in *Clivia* can add to the tremendous progress in the breeding of *Clivia miniata*, and of the interspecific hybrids, that has taken place in recent years. The founding of the Clivia Club and then the Society, and the easy communication between people over the Internet, are important contributors to this phenomenon.

As stated before, polyploids can show wanted characteristics in floriculture. In *Clivia* we can think of bigger flowers, but also more extreme broadleaf types as appreciated by Chinese growers, and interspecific hybrids with unequal genome number (triploids).

If the tetraploid status in *Clivia* would be too extreme (Brandham, 1995), tetraploids could be used to breed triploids (three genomes: 3x=33) or aneuploid (normal genome plus or minus one or more chromosomes) material with superior characteristics.

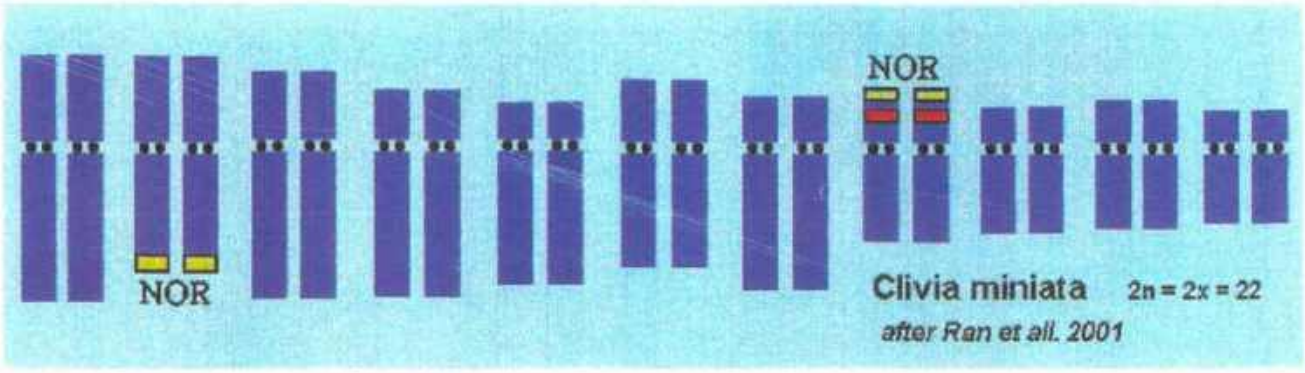

Figure 2. Genome of *Clivia miniata*

Materials and Methods

Berries from a cross between two Belgian hybrid type *Clivia miniata* plants were harvested when the color of the berries changed from green to orange/red.

The berries were dipped in 96% ethanol and flamed. This procedure was repeated and after that the seeds were removed from the berries under sterile conditions in an airflow cabinet.

The embryos were excised from the seeds and placed on a medium in 9*cm* petri dishes. The petri dishes were first filled with 15*ml* sterile MS- medium with 3% sucrose and solidified with agar (Murashige & Skoog, 1962). The petri dishes were supplemented with 2*ml* filter-sterilized colchicine. The total concentration of colchicine in the 17*ml* medium was calculated at 0,05%.

Each petri dish contained ten embryos and was placed in a culture room in the dark at 25°C.

After 66 hours the embryos were transplanted to test tubes with 15*ml* MS medium and placed in a culture room with fluorescent light (±2000 Lux) at 21°C.

Four months later the surviving plantlets were hardened under mist in the greenhouse.

Flow cytometer analysis (FCM) was performed on newly formed leaf parts.

Pollen grains were colored in a drop of aceto-carmine (Carmine in 45% acetic acid) and checked under 40x and 100x magnification.

Results

# embryos treated	#plants to greenhouse	# plants analyzed FCM	2n	2n<x<4n Chimera	4n	% embryos converted
78	55	37	24	11	2	16,7

Table 1. Number of embryos treated with colchicine and the results from this treatment

Figure 3. Pollen grains of normal diploid *Clivia miniata* hybrid (left) and plant 94001-27 at the same magnification (Pictures taken at 100x magnification).

94001 - 4 (2n) **94001 - 27 (Chimera 2n<x<4n)**

Figure 4. Two of the plants flowering grown from the colchicine treated embryos. The flower diameter in plant 94001-27 has increased by one third compared with the average flower diameter of the diploids from the same cross

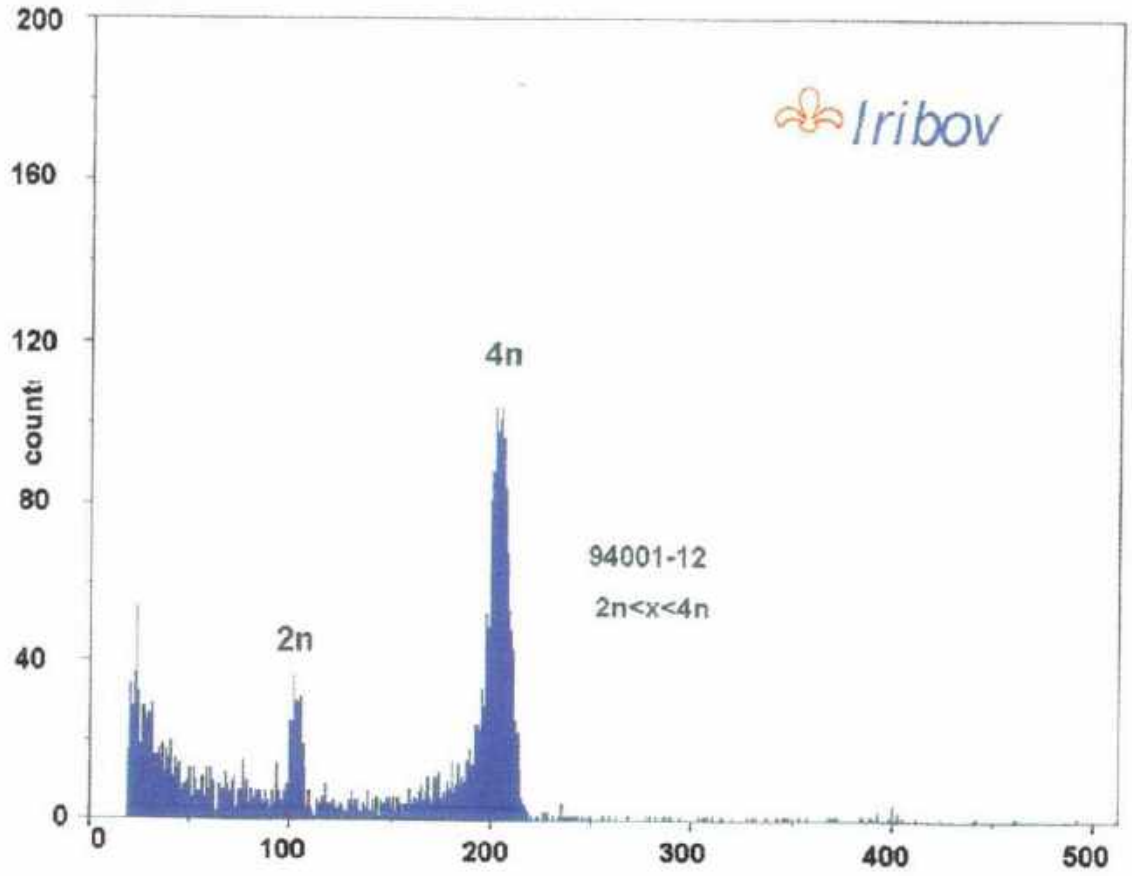

Figure 5. Flow Cytometer analysis *Clivia miniata* plant 94001-12 after colchicine treatment

Discussion

In general, the best procedure to raise the ploidy level in floriculture is to select several superior hybrids and treat a sufficient amount of individuals of each hybrid with the right chemical. After doubling the chromosome number you may have reached your goal and possess better hybrids or at least have good germplasm to start breeding on a higher ploidy level.

In *Clivia*, however, this procedure is very difficult to realize because of the slow propagation rate using divisions and the problems you will have to deal with in applying the chemical to the meristem of an adult plant, which is hidden deep in the heart of the plant.

Using embryos, seeds or young seedlings excludes a number of problems, but then you are not sure about the quality of the resulting polyploids, because your starting material is the result of a cross with unknown qualities. To have some influence on the result it is important to use good breeding parents that are both the result of crosses between parents that are genetically distant from each other. In this way you can make the best of a not ideal situation: you can start your polyploid breeding with material that can offer you a maximum of variation.

The method described to treat *Clivia* with colchicine is effective for several reasons. First exposing the naked embryo to colchicine *in vitro* gives a direct effect where it is needed. To work properly the colchicine has to reach fast dividing cells. Excised mature embryos will start to develop almost immediately after they are placed on the tissue culture medium and form a good source of quickly growing cells. There are two meristems in the young embryo: the shoot meristem and the root meristem. The shoot meristem is the one to be converted. If this meristem is made tetraploid in due time tetraploid new roots will be formed. If only the root meristem is changed to tetraploid, the plant that develops will still be diploid. Another benefit of *vitro* culture is that after the treatment the embryo can recover under ideal conditions and can even survive for example the situation where the root meristem is killed by colchicine.

To check if the colchicine treatment has been successful several methods can be used. The actual number of chromosomes can be counted in fast growing plant parts like root tips. The stomata size can be measured; the stomata are bigger at higher ploidy levels. The pollen size can be determined (*figure* 3). Another elegant method is flowcytometry, which estimates the nuclear DNA content of individual cells (Van Tuyl & Boon, 1997). Only a small piece of tissue is needed, so the ploidy level can be established at a very early stage of plant development.

The results show that two complete tetraploids were formed. One of them died in the greenhouse and the other one fell back to the diploid status. The chimaeric plants have a percentage of tetraploid cells; they are mixoploid (*figure* 5.). There is a possibility that some of those chimeras will become either diploid or tetraploid in the course of time. As diploid cells grow faster than tetraploid cells a diploid status will be favored. On the other hand, there are also stable forms of chimeras, for example the so-called glove type. The outer layer of the plant is of another ploidy level to the inner layer(s). If the layer from which the sex cells originate is tetraploid, the plant will breed as a true tetraploid. Which type the 11 chimaeric plants represent is not known. The first plant of this group that flowered in 2000 gave almost 100% large pollen grains (*figure* 3). Pollinating diploids gave three triploid plants (*vitro* culture). Selfing resulted in a tetraploid. In 2002 the same plant flowered for the second time. Crosses were made with other chimaeric plants to get complete tetraploids.

In 2001 crosses were made to determine if *vitro* culture is really needed for triploids in *Clivia*. The first crosses with plant 94001-27 gave a small number of well- developed seeds with almost normal looking endosperm. From these seeds, which were grown after chipping

in vitro, the first triploids were raised. A portion of the material from the 2002 crosses was chipped and placed *in vitro* and another portion of the seed was sown *in vivo*. The results are not clear yet because of the slow germination of the seeds *in vivo*.

What are the possibilities for polyploidy in *Clivia*? First the tetraploids. If we look at other floricultural crops we see that the number of tetraploids steadily grows after introduction (Brandham 1995). Seeds are the main source of commercial *Clivia miniata* propagation. Breeders are developing strains that show early flowering. For this purpose tetraploids are not well suited, because of their slow growing nature and low seed set. These characteristics can be improved, but this will take many generations of breeding. If superior tetraploid hybrids are produced, only division or tissue culture can be used for propagation. Propagation by division is a very slow process. Tissue culture in *Clivia* is difficult although there are several studies published (Min & Jinsheng,1984 ; Sato & Hasegawa, 1994 ; Finnie, 1998) Vico Yellow is the only hybrid propagated by tissue culture in larger quantities (Smithers, 1995). To increase the number of tetraploids more material can be made tetraploid, but another option is to cross tetraploids with hybrids that produce unreduced gametes. It is not known if there are many *Clivia* hybrids that produce unreduced gametes, but a survey revealed in any case one in my own small collection (*Figure* 6.).

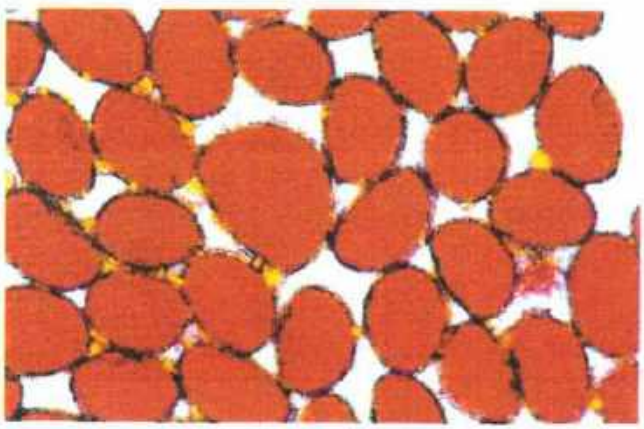

Figure 6. Pollen grains plant IK 01 with unreduced gamete.

Interspecific hybrids are another possible source for unreduced gametes (Ramanna, 1992).

In such interspecific hybrids unreduced gametes are in many cases the only functional gametes produced. In *Clivia*, interspecific hybrids can be produced by seed and are fertile. There are no records about the presence of unreduced gametes among their pollen grains.

When a tetraploid is crossed with a hybrid that produces unreduced gametes the normal reduced and the unreduced gametes can take part in the fertilization process resulting in triploid and tetraploid embryos. In most plant species endosperm formed after the fusion of n and 2n gametes is not functional or absent, so no viable seeds are formed. The fusion of two 2n gametes however may result in a normal seed. So if seeds are formed as a result of a cross between a tetraploid and a hybrid producing 2n gametes the resulting plants will be tetraploid. As stated before it looks as though *Clivia*, as an exception, produces viable triploid seeds and if this is the case, all the progeny of a 2n x (n+2n) cross will have to be checked for ploidy level. Triploid breeding however will be much easier if normal seeds are formed and embryo culture is not necessary.

Triploids cannot be multiplied by seeds so only divisions and tissue culture can be used for propagation. Triploids are in most plant species sterile, but sometimes a small percentage of good pollen is formed and often one or more extra chromosomes are present. Used on diploids these gametes can give rise to aneuploids. In a number of plant species aneuploids are valued hybrids like in Japanese Garden Iris (*Iris ensulata*; Yabuya *et al.*, 1992) *Hyacinthus* and *Freesia* (Van Scheepen, 1991) and *Kalanchoe* (Van Voorst & Arends, 1982).

At this moment it is too early to predict as bright a future for *Clivia* polyploids as we see in *Narcissus* (*Figure* 1). But if there are positive elements in *Clivia* polyploids, they will surely be exploited by many *Clivia* lovers all over the world. Here I may add that I am working on a

method for inducing polyploidy that can be applied in the home, rather than in a laboratory. I hope to have an article on the method ready for publication in the next Yearbook in 2004.

Who knows what the ploidy status of *Clivia* hybrids will be in a hundred years.....

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'Appleblossom' – the way forward

By Wayne Haselau

(2014 Conference Paper dedicated to John Winter)

Introduction

I am a professional fly fishing guide and spend most of my year travelling. My base is Morgan Bay in the Eastern Cape, South Africa. My home is close to numerous *Clivia nobilis* habitats as well as to the most southerly known locality of *Clivia miniata* on the Kei River. During the off-season I am able to focus on my other passion, *Clivia*. Over many years I have established a *Clivia* biodiversity collection. The success has been with the help of prominent fellow *Clivia* addicts such as Sean Chubb, Hein Grebe, Andrew Harding, Francois Van Rooyen, Val Thurston, Felicity Weedon, Attie Le Roux and the late Fred van Niekerk, to name a few. My nursery, "Wild Coast Clivias", specialises in pendulous habitat species. We also have many unusual and unique habitat *C. miniata* plants. Many of these *C. miniata* are select clones originating from the Transkei and acquired over time from other breeders and collectors. My other plants have been selected from habitat seed grown at our nursery in Morgan Bay. The nursery has a number of original

'Dwesa Yellow' habitat clone compatible with 'Appleblossom' and very hardy

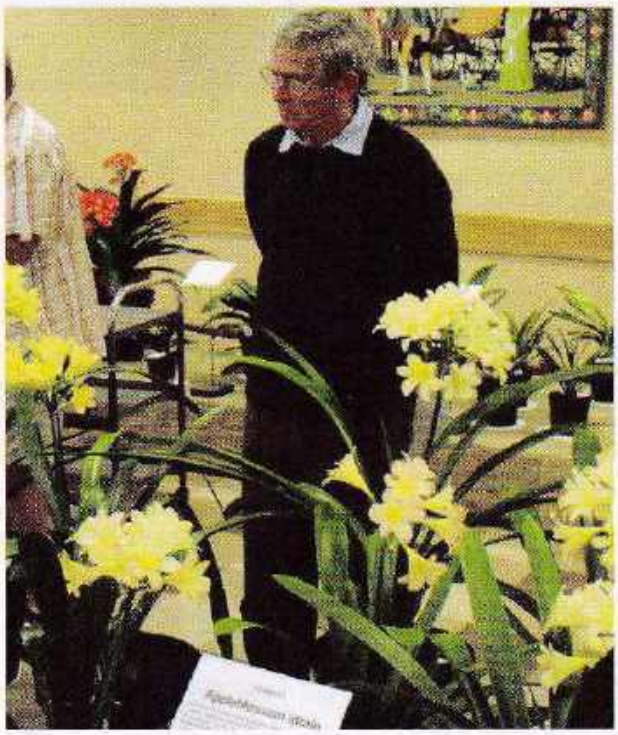
Clivia growing in forest on scree on river bank

'Appleblossom' clones or Q complex plants. We also have some "new" 'Appleblossom' clones which are now part of our breeding programme. There was a time when mystery surrounded the Q complex plants and for many years little was known about these sensational, sought-after plants. Record prices were paid by breeders for offsets of these rare plants in the late 1990s and early 2000s.

History

John Winter's discovery of the Q complex plants, consisting of eight wild-collected, uniquely coloured, blush habitat *C. miniata* clones from the Qhora River area in the southern Transkei in the mid-1990s, is now legendary. The discovery of these lovely and unusual clones created a sensation, especially when it was discovered that they bred true when crossed with each other. Ian Brown was the first to flower an 'Appleblossom' from seed and although of unknown parentage, he named this plant, 'Woodland Pink Blush'. John Winter collected these plants as part of the South African National Botanical Institute (SANBI) sanctioned programme to bring rare habitat clones back to Kirstenbosch. He did so very successfully over a period of many years,

Google Map of Qhora river mouth, Southern Transkei showing forest patches


John Winter at Cape Show with his 'Appleblossom'-strain plants

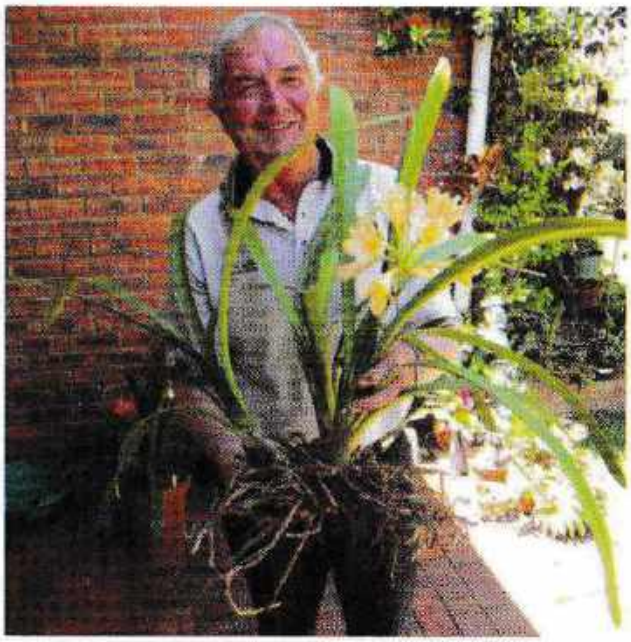
travelling extensively throughout South Africa, having visited many *Clivia* habitats. SANBI offered seed from these early 'Appleblossom' crosses and labelled them as 'Transkei Mutating Colony'.

On retirement John maintained a close connection with the Kirstenbosch Botanical Gardens, working extensively with his *Clivia*, which were housed in a special tunnel at the Gardens. It was here that he raised the first *C. mirabilis* in cultivation from seed. The resulting seedlings he distributed far and wide. Many of the seedlings were sent to overseas growers. I had the good fortune to spend quality time with him there, pottering around in his tunnel amongst a fabulous collection of habitat *Clivia* plants. He bred with his collection extensively and quite obviously his focus was on his collection of Q complexes and Q crosses. He was the first to breed hybrids with *C. mirabilis* and produced these crosses as well as the first *C. nimbicola* crosses. During these impromptu sessions in the tunnel we discussed the Q complex plants at length. Our discussions were very informative and I learned a great deal during the time we spent together. I have included a description of the eight known Q complex plants as I understand them.

The Q complex plants, a brief description:

Q1: A medium-sized plant with narrow leaves and an unusual fairly small flower, which is a white and yellow with a faint pink blush. A very distinctive clone that fades to almost white with age. It is difficult to establish in cultivation and does not like to be disturbed, however once


'Levundu' one year later



Peter Miles with garden clone 'Appleblossom' ex Levundu Forest

established it is a solid plant that forms offsets readily.

Q2: The famous mother of the Qs and the plant that inspired the name 'Appleblossom'. It has lovely flowers which remain slightly closed and blush deep pink as the flowers mature. It breeds true to type. Q2 fetches high prices, up to R15 000 has been paid for a mature plant! I purchased such a plant which did not flower true to type and I suspect that it may have been a selfed individual. John Winter had the plant and was trying to figure out where it originated from. He, however, became ill and no further progress on the origin of this plant took place. Q2 is an attractive large plant with narrow leaves. It is a fertile parent and breeds well with other 'Appleblossom' clones especially when crossed with Q4. Moderate formation of offsets occurs, unfortunately with a tendency to rot.

Q3 is a little known, underrated clone which is also quite rare. This clone breeds well and typically has a well-rounded umbel of perfect shape, open pink and white flowers. The flower count is generally higher than that of the rest of the group, often with 20 plus flowers in the head. It breeds well and has great potential for further breeding work. It is a fairly small compact plant.

Q4: Rare and the big daddy of the group. It

Q2 selfed

is a large plant with the large, open, superbly coloured flowers in pink and white. This clone has broader, heavier and tougher leaves but is very reluctant to make offsets. As a result it is still very rare in cultivation and is possibly the most valuable clone for breeding purposes. It is a slow grower and will also rot if not cultivated carefully. It is highly likely that it will self itself true to type.

Q5: Is a fabulous clone. It has full heads of lovely pink and white flowers. It is a medium-sized clone with great breeding potential. It is very similar to Q3, however the flowers are more textured and don't open fully. It is similar to Q3 although slightly larger. When viewed side by side, the differences between the flowers are obvious. This plant forms a moderate number of offsets.

Q6 is the largest plant of the group with large upright broader leaves and heads of fairly spidery yellow and white flowers suffused with pink. It is the most common 'Appleblossom' form in collections as it offsets well and as such is the Q plant most often used in breeding. John Winter selected out a plant from the original clump of plants collected in the wild which was infinitely superior to the standard plant. He

Q3 Sanbi Kirstenbosch. Photo: Ian Coates

called it Q6A and this is the plant he worked with extensively. It is a larger and more vigorous plant with better quality flowers. He believed it to be a self-pollinated or original plant from habitat that was growing within the original habitat clump.

Q7: Sadly most of the material in collections of this clone is possibly diseased, having a white viral pattern on the leaves. I was told that the original habitat plant was also infected with virus, however John was adamant that this was not so. It was possibly collected without any virus and became contaminated later in cultivation. It is the most yellow of the Q series plants and is a smaller compact plant. Q7 is valuable for future breeding programmes as it is yellowest of the Qs. Mr Masami Uno of Japan is a fanatical breeder of 'Appleblossom' and has a superb 'Appleblossom' plant he bred from Q7.

Q8: This is a very interesting clone according to Sean Chubb. The plant is a wild-collected clone, originating close to one of the original Qs as a wilding. It matured and flowered some years later at Kirstenbosch and was named 'Peach Glow' by John Winter. It is a peachy coloured 'Appleblossom' and is rare in cultivation. I have not had the privilege of seeing it in flower.

The above is a rough guide of the eight different Q habitat clones. Please be aware that unless you have an accurate, detailed providence you cannot be sure that the plant you have or want to purchase is in fact a true Q clone. The Q complex plants are all habitat plants. When acquiring Q complex material, do so from a reputable source. There are a number of new and undescribed habitat 'Appleblossom' clones. Of these undescribed clones little is known. Since 2005 "Wild Coast Clivias" has acquired a number of Q complex plants as well as a few of these newer clones and we use the prefix TB or 'Transkei Blush' when describing them. One of these named clones is 'Transkei (B) Grandslam', a superior form with a large full head of pink and white flowers that forms offsets readily. A number of offsets of this clone have been placed in heritage and biodiversity collections for safe-keeping. Some of its seedlings have matured and flowered and are very similar to the original clone.

Habitat and ecology

I am fortunate to have travelled to *Clivia* habitats throughout southern Africa. Most of my effort was simply to learn as much as possible about *Clivia* and their fascinating ecology. As a result of all the information I have gained during my many travels, I have decided to write a book on *Clivia* habitats. Many of the visits to habitat sites have been in the Transkei and as such I have learned a great deal about the regional *Clivia* distribution and ecology in

Qhora Estuary: note heavily forested valley and misty hills. Classic Southern Transkei *Clivia* habitat

this often remote and inhospitable region.

In the southern Transkei and the Eastern Cape, *Clivia* are sometimes found close to the the sea, often growing on coastal dunes just above the high water mark. The habitat from which the Qs originate is no exception, with many plants growing in the coastal forest close to the sea. The Eastern Cape coast is known for its strong winds and there is almost always wind blowing in these *Clivia* localities. As a result there is constant air movement in these habitats which ensures that water very seldom, if ever, lies on or around plants for any length of time. Wind movement and the presence of epiphytic lichens growing on the leaves of wild *Clivia* in many habitats help protect the plants from fungal pathogens. It is believed that these lichens produce anti-fungal chemicals and aid in the absorption of water. The coastal forest habitat provides a protected environment, especially with regards to proximity to water which helps buffer the changes in ambient temperature. The plants grow in scree (rocks) allowing further stabilisation of the growing environment. Rocks help to buffer temperature changes and hold moisture around the roots (i.e. rock mulching is a known landscaping and permaculture technique). Proximity to the sea and the estuaries moderates temperature and provides good humidity, keeping the associated *Clivia* cool, even during the hot summer months. *Clivia* in very heavy shade are often reluctant to flower, showing a fine line between too much and too little shade in the wild.

The narrowness of the river gorge and the heavily forested banks provide between 50% to 80% shade which varies only according to position and/or aspect and the season. In many colonies it is possible to see how positively *Clivia* plants respond to the increased light available when a large canopy tree such as a Wild plum (*Harpyphyllum caffrum*) falls over. The increased light often results in a mass show of flowers in the season following such an event. *Clivia* in this environment are found growing mainly on rock under the forest canopy. The locality from which the known 'Appleblossom' Q clones originate

'Qhora Lobster Orange' Appleblossom

and where the other newer clones were found is west facing. Plants here grow on rock and scree under a moderate to heavy forest canopy. Drainage is consequently very sharp (good) with *Clivia* plants rooted in leaf litter and Dassie dung. Dassie or Rock Hyrax are often closely associated with wild *Clivia* as they frequent the same steep rocky habitats and their droppings provide much needed nutrients for *Clivia*. Forest habitats are generally poor in nutrients and there is a great deal of competition among the various forest plant species for these essential and scarce resources. In this particular locality *Clivia* are in some instances rooted entirely in Dassie dung amongst the rocks. I mention this fact as when researching this area, the habitat was once described to me by an old Transkei trader as "Yes man, there were these white flowers growing there amongst the Dassie dung". We used to see the *Clivia* plants there when we went fishing.

When taking into account all these environmental factors, it follows that plants from this locality and similar localities in the Transkei

'Suzette Too', Appleblossom complex hybrid

and KwaZulu-Natal are particular about their growing conditions in cultivation. Every grower has his or her own particular recipe for success. I have found that the use of clay pots is a big help when attempting to grow these Q complex clones. Cutting longitudinal slots down the side and to the base of the pot further enhances the drainage potential. Using gravel chips and coarse bark as a major part of the potting medium ensures further good drainage. Plants from these localities enjoy a great deal of wind movement and stagnant air is not suitable for the growth of these plants. Providing good air movement in a greenhouse or shade house is essential. Growing the plants under 50% to 70% shade cloth is optimal. The deciduous nature of many coastal forest trees means that in winter when the hours of sunlight are limited, there is more light available to understory plants. The fallen leaves of such forest trees provide the much needed nutrients to understory plants as well as serving to mulch them. This helps to retain moisture and reduce heat loss. Bear this in mind when planning a winter regime in cultivation!

The plants

Why these wonderful wild clones occur specifically here in the Southern Transkei is not clear. The presence of two species, *Clivia nobilis* and *C. miniata*, together in this habitat is almost unique! In some places the two species are found literally growing side by side and although the two species have different flower shapes, one pendulous and the other open, they flower at the same time in spring. The two species have predominantly different pollinators, *C. nobilis* the sunbirds and *C. miniata* butterflies. There is a small black solitary bee that collects pollen on both species. It is this solitary bee which I have written about in the past that moves pollen freely between the two species and is extremely common in this locality. I believe cross-pollination in the wild has given rise to a hybrid-swarm with interbreeding producing some plants with obvious interspecific traits. It seems quite obvious that this free mixing of genes between the species has in some way had a role to play in creating this unique mutating colony. It is within this genetically diverse colony that the blush 'Appleblossom' plants occur. Scientists tell us that *Clivia nobilis* has a great deal more potential colour variation in its genes, because apparently the anthocyanin pathways in *C. nobilis* are far more varied and developed than in *C. miniata*. This is interesting as it means that by combining the genes of the two species there are better chances of colour mutations developing.

The 'Appleblossom' strain as it is now known, consists of eight known named clones, the so-called Qs numbering one to eight with each one of these plants being unique. What is however not common knowledge is that there are more wild or habitat blush clones from this immediate area.

Most of these other plants originate from wild collected seed and in some instances from offsets and wildlings from mature plants in the habitat. Over the years, local traders and fisherman visiting the area collected attractive or unusual plants to take home to their gardens. In fact, most of the recently discovered "new"

clones have been found in suburban and farm gardens in the Eastern Cape, as well as in the gardens of trading stores in the Transkei. Fortunately, we have the providence of these plants in most cases, as is the case with the now-famous 'Dwesa Yellow' *C. miniata* clones. Peter Miles is a passionate *Clivia* grower and breeder and recently he discovered a superb 'Appleblossom' clone in a garden in East London. We followed the providence of this special clone and it turns out that it was collected from a forest that no longer exists. The Levundu forest was part of the Qhora catchment, close to Willowvale in the Southern Transkei. Unfortunately, this forest has been destroyed and this *Clivia* is our last link with it.

Qhora river valley landscape – searching for Levundu forest!

Sean Chubb has questioned the fact that the '4 Marys' group of Blush clones is separate from 'Appleblossom' group of plants. I agree with his claim. They are morphologically very similar and DNA testing in the future may be able to throw some light on this mystery. Gordon McNeil purchased the collection of Gladys Blackbeard which originates from Grahamstown in the Eastern Cape. Gladys Blackbeard was a pioneer *Clivia* grower and started her collection in the 1940s and 1950s. Living in the Eastern Cape she would have had access to *Clivia* from many areas. The 'Appleblossom' locality on the Qhora river in southern Transkei is only a couple of hundred kilometres away from Grahamstown, as the crow flies. There is a famous hotel there called the Kob Inn which has been a popular holiday destination for a long time. I believe it is highly likely that there is a connection between these two groups, albeit it is only speculation at the present time. The spontaneous appearance of a blush *Clivia* almost identical in appearance to 'Appleblossom' in McNeil's collection seems just too much of a co-incidence. It has become clear that the 'Appleblossom' gene is a mutation, which although not presently fully understood, presents itself spontaneously amongst progeny of normal or orange flowered plants on occasion. To conclude, it is highly likely that the '4 Marys' clones are genetically compatible with the known 'Appleblossom' clones, as they may have the same origins and consequently the same genetic make-up. The Transkei has a wonderful and largely unexplored *Clivia* gene pool and the unique blush *Clivia miniata* clones of the 'Appleblossom' strain are no exception.

The future

The 'Appleblossom' complex presents a unique opportunity to current and future breeders. The blush genes of these wild clones are strong and constant, and although their breeding patterns are not currently fully understood, it is obvious from early results that this special group of plants will have a great influence on *Clivia* breeding in the future. Established breeding techniques such as line breeding could result in future 'Appleblossom' breeding programmes which produce sought after traits such as short, broad-leafed plants with large umbels of broad tepalled blush flowers. Personally, I enjoy larger well-formed plants and although the current trends are for more compact plants, I hope to improve on the wild forms by producing robust plants with both larger flowers and larger numbers of flowers in the umbel. Some of the problems associated with growing 'Appleblossom' plants is that

Select clone broad leaf full petal (Q2 x Q4)

they are slow-growing and may be inclined to rot. By breeding to improve on the hardiness and disease resistance of these plants and by incorporating traits such as leaf-variegation, rapid growth and good offset production, the future for this group is bright.

Conclusion

John Winter's 'Appleblossom' legacy will have a lasting influence on future *Clivia* breeding and the introduction of new clones into established breeding programmes can only bolster the currently available gene pool. It is essential that specimens of all original habitat clones are preserved in heritage and biodiversity collections for future generations and the 'Appleblossom' complex is no exception. It is important not to lose these valuable, original clones in uncontrolled and frenetic Q x Q x Q x Q breeding scenarios. While most of the current breeding programmes are of this type, more sophisticated techniques may be of benefit to future breeding programmes. If we are ever going to fully understand these plants and their breeding habits, it is of paramount importance to label plants correctly and to keep records of providence and stud books. Preserving the providence of this founding stock and keeping pure habitat *Clivia* clones as well as named clones resulting from breeding programmes will be vitally important to future breeders.

Finally, I think it is important that a group of specialist growers and/or breeders form a dedicated APPLEBLOSSOM WORKING GROUP to share knowledge and material. Such a group could facilitate easy co-operation internationally amongst serious breeders and help conserve these precious wild clones for further generations.

'Transkei (B) Grand Slam'

Book Recommendation

"Illustrated Terms and Definitions for describing Clivia"

Written by William McClelland, First Edition 2011

Published by and available from the North American Clivia Society

www.northamericancliviasociety.org

Table of Contents: -

- **Umbel Characteristics**
- **Flower Characteristics**
- **Tepal Characteristics**
- **Tepal Patterning**
- **Inflorescens Characteristics**
- **Leaf Characteristics**
- **Leaf Qualities**
- **Leaf Chlorophyll variations and**
- **Plant Characteristics.**

In his introduction of his book, William gives a very special thank you for their assistance to:

- **Dr Keith Hammett, New Zealand**
- **Dirk Lootens, USA**
- **Eddie Pang, Australia**
- **Alan Petravich, USA**
- **Shige Sasaki, Japan and**
- **John Winter, South Africa.**

All of these gentlemen are world renowned experts on the subject of Clivia.

I would encourage every Beginner to gain a copy of this Book as it describes in detail all aspects of the Clivia from the Umbel, flower, tepal, leaf and plant characteristics.

To obtain a copy please contact the North American Clivia Society via their website mentioned above.

Growing Clivias for Beginners

Breeding for Colour in *Clivia miniata*

Rudo Lötter, South Africa

Introduction

I am a horticulturist and plant breeder, more specifically a *Clivia* breeder – I am not a geneticist. I observe my plants and the results of my breeding and try to draw conclusions from them. In this I am assisted by the knowledge passed onto me by my father, Wessel Lötter, from the more than 30 years of work he has done on *Clivia*. I have written this article as a tribute to him, to build on what he has taught me, and specifically to elaborate on his article '*Clivia* mutations and colour variations' published in CLIVIA 1, back in 1999.

This article relates to *Clivia miniata* only. In what follows, the word '*Clivia*' is used throughout as short-hand for *Clivia miniata*. I begin by discussing the colour pigments in *Clivia*; firstly the primary colours, then the distribution of the pigments chlorophyll and carotene in the mesophyll - the inner layer of the petal. Next, I deal with the anthocyanin pigments that are found in the epidermis, or outer petal layer, and their colours, and the distribution and concentration of pigments in the cells that contain anthocyanin. Then I move on to dilute mutations, anthocyanin absence due to recessive mutations, a discussion of how secondary colours are formed, and the influence of pattern genes as they affect the distribution of colour in *Clivia* flowers. I conclude by speculating on some possible new colours that could be produced.

Colour pigments in *Clivia* flowers

There are basically four *primary* colours in a *Clivia* flower, namely red, yellow, green and white (Figure 1). These primary colours are the result of three pigments contained in the cells; anthocyanin (red), carotene (yellow) and chlorophyll (green). White, the fourth colour, is the result of cells that do not contain any of the above three pigments and which thus reflect white light to the eye. These primary colours, in combination, make up the *secondary* colours that are what we actually see in the *Clivia* flower.

Figure 1

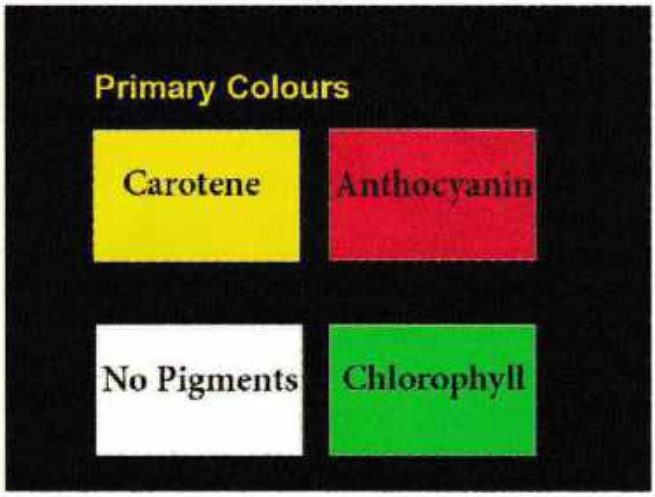
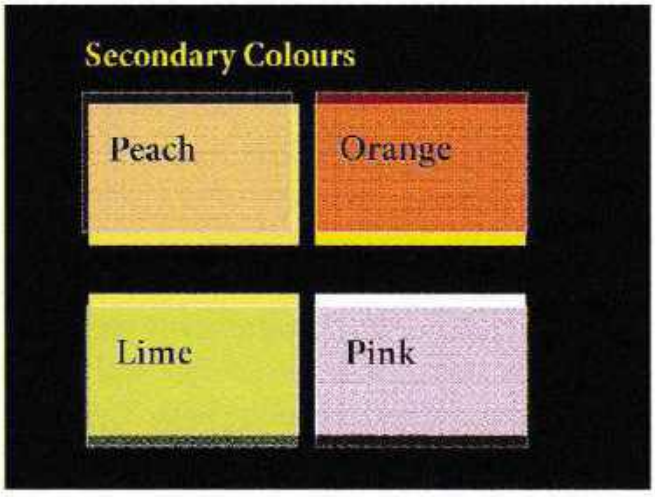


Figure 2



The pigments in the mesophyll

The mesophyll is the spongy inner layer of cells that underlies the epidermis. It contains the chlorophyll and carotene pigments in what almost looks like little grains of sand. The shade of green or yellow that we see may vary with the distribution of either of these

pigments. The more sparsely they are spread the lighter the shade will appear. For example, a sparse distribution of carotene will show up in the flower as a cream colour. Conversely, a denser distribution will cause the green or yellow to be more intense. Thus, more tightly packed carotene-containing cells will give a darker yellow colour. On the other hand, a lack of these pigments in these inner cells will show up as white or cause them to appear colourless. Because those in the epidermis overlay these inner colours I term them *background colours* (Figures 3, 4).

Figure 3

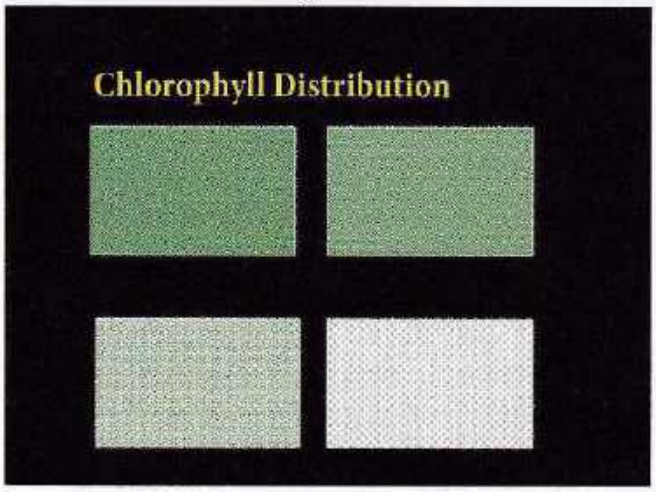
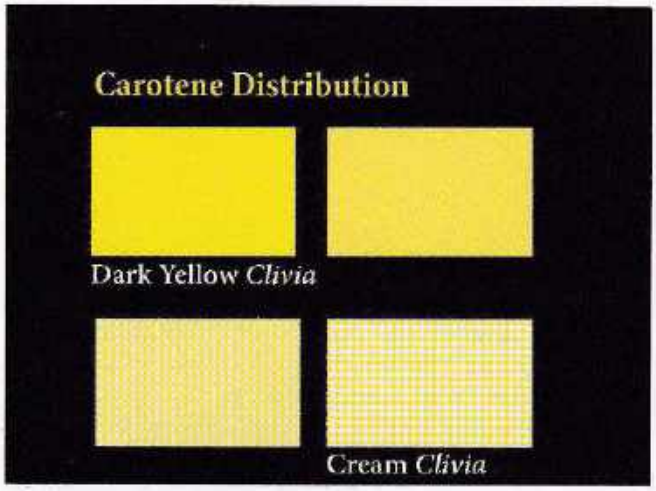


Figure 4



Through selective breeding it is possible to select plants with no chlorophyll and no carotene in the underlying mesophyll. Now if, in addition, there were no anthocyanin in the epidermis, the flower would appear to us as white. It is, as we know, not a difficult task to get rid of the anthocyanin within two generations by crossing our selected plant with a suitable yellow. I understand that white *Clivia* have already been bred in China. Of course, in any normal *Clivia*, there will always be a little of both pigments, usually more carotene than chlorophyll, but in rare cases the reverse may apply. Then, if there is no anthocyanin present, the otherwise yellow flowers will appear distinctly lime coloured. On the other hand, if anthocyanin is present, and in good quantity, the overlay of red pigment in the epidermis, over the predominant green in the mesophyll, will result in flowers that appear bronze or even brown.

Photo: Courtesy Rudo Lötter

The cream and green colours of 'Charl's Green'

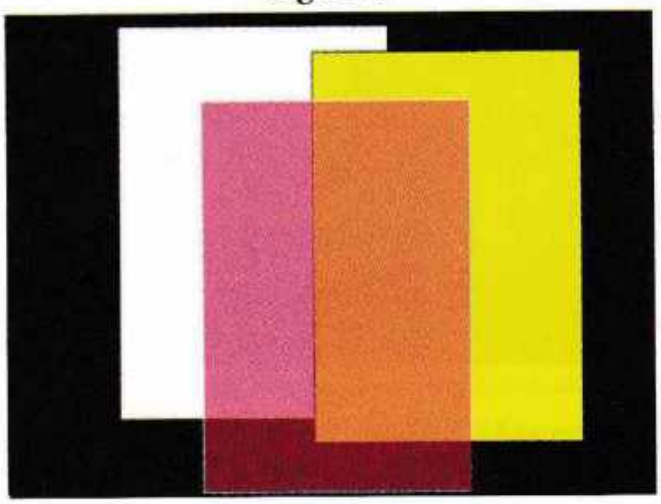
A yellow and green *miniata* of Rudo Lötter

Photo: Courtesy Rudo Lötter

The pigment in the epidermis

The layers of the tepal on either side of the mesophyll are thin and are made up of large cells containing only one pigment, anthocyanin. Anthocyanin gives the last of the primary colours in the *Clivia* flower - red. However, we do not see the flower as red. Rather, our view of the flower is similar to that obtained by placing a red-tinted transparency over an underlying piece of paper, coloured green, yellow or white, as described in Figure 5. An orange *Clivia* flower appears orange to us because of the overlay of red pigment over a yellow background.

Figure 5



Anthocyanins are water-soluble and are distributed through the cell sap. The distribution of these coloured cells will create lighter and darker shades of red and what we see will thus vary in colour and intensity. Figure 5 illustrates this point. The denser the distribution, the darker the shade of red; sparser distributions of anthocyanin-containing cells result in pastel, peach and pink colours.

The concentration of the coloured cells can be so reduced that it is theoretically possible – and I am certain that such plants do exist – for the flowers to appear peach, and also yellow. It will be impossible to tell these peaches and yellows apart from those that are mutations, and breeding with such plants will be interesting.

Photo: Courtesy Rudo Lötter

'Elroy' with its low anthocyanin concentration

If a *Clivia* with a low anthocyanin concentration is cross-pollinated with a *Clivia* with a higher concentration, the result will be a flower with an intermediate concentration. This is termed 'intermediate inheritance'. It is important, however, to remember that

Photo: Claude Felbert

This bloom shows colour from mid-orange to pastel orange, as well as peach and pink near the edges. Near-white can also be seen.

in a recessive yellow *Clivia* mutation the concentration of anthocyanin-coloured cells is still present, even though the colour is not expressed. If such a yellow is crossed with a pastel the result could be flowers that are orange, rather than a colour intermediate between the colours of the two parents. It would thus be preferable to cross a plant with *C. miniata* 'Appleblossom'-like colours with another of similar colouration, in order to develop a line of plants with colours like those of the parents.

Photo: Courtesy Rudo Lötter

Clivia miniata 'Appleblossom'

Some rare colours

Let us first move to the other end of the anthocyanin spectrum. Very dark red or true red *Clivia* are extremely rare. It is in fact almost impossible to obtain red *Clivia* through selective breeding. The ones that do exist are more likely to be the result of an anthocyanin mutation.

Photo: Claude Felbert

A true red

Another rare colour in *Clivia* is true apricot, which is different from a pastel arising from a sparser distribution of cells containing the normal red anthocyanin. Breeding results suggest that apricot arises from a recessive mutation that changes the colour of the anthocyanin to orange. In order to establish that the anthocyanin in such a flower is indeed orange you would have to peel the epidermis off a petal and lay it on a piece of white paper. If that thin outer layer of petal remained orange when viewed over the white paper then you would know that you were dealing with a very special plant!

True pink flowers exist but are also extremely rare. Furthermore, it is difficult to distinguish pink from pastel or peach because the pink in the epidermis overlays the carotene in the inner tepal layer, to produce a flower that looks pastel or peach. The pink can only show up properly if there are in fact no yellow pigments in the underlying mesophyll.

At this stage let me summarize - there are three possible causes of unusual colours:

1. Those due to changes in the way normally coloured pigments are distributed;
2. Those due to mutations in pigments; e.g. red anthocyanin to orange or very dark red; and
3. Those involving a combination of the above two causes.

Dilute mutations

These may involve mutations that cause partial blocking in the pathway for the production of anthocyanin, whereby the end result is not the normal red pigment but a diluted version, because only a little anthocyanin is produced. We see this for

example in the Chubb and Tipperary peaches. In both cases these are recessive mutations, though each arises at a different stage in the anthocyanin production pathway.

These dilute mutations are recessive to the normal orange colour, but Chubb peaches generally breed intermediate shades when crossed with Group 1 yellows. One of their characteristics is that they open almost yellow and then flush with colour from the dilute anthocyanin as the flowers mature.

Breeding with *Clivia* where the anthocyanin colour has been altered can initially be difficult. Because it is a mutation, the inheritance of the mutation first needs to be determined. Is it dominant over, or recessive to, the normal orange colour? What colour will arise when a plant is self-pollinated, or when it is crossed with a Group 1 or 2 yellow?

In the case of the lighter colours, the mutation could be recessive but almost impossible to distinguish from other known mutations. Anthocyanin, which is so dilute that it appears colourless, will always result in a yellow *Clivia* that looks like any other yellow *Clivia*.

Anthocyanin absence

We now know that a yellow *Clivia* may be the result of no coloured cells in the tepals; the cells may be present but the anthocyanin in them is colourless, or the anthocyanin is so diluted that the flower appears to be yellow.

A fourth type of yellow is obtained when there is a mutation in the anthocyanin pathway that completely blocks the production of red pigment. There are many positions in the pathway where such a blocking mutation could occur. For example, Group 1 yellows have a block at a different position from that giving rise to the Group 2 yellows. These two mutations are not compatible. If a yellow *Clivia* with a mutation on position A is crossed with one with a mutation on position B, all the offspring will be normal orange *Clivia*. The reason for this is that the one mutation corrects the 'mistake' in the other one. Since each mutation is recessive, the orange offspring will be split for both yellow groups.

Both Group 1 and Group 2 yellows are true-breeding *provided* they are crossed with other yellows *within* their group. Group 2 yellows can sometimes be identified by the red spots on the tepals and berries. There is also a yellow mutation with red berries.

How secondary colours are formed

We can now add all the pigment colours together to see how the different colours in *Clivia* are obtained. If there is a yellow (carotene) background under a red (anthocyanin) overlay, the flower colour is seen as orange. If there is a white or very pale yellow background colour beneath the red outer layer, the colour of the flower will appear dark orange or red. In pink, peach and pastel *Clivia* the chlorophyll and carotene are reduced and the anthocyanin is also less intense. To create a bronze, much more chlorophyll is needed in the background and more anthocyanin is needed in the overlay.

Pattern genes

Some of the most interesting *Clivia* to me are picotees, and those with bi-coloured or bleached flowers. Pattern genes are those genes responsible for the distribution of anthocyanin to certain parts of the petal but not to others. In normal *Clivia* anthocyanin is distributed to about one half of each petal, giving the impression of a yellow throat, the shade of which depends on the carotene content of the inner petal layer. In extreme cases the throat

can be enlarged. The 'Ramona' and 'Bull's Eye' *Clivia* are nice examples of flowers with a large yellow centre. It seems that flowers like this can only be obtained through selective breeding.

The distribution of colour in the tepals can also be affected by mutations in the pattern genes. Some cause normal anthocyanin to be distributed to only the very edge of the tepals. Such flowers are called picotees. Another mutation affecting the distribution of anthocyanin gives rise to bi-coloured flowers.

Anthocyanin is normally broken down as a flower ages, but bleached flowers are curious because they open normally and then start to bleach away more quickly than usual as the flower matures. The anthocyanin seems unstable and thus fades faster in certain parts of the flower.

Conclusion

In conclusion, there are five ways in which nature can produce yellow *Clivia* by altering the anthocyanin in the flower:

1. There can be so few cells containing anthocyanin that the flower appears yellow.
2. The anthocyanin may be colourless.
3. The anthocyanin may be so dilute that it appears colourless.
4. There are recessive mutations that cause anthocyanin not to be produced or to be produced erratically.
5. Finally, there are yellows that are the result of mutated pattern genes, so that anthocyanin is not distributed to where it is supposed to be.

It is important for the breeder to understand not only how colour in *Clivia* flowers is produced and distributed, but also which variations are mutations and which can only be obtained through selective breeding. Compatibility, and how the different colours and forms inherit, are of crucial importance in creating new cultivars.

More mutations in the anthocyanin pathway can open the door to a larger spectrum of colours. A mutation causing blue anthocyanin is a real possibility. Even with blue anthocyanin in the outer petal layer, a blue *Clivia* will be hard – but not impossible – to breed because of the green chlorophyll and yellow carotene in the inner petal layer. Certainly, if we can add blue to the spectrum, some new *Clivia* colours will emerge.

(Blue anthocyanin – pelargonidin – was detected in the flowers of Nakamura Crimson, a dark red miniata, as described by Keith Hammett in his article "Pigment Surprise" in CLIVIA 8. Eds.)

Photo: Claude Felbert

An orange *Clivia* flecked with white, belonging to Ian Brown, shows where anthocyanin and carotene are present in sufficient quantity, you will see orange but where absent you see white.

striving to produce more uniform and stable plants. In the absence of having one of these plants, what does one do to start the long journey for breeding a "super" polytepal type with limited resources of *Clivia* plants like polytepal, polytepal with keeled tepals, six tepal flowers but with keeled tepals or one with stamen petaloids? Once it was thought that plants with keeled tepals might hold a key to the development of petaloids but with limited history available it would appear that the two might be unrelated.

We have pondered on how to breed "super" polytepal *Clivia* plants and have embarked on a long journey of crossing a *Clivia* plant with stamen petaloids with a polytepal *Clivia* plant. A big assumption in our plan of action is that the stamen petaloid trait is recessive to the polytepal trait so the progeny of the initial cross would be backcrossed over the *Clivia* plant with stamen petaloids. From this new population we intend to discard plants that do not show polytepal and petaloid traits, to self the remainder and to continue a program involving backcrossing and selfing. Like all plans one must be prepared to modify it if it is not delivering on expectations. Different strategies would be adopted if it is found that the two traits are co-dominant or the polytepal trait is recessive to the petaloid trait.

And as for the finished product, that may well be many CLIVIA Yearbooks away! In the interim, enjoy your polytepals!

All Photographs are courtesy of John Craigie unless otherwize stated. (Eds.)

Photo: Claude felbert

A Nakamura Polytepal - Grower Ian Brown

Breeding for Polytepalous Clivia

John Craigie, Australia

Polytepal *Clivia* are both fascinating and challenging. They all vary because this trait exhibits the indicia of being recessive irregular inheritance. My first polytepal seed purchase was from the master breeder, Mr Yoshi Nakamura, and these plants have produced some of the best polytepal flowers.

Knowledge about polytepals appears to be limited. It is only through discussions with others and the limited number of years invested in breeding for polytepals that I am now starting to get a better understanding about them and about breeding with them. This article is not scientifically based and provides a general introduction into breeding polytepals. For further information on polytepal breeding see the article by Shigetaka Sasaki of Japan in CLIVIA 6.

The polytepal trait is recessive, variable and unstable

The science of plant breeding tells us that plants that have been self-pollinated and selected for type for many generations become homozygous at almost all gene loci and produce a uniform population of true breeding progeny. However, what happens if one crosses one homozygous plant with another? The scientists tell us that a cross between two different homozygous plants produces a uniform population of plants that may be heterozygous for many gene loci. However, a cross of two plants each heterozygous at a number of gene loci will produce a population of plants that differ genetically and will not be uniform. And so the cycle goes on!

Polytepal *Clivia* are not homozygous. From discussions with a number of enthusiasts, it would appear that the gene or genes responsible for the polytepal trait seem(s) to be very weak. The trait's variable expression and irregular inheritance suggests that it may take several generations to achieve higher levels of stability. However, for the reasons outlined above I doubt that homozygous polytepal *Clivia* plants may be achieved, at least within my lifetime.

The irregular inheritance suggests that the gene or combination of genes responsible for the polytepal trait is recessive to six tepal flowers. An added complication is that there appears to be a significant lack of uniformity in its expression (polytepal *Clivia* can have flowers on the same scape with four, six, seven, eight, ten, twelve and even fourteen tepals). It is highly probable that there may be multiple gene mutations in polytepal *Clivia* that exhibit a high lack of uniformity in tepal expression.

In the pursuit of creating a good red wine, there are good and bad grapes (genetics, climate, soil types, vinyard practices, etc. play a role), good and bad winemakers and some good old fashion luck. So it is with breeding polytepal *Clivia*. Firstly, one has to identify whether the *Clivia* plant in question actually has the polytepal trait. Climatic and other conditions under which a plant is grown may mask the expression of this trait. Secondly, it is important to have some understanding of the genetic history of the plants being used in a breeding program in order to have some feel about the extent to which the polytepal trait may be expressed in subsequent generations. Just because the plant is polytepal do not assume that it will produce many polytepal offspring. Thirdly, one needs to identify the objectives of a breeding program. Once this has been identified

it is then possible to make plant selections and to develop a plan to breed offspring, for example, with higher levels of uniformity in expression. For that example objective, one would select polytepal *Clivia* with more uniform expression and a history of producing higher percentages of polytepal offspring in preference to those that exhibited extreme variability of expression or low percentages of polytepal inheritance. If the objective is to produce monster polytepal umbels then the selection process would include at least one monster polytepal *Clivia* irrespective of the level of variability in its trait expression.

Mistakes can occur each time plant cells divide and these mistakes are called mutations. These mutations may result in a change in the expression domains of the structural genes. We know that the polytepal trait is recessive and because of the significant lack of uniformity in its expression (polytepal plants can have flowers on the same scape with four, six, seven, eight, ten, twelve and even fourteen tepals), it is highly probably that it is the result of a mutation.

The gene or genes responsible for the trait seem to be very weak and its variable expression and irregular inheritance suggests that it may take several generations to achieve higher levels of stability. Knowing the genetic background of polytepal plants is a crucial first step to understanding the extent to which they may produce offspring with higher levels of uniformity in expression. Just because the plant is polytepal do not assume that it will produce many polytepal offspring

Identifying a polytepal

Clivia that have fasciated (double) flowers that are usually fused at the base of the pedicles are *not* polytepal. Sometimes polytepals just occur and these may be called "spontaneous" polytepals. In the first year of flowering there may be one or two polytepal flowers but in subsequent years the number of polytepal flowers may increase in some plants. In others, the number of polytepal flowers remains the same from year to year - one to two. An umbel that has only one or two polytepal flowers may not be genetically polytepal. Look at where they are positioned in the umbel. If these polytepal flowers appear in the centre of umbel and the other flowers only have 6 tepals then it is highly probable it is not a true polytepal. Further flowering may prove otherwise if more than two florets are polytepal.

Fasciated (Double Florets)

Non-Polytepal

If the *Clivia* plant is not a true polytepal then the polytepal flowers are not expected to have any different genetic information

True Polytepal

than the 6-tepal flowers so there is little point in using pollen from them in a breeding program. With a true polytepal each of the flowers including 6-tepal ones carry the same polytepal genetic information.

Polytepals only show their full potential when they are vigorous, mature plants. The trait expression is influenced by environmental conditions. For example, with plants grown under stress, there is a decline in the degree of the polytepal observance. Also, plants flowering for the first time may show no or limited polytepal expression, so do not discard them. Expression of the trait improves with successive flowering and maturity.

Often the polytepal trait is associated with strong green throats. Green throats are due to the presence of chlorophyll and this is present in the plastids within the cytoplasm of the plant cells. This would suggest that many of the early polytepals may have come from maternal parents with green throats. The gene or genes responsible for the polytepal trait does not appear to be linked to the genes that influence the other colours observed in flowers. There are a lot of true polytepals that do not have green throats. However, there may be a link between green throats and the ability to produce stable (normal) flowers.

It was thought that there was a link between yellow and peach polytepal material and narrow leaves but some breeders like Shigetaka Sasaki have short and broad leaf polytepal types.

Polytepal Hopeful

Green Centre

Non-Green Centre

It would be beneficial if polytepals have the same number of tepals and stamens in each flower. However, as the trait is unstable it is possible for flowers to contain additional layers of tepals although they retain their normal number of 6 stamens and a 3-lobed stigma. Other variations are also possible. Often polytepal flowers may have more than 3-lobed stigmas (for example, flowers with 8 tepals will often have 4 stigma lobes). Stigma lobes are a reflection of the general overall ratio of floral parts. They are fairly closely linked but their importance should not be overemphasized. Sometimes the style is spiral shape. Also a plant may exhibit a combination of polytepals and a modification of some of the stamens into petaloids.

Importantly, if the umbel has a majority of eight, ten, twelve, etc. tepals in the flowers then this would be a true polytepal and, as previously mentioned, any of the flowers (six, eight, ten, twelve, etc. tepals) could be used to breed for polytepals, either as the maternal or pollen parent.

Genetics of polytepal *Clivia*

I cannot emphasize enough the importance of knowing the genetic background of the polytepal *Clivia* to be used in a breeding program. Just because a *Clivia* plant has a polytepal umbel one should not expect it to produce 100% polytepal offspring. The expression of the trait is recessive and variable. Knowing the genetic history of polytepal *Clivia* may assist in predicting whether they may produce 30, 50 or some higher percentage of polytepal inheritance. A polytepal *Clivia* plant that has a genetic background of polytepal x polytepal may be preferred to one that has polytepal x non polytepal if one is, for example, seeking to produce higher levels of inheritance of the trait. Whilst further generational improvement may enhance the inheritance of the expression, this is not guaranteed. This has also been found to be the case with polytepal expression in some other ornamental plants.

Beyond polytepal *Clivia*, there have been many success stories in breeding doubled-flowers in other ornamental plants. Shigetaka Sasaki of Japan in CLIVIA 6 referred to results of breeding doubled-flower *Hippeastrum* cultivars by Nobuyuki Katsuyama. Other information on breeding doubled-flower *Hippeastrum* can be found on the internet, for example, "Trends in Modern *Hippeastrum* Hybridizing" by Charles Hardman. These and other articles suggest that crossing a doubled-flower with a single flower *Hippeastrum* would produce no or a very low percentage of doubled-flower F1 progeny, but crossing two doubled-flower *Hippeastrum* may produce up to 50% of the resultant seedlings that would have some doubled-flowers. Also crossing the F1 non doubled-flower progeny may produce higher levels of doubled-flower *Hippeastrum*.

Whilst one should be cautious about applying genetic results for one plant type to another, even though in this case they both belong to the *Amaryllidaceae* family, the work done with doubled-flower *Hippeastrum* provides some useful insights. From our own experiences, crossed or selfed polytepal *Clivia* grown from seed that we acquired produced less than 50% polytepal. No doubt the genetic background, if known, would have helped explain this outcome.

It would be beneficial if polytepals have the same number of tepals and stamens in each flower. However, as the trait is unstable it is possible for flowers to contain additional layers of tepals although they retain their normal number of 6 stamens and a 3-lobed stigma.

Other variations are also possible. Often polytepal flowers may have more than 3-lobed stigmas (for example, flowers with 8 tepals will often have 4 stigma points). Stigma points are a reflection of the general overall ratio of floral parts. They are fairly closely linked but their importance should not be overemphasized. Sometimes the style is spiral shape. Also a plant may exhibit a combination of polytepals and a modification of some of the stamens into petaloids.

Objectives of a Breeding Programme

The objective of a breeding program may be as simple as breeding for uniformity or as complex as breeding the hottest polytepal *Clivia* plant ever conceived. You know the one, it includes the following traits:

- Longitudinal and non longitudinal variegated foliage;
- Short but ultra broad leaves;
- Leaves that grow completely in a plane with the previous leaf to create a perfect fan shape with leaf tips that gradually arch to a rounded apex;
- A soccer ball umbel with 40 plus flowers;
- Flowers with layers upon layers of very broad "blue" particoloured tepals!

Unfortunately, the more desirable traits one includes in a breeding program, the lower is the probability of achieving the combined outcome.

To breed for uniformity, it is recommended to select polytepal parents that have the greatest percentage of uniform flowers and crossbreeding with them. Such breeding may lead to polytepals with greater stability and beauty, for example by crossing between the F1 generation, F2 generation, etc. or between the parents and subsequent generations. If only one polytepal *Clivia* plant meets your criteria then self pollination may be a better strategy than crossing it over another polytepal that is less than desirable.

In my opinion umbels which have a

Polytepal

mixture of eight, ten, twelve, etc. tepal flowers are less preferred than ones that have uniform polytepal expression. But which tepal version is preferred? Connie and James Abel have suggested that the aim should be to breed *Clivia* with well-rounded 8-tepal flowers. I agree that an umbel of uniform flowers of eight tepals, eight stamens and a 3-lobed stigma would provide an impressive display.

Polytepal *Clivia* now come with yellow, pastel and peach flowers. A lot of patience is required to breed new polytepal colours if using orange flowering polytepals as the foundation. Pollinating an orange flowering polytepal with pollen from a yellow flowering *Clivia* plant is expected to produce no or little progeny (F1) with the observed polytepal trait. If you want to create good quality polytepals from these F1 progeny use only the best F1 plants. Intercrossing these F1s may produce some

Pastel Polytepal

Count the tepals in the Polytepal Bud

A Cream Polytepal

percentage less than 25% with an observed polytepal trait. Crossing the best F2 progeny should improve the number of offspring that have the polytepal trait and with some good luck some of the polytepal progeny may have yellow flowers.

"Super" polytepal *Clivia* also exist. In these

Yellow Polytepal

plants the flower appears to be a combination of polytepals and a modification of some of the many stamens into petaloids creating some very

Photo: Courtesy Shigetaka Sasaki

A Nakamura Polytepal

full polytepal flowers. So then how does one go about breeding for a "super" polytepal type? Most of us may never get access to *Clivia* that exhibit a combination of polytepals and petaloids. Those that have them are probably well-advanced in

Breeding Green Flowers

W. Morris, Australia

Shigetaka Sasaki in his CLIVIA 7 article "New developments in clivia breeding in Japan" refers to the breeding of green flowers. The article below is a simple "how to do it" guide, using plant material that is reasonably easily available.

(Eds.)

In the past decade there have been illustrations of green *C. miniata* flowers in the Clivia Society Yearbook and on the internet, most of which have been bred in Japan. I suggest the following method to obtain them, other than by chance.

Photo: Shigetaka Sasaki

C. miniata 'Hirao' as seen on the back cover of YB 7

We have all seen *C. miniata* flowers with green throats. Red, orange or yellow cultivars sometimes have green throats which at times are quite deep green. What is needed is to get the green colour throughout the whole flower. The only flower that I have seen that is decidedly greenish throughout is *Clivia* 'Natal Yellow' which opens a definite greenish yellow. However, this green tint fades in a few days and the flower becomes simply yellow. What is required is to keep that green tint over the whole flower and not just in the throat, and to intensify it. The easiest way to do this is to cross it with a plant which *already* has green throughout the flower, and then to select from the offspring.

Photo: Ken Smith

A 'Natal Yellow', Grower Fred van Niekerk

I suggest the following two successive crosses as suitable. *Clivia* 'Natal Yellow' is one parent; the other is a strongly green-throated flower, such as a bronze flower e.g. *Clivia* 'Bertie's Bronze'. Bronze flowers are a bronze or brownish orange because the normal orange or red pigment in the external layer (epidermis) of the flower is underlain by green chlorophyll in the deeper tissues. Breeding for deeper and deeper brownish flowers is really only breeding for more and more chlorophyll in the deeper

Photo: Claude Felbert

A dark bronze green throat

CLIVIAS FOR ALL SEASONS

Can interspecifics flower throughout 12 months of the year?

Helen Marriott (Australia)

From time to time I see reference to claims that *Clivia* bloom for their Australian owners over eight months of the year. However, as my own collection of *Clivia* – including interspecifics – grew, I had the impression that here in Melbourne, Australia, interspecifics, in conjunction with the other pendulous species (or intraspecific hybrids) available up to date (*C. caulescens*, *C. gardenii*, *C. nobilis* or *C. robusta*), resulted in flowers (or buds) throughout the full year. It was also my impression that the Australian forms of *C.* x *crytanthiflora* in my garden flower during any of the four seasons, though slightly less so during spring.

Like other growers of *Clivia*, I am of course delighted to be able to enjoy *Clivia* flowers or their buds, and frequently also berries, over many months of the year, but I became curious to understand a little of the patterns behind this flowering. I thus started to keep simple records of the months when interspecifics were in flower, commencing in December 2008 and continuing until the present (mid-November 2010).

My observations are from a hobbyist perspective, recording the flowering times of the interspecifics which I happen to be growing and where I have some knowledge of the plants' apparent background. I thus have not counted those plants just labelled as "interspecifics" or where they emerged from general "breeding mixes" or else where they are named cultivars for which I have no definite parentage background. My main interest was to identify the months when the interspecifics were in flower, and more particularly, to identify the parents involved in these flowering patterns.

To date, my own collection of interspecifics is primarily based on combinations of *C. miniata* with three pendulous species – *C. caulescens*, *C. gardenii*, *C. nobilis* – with very few combinations with *C. robusta*, and, of course, some *C.* x *crytanthiflora*. I will employ the term primary interspecific hybrid for the first generation hybrids between different *Clivia* species, and am still searching for an appropriate term or terms to describe subsequent combinations.

Despite what I felt were fairly simple and worthwhile aims, when I came to do the analysis, the more I studied my records, the more problems I found with them. I was dealing with an unspecified number of plants, with unequal numbers in any of the varying combinations.

Also, I had not, for instance, differentiated between first and second flowers from the same rhizome in any one year, nor did I distinguish between flowers on the main rhizome in a pot, or offsets which flowered in the same pot. Quite a few flowers were counted twice, if they flowered in one month but continued flowering into the next, as was often the case.

Of most concern was the fact that I had insufficient knowledge about the backgrounds of some of the interspecifics. For instance, though a plant may have been grown from Nakamura seed which was labelled as *C. miniata* x *C. caulescens*, sometimes I was unsure if this is a primary interspecific hybrid or if the latter had been selfed or crossed back to *C. miniata*, since Nakamura produced all three kinds of interspecific hybrids. I wanted to include 'Moonchild' in the analysis, but because I am doubtful about it being a primary interspecific of *C. miniata* x *C. gardenii*, I have omitted it from the analysis, though obviously have been more lax with other cases where ignorance reigns.

Because of all of these problems, at times I felt like abandoning any effort to analyse the

results, but given the time put into the exercise to date, have proceeded anyway. A more rigorous observational study can be undertaken by others in the future.

I attempted to produce a chart which separated the primary interspecifics hybrids from other kinds of interspecifics. The primary interspecific hybrids were categorized according to the following simple patterns:

(a) (*C. miniata* x *C. nobilis*) or (*C. nobilis* x *C. miniata*) or C. x *cyrtanthiflora*;

(b) (*C. miniata* x *C. gardenii*) or (*C. gardenii* x *C. miniata*); and,

(c) (*C. miniata* x *C. caulescens*) or (*C. caulescens* x *C. miniata*).

Since I also have a number of interspecifics where a primary interspecific has been crossed again to *C. miniata*, in the main, and only very occasionally to another pendulous species, I analysed a further group which I have loosely labelled as "other interspecifics, for want of a better term.

Koopowitz (2002), followed by Duncan (2008), employ the term "advanced interspecific hybrids", but I have heard that such a label may apply more to orchids than to *Clivia*, so I remain unsure of a suitable alternative. As with the primary interspecific hybrids, three subcategories were created, such as (*C. miniata* x *C. caulescens*) or (*C. caulescens* x *C. miniata*) which are crossed again to *C. miniata* (in nearly all cases).

The table that I produced, not surprisingly, shows fairly small numbers in some of the monthly cells, so I shall only descriptively summarize some of the main or interesting findings:

1. Of the 193 instances of flowering recorded (remember that this is over a two-year period and includes repeat flowering, multiple flowers in the same pot or divisions), 54% of this flowering occurred during winter, with July and August being the main months.
2. Spring was the next season to produce the highest number of interspecifics, with 20% of the flowers occurring at this time, the majority of which flowered in September.
3. Summer and autumn together produced just under one-half the number of the winter flowers, slightly over 13% and 13% respectively.
4. A month by month sub-total shows substantial monthly variation. The month with the highest to the lowest number of interspecific flowers was as follows: August (50), July (40), September (25), June (14), December (13), January, March and May (9 each), October (8), April (7), November (5) and February (4) instances.
5. Primary interspecifics involving *C. miniata* and *C. gardenii* flowered in late autumn (May) and in winter (June, July and August) but never during the other months.
6. (*C. miniata* x *C. gardenii*) or the reverse cross, crossed again to *C. miniata* occurred mostly in late winter (August) and a little in mid winter (July), early spring (September) or mid summer (January), but only rarely in two of the other months (April or October).
7. Primary interspecific hybrids involving *C. miniata* x *C. nobilis*, its reverse cross or *C.* x *cyrtanthiflora* flowered over 10 months of the year, but not in October or November, even if the number of occurrences were low in some of the other months.
8. When crossed again with *C. miniata*, interspecifics from *C. miniata* and *C. nobilis* or *C.* x *cyrtanthiflora* flowered in every month except January, with the majority of instances occurring in early spring (September).
9. Primary interspecifics involving *C. miniata* and *C. caulescens* flowered in every month except October, but when crossed again with *C. miniata*, flowered most commonly in August and September, but not in December or in the period February to May.
10. Due to the small number of instances, I have not attempted to analyse other combinations such as (*C. miniata* x *C. gardenii*) x (*C. nobilis* x *C. miniata*), which were classified under "other combinations".

Mid-winter *C. miniata x C. caulescens.*

Early spring *[(C. miniata x C. caulescens) x miniata].*

Mid-summer 'Mandala' (from *C. miniata x C. caulescens*).

Early autumn *C. caulescens x C. miniata*.

The re-blooming characteristic of interspecifics involving *C. nobilis* (or *C.* x *cyrtanthiflora*) and *C. caulescens* may account largely for their wider spread throughout the year in comparison with the more restricted flowering of interspecifics based on *C. gardenii*. Since I wish to extend the flowering season over early autumn, mid to late spring and summer, this means that *C. gardenii* or its interspecific hybrids should not be my first choice in further crosses.

This exercise was an observational one of the plants in my collection and is quite different from a rigorous one, where, for example, equal numbers of plants of any particular combination would be used and much more rigorous recording criteria developed. I have not attempted to decipher any differences according to whether a particular species was used as the seed/pod or pollen parent and nor have I analysed re-flowering, which I actually consider to be an important feature of interspecific flowering.

As I write this short text in the "quieter" period of early November, interspecifics in flower are limited to an unspecified one from a breeding mix and another involving (*C. miniata* x *C. nobilis*), crossed again to *C. miniata*. How- ever, *C. nobilis* and *C. caulescens* are in flower, and some late flowering *C. miniata* are still displaying a few flowers – this year anyway.

Can interspecifics flower in every month of the year? I think I can give a positive answer, with the qualification that the frequency varies considerably according to the season or month. I hope that one will flower at Christmas time again this year. &

Chinese Clivia, a leaf love story

By Marilyn Paskert

(Printed with permission from NACS) (Photos by M. Paskert)

Imagine arriving at Changchun train station in northern China on an unseasonably warm morning in late March. The station is modern and the light standards (Fig. 48) decorated with a stylized version of your favourite flower: *Clivia*! *Clivia miniata* is the Changchun city flower and nowhere is this plant from South Africa more revered and grown in greater quantity in the world than here. Later in the evening, after touring several growers on the outskirts of town, we returned to the city to streets lined on both sides by flashing neon *Clivia* lights (Fig. 49). Having been taken by these plants for more than three decades, I still never could have imagined the delight and reverence this plant has instilled in so many in China and how much I would come to love their vision in breeding *Clivia* for leaf structure. My education in Chinese *Clivia* has only begun but it is a love story of sorts and I would like to share it with you. In the course of this article I will tell you about important leaf characteristics that have been focused on by Chinese breeders and how their *Clivia* are grown.

Eddie Pang is an Australian businessman who has collected and bred Chinese *Clivia* for many years. He could see that many *Clivia* collectors in the West were attracted to the wide-leaf compact form of Chinese *Clivia* but didn't know enough to separate that which is good from poor quality and plants that appear to be one thing but when grown at home will not maintain desirable characteristics because they don't really have the genetics but have been manipulated (not necessarily with ill intent) in some way. Fortunately for all of us Eddie is writing a book about Chinese *Clivia* but as a businessman who flies around the world on a constant basis, he has been too busy to complete it yet. I was very fortunate to be included in a group Eddie

Fig. 48. Changchun Railway Station Lamp post

Fig. 49. Changchun City Street Lamp

Fig. 50. Entry sign for *Clivia* housing

Fig. 51. Typical *Clivia* housing

Fig. 52. Eddie Pang surrounded by the He family

Fig. 53. Mr. He in his *Clivia* house

Fig. 54. Beautifully grown Chinese plants

took to China for a week of intensive *Clivia* viewing, education and yes, buying. My travelling companions besides Eddie were from South Africa: Joubert van Wyk, Paul Kloeck, and Dawie and Ebeth Strydom. We were also joined by Eddie's good friend Mr. He Shi Zhong and his son Jun Hua from Shenyang, China who treated our group with the warmest hospitality.

Clivia arrived in China in the mid-1800s brought by German missionaries but were confined to the glasshouses of the wealthy. *Clivia* found their way into the general population well after the revolution and that is when the breeding of Chinese *Clivia* became uniquely theirs. The major *Clivia* growing area in China is northwest of North Korea in the cities and environs of Shenyang, Anshan and Changchun. Winters here are harsh so all *Clivia* are grown indoors in glasshouses with heaters. Outside of the cities large

Not me! Boring! Leave that to scientists. I want to create new flowers. I confess to be a compulsive pollinator!

So, let's look at hybridizing and growing your own Clivias. You know what clivias are, don't you? Shade loving, semi-tender, evergreen, rhizomatous perennials, native of South Africa. They look like Agapanthus, but flower in late winter/early spring, with large, eye-catching heads of flowers in shades of scarlet, orange, apricot, or creamy yellow. Clivias have recently been 'rediscovered' by gardeners, and there is intense interest in them worldwide. Their large flowers make them easy to pollinate, (perfect for novice plant breeders!), and the seed is large and easy to handle. The only drawback is that they are slow growing, taking on average three to four years to flower from seed. But don't be put off by that, it simply makes the thrill of the ultimate flowering so much greater!

In their natural habitat in South Africa, clivias flower at the end of the dry season, and are pollinated by moths, butterflies and perhaps small sunbirds. Here in NZ, it is quite wet during their flowering time, there is little insect activity, and the pollen is killed by the rain, so often pollination is limited, and little seed is set. A good reason to interact with nature and pollinate by hand.

Just in case you've forgotten the elementary botany you learned at school oh so long ago, we need to quickly look at basic flower structure. The flowers of Clivia miniata are made up of three sepals and three petals, collectively called tepals, which are held in a circular whorl. From the centre of the flower extends the pistil, connecting the ovary, which is below the petals, to the slightly sticky receptive parts called stigmata at the upper tip. Arranged around the pistil and attached to the base of each sepal/petal are the

six thin filaments carrying on their tips the anthers, which split open to release pollen. When grains of pollen, (male parts), come into contact with and stick to the stigma, (female anatomy), pollination occurs. The grain of pollen produces a tiny tube which grows down towards the ovaries in search of an ovule, (egg), and when one is located, sperm is produced, which fertilizes the ovule and begins the development of a seed. The seeds are enclosed in a fleshy pulp, and take several months to mature, being viable (ripe) enough to germinate (begin growing) after about six months. If left on the plant, the berries containing the seeds will soften and colour up red or yellow after about ten months, and can remain on the plant, staying viable and looking attractive, for anything up to two years. (The whole purpose of the colour change is to attract birds/small animals to eat the pulp and release and scatter the seed, which is not palatable to them). Each berry can contain up to fifteen seeds, which are large and composed mostly of endosperm, (stored food), which the germinating plantlet uses as an energy source over the first few months of its life.

Vico Yellow seedling with broad reflexed petals

The mechanics of pollinating are simple, all you need to do is transfer pollen from one flower on to the stigma of another flower on another plant. This can be done with a small paintbrush, the tip of your finger, or a pair of tweezers. It is best done in the morning when the flowers have been open only a day or two, while the pollen is dry and dusty, and the stigma tip has just split into three and is still sticky and receptive to receive

It would be beneficial if polytepals have the same number of tepals and stamens in each flower. However, as the trait is unstable it is possible for flowers to contain additional layers of tepals although they retain their normal number of 6 stamens and a 3-lobed stigma. Other variations are also possible. Often polytepal flowers may have more than 3-lobed stigmas (for example, flowers with 8 tepals will often have 4 stigma lobes). Stigma lobes are a reflection of the general overall ratio of floral parts. They are fairly closely linked but their importance should not be overemphasized. Sometimes the style is spiral shape. Also a plant may exhibit a combination of polytepals and a modification of some of the stamens into petaloids.

Importantly, if the umbel has a majority of eight, ten, twelve, etc. tepals in the flowers then this would be a true polytepal and, as previously mentioned, any of the flowers (six, eight, ten, twelve, etc. tepals) could be used to breed for polytepals, either as the maternal or pollen parent.

Genetics of polytepal *Clivia*

I cannot emphasize enough the importance of knowing the genetic background of the polytepal *Clivia* to be used in a breeding program. Just because a *Clivia* plant has a polytepal umbel one should not expect it to produce 100% polytepal offspring. The expression of the trait is recessive and variable. Knowing the genetic history of polytepal *Clivia* may assist in predicting whether they may produce 30, 50 or some higher percentage of polytepal inheritance. A polytepal *Clivia* plant that has a genetic background of polytepal x polytepal may be preferred to one that has polytepal x non polytepal if one is, for example, seeking to produce higher levels of inheritance of the trait. Whilst further generational improvement may enhance the inheritance of the expression, this is not guaranteed. This has also been found to be the case with polytepal expression in some other ornamental plants.

Beyond polytepal *Clivia*, there have been many success stories in breeding doubled-flowers in other ornamental plants. Shigetaka Sasaki of Japan in CLIVIA 6 referred to results of breeding doubled-flower *Hippeastrum* cultivars by Nobuyuki Katsuyama. Other information on breeding doubled-flower *Hippeastrum* can be found on the internet, for example, "Trends in Modern *Hippeastrum* Hybridizing" by Charles Hardman. These and other articles suggest that crossing a doubled-flower with a single flower *Hippeastrum* would produce no or a very low percentage of doubled-flower F1 progeny, but crossing two doubled-flower *Hippeastrum* may produce up to 50% of the resultant seedlings that would have some doubled-flowers. Also crossing the F1 non doubled-flower progeny may produce higher levels of doubled-flower *Hippeastrum*.

Whilst one should be cautious about applying genetic results for one plant type to another, even though in this case they both belong to the *Amaryllidaceae* family, the work done with doubled-flower *Hippeastrum* provides some useful insights. From our own experiences, crossed or selfed polytepal *Clivia* grown from seed that we acquired produced less than 50% polytepal. No doubt the genetic background, if known, would have helped explain this outcome.

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Fig. 63. U-clip to make leaf stronger

Fig. 64. Painted Face with shine

bred for by the Chinese. Not only are prominent veins attractive but these reveal something about the future of the plant. Some dwarf plants are not really genetic dwarfs but are kept small by root-pruning and by fertilizer deprivation. This is not "cheating"; it is an art not unlike bonsai. I am very attracted to compact wide leaf plants and would want to buy such plants when I saw them. Eddie Pang would always kindly inform me that the plant I selected would not stay small and pointed out the vein pattern. Not possessing a photographic memory like Eddie's, it took a while for his lessons to sink in. Let's look at some veins (Figs. 65 - 66). Both

Fig 65. Seedlings with vein "cells" close together at the leaf tip

Fig. 66. Seedlings with larger vein cells at the leaf tip

Fig. 67. Elongated vein "cells" that look like bamboo

Fig. 68. Elongated vein "cells" that look like bamboo

of these photos are of seedlings. The plants in Fig. 66 have leaf vein cells that are closer together at the tip of the leaf. These are more likely to stay compact than the seedlings in Fig. 67 with long leaf cells at the tip of the leaf because densely packed horizontal veins at the leaf tip are evidence of Chinese short-

Fig. 69. A 10! Great leaf placement, rigidity, shine and prominent veins

leaf genetics. In fashion now are plants with long leaf cells that look like bamboo (Fig. 67). These long cells mean the leaves will be longer. When the leaf color is pale, even yellow and the veins darker, this is called "painted face" (Fig. 68). This photo is of a painter x painted face, shiny and pale cells with dark veins make this a real beauty. A few market growers use a vein mould to stamp out temporary protruding veins but there are real genetics for these traits out there. That said, not growing plants in the conditions Chinese grow them in may lessen the protruding veins and painted face traits. For optimum protruding veins, the potting medium is drier but the environment humid.

My last leaf photo is of an amazing plant that one could only dream to own (Fig. 69). The form is excellent with leaves on each side directly over the older ones, rigid shiny leaves with protruding veins, so what is not to love? A plant like this is unobtainable for most of us but at least I was able to get a photo of it! None of its traits are manipulated; this plant is the result of years of breeding for such leaves.

Are you still with me? I don't want to be discouraging when I say most of the important leaf characteristics can be fabricated or that growing conditions can affect the shine and painted face characteristics. It is important to know these things if you want to collect

Fig. 70. Chinese *Clivia* potting mix components

or breed with Chinese plants. So how do the Chinese grow their *Clivia*? The growing medium varies from barely rotted oak leaves to well-rotted oak leaf compost (Fig. 70). At the base of the pot a small amount of boiled sunflower seeds, hemp seeds, and well fermented fish scales are blended in. The seeds are boiled because they want to grow *Clivia*, not sunflowers or hemp. The idea is that the seed oils help with the leaf shine while the fish scales give the plants calcium and phosphorus to aid leaf rigidity. As I mentioned earlier, the glasshouses are quite humid and these plants really thrive in that environment. The plants are repotted frequently thus refreshing the nutrients. When my shade house is built I will make sure I have an enclosed humid location for my Chinese plants since our air in California is very dry.


Figs. 71 - 73. Some beautiful flowering Chinese *Clivia*

All this leaf talk, what about flowers? Most breeding efforts in China have been towards improving the leaves. The leaves can be appreciated all year round after all. There is a rising interest in flowers other than orange and Mr. He, our host, has a stunning collection. I will write that article for a future NACS newsletter but here is a little teaser Figs. 71 - 73.

I know everyone in our little group is eternally grateful to Eddie Pang and Mr. He for allowing us to meet Chinese growers and see their collections. Trying to buy a plant in China would have been impossible without them. In my direct western way I normally just ask how much something costs...that simple. In China such a transaction is a lot more complicated. First you have to establish a friendship (in Chinese!) before you do business. If either party doesn't warm up to the other, no sale is transacted. Being a "friend" can get better prices but very special plants are indeed worth more than anyone in the west would normally pay, even at a Clivia Society auction! So how can we get quality Chinese plants here? Most purchases have to be made through middlemen, not directly from growers. It isn't easy for most growers to get phytosanitary certificates in China but that may change in the future. Seeds are probably the easiest way to get a hold of Chinese *Clivia* genetics as long as you know the person you are buying from is honest and that the person he is buying from is honest. Let's just say: "it's complicated!" I am grateful to Li Qiang, a middleman and grower himself, for making it possible to get my plants home.

It is impossible not to fall in love with the leaves of Chinese *Clivia*, the warmth of the Chinese people and REAL Chinese food... don't get me started!

CLIVIA - CREATE YOUR OWN AND GROW YOUR OWN.

Have you tried growing your own plants from seed? It's fun, can be challenging, and is far more economical if you need lots of them. Of course, the downside is that it's considerably slower too, and doesn't fit with today's instant "I want it big and I want it now" kind of philosophy, if that's where you're at. And you need to be reasonably well organised and think in advance. If things are attempted at the wrong time, out of season, they're seldom successful, and often result in disappointment. In nature, everything has its season, and can't be rushed. I've found that becoming more aware of the seasons and cycles of the natural world is an extremely relaxing and rewarding experience, and sowing seed and nurturing plants to maturity and harvest is one of the best ways to raise that awareness.

C.miniata Picotee

But why not go a step further, and actually do the pollinating and make your own seed as well? Hybridizing is easy and doesn't necessarily involve a lot of skill. Creating new or different flowers is a real thrill and adds a completely new dimension to your gardening hobby. And I am talking flowers here. Who wants to make new varieties of vegetables?

Not me! Boring! Leave that to scientists. I want to create new flowers. I confess to be a compulsive pollinator!

So, let's look at hybridizing and growing your own Clivias. You know what clivias are, don't you? Shade loving, semi-tender, evergreen, rhizomatous perennials, native of South Africa. They look like Agapanthus, but flower in late winter/early spring, with large, eye-catching heads of flowers in shades of scarlet, orange, apricot, or creamy yellow. Clivias have recently been 'rediscovered' by gardeners, and there is intense interest in them worldwide. Their large flowers make them easy to pollinate, (perfect for novice plant breeders!), and the seed is large and easy to handle. The only drawback is that they are slow growing, taking on average three to four years to flower from seed. But don't be put off by that, it simply makes the thrill of the ultimate flowering so much greater!

In their natural habitat in South Africa, clivias flower at the end of the dry season, and are pollinated by moths, butterflies and perhaps small sunbirds. Here in NZ, it is quite wet during their flowering time, there is little insect activity, and the pollen is killed by the rain, so often pollination is limited, and little seed is set. A good reason to interact with nature and pollinate by hand.

Just in case you've forgotten the elementary botany you learned at school oh so long ago, we need to quickly look at basic flower structure. The flowers of Clivia miniata are made up of three sepals and three petals, collectively called tepals, which are held in a circular whorl. From the centre of the flower extends the pistil, connecting the ovary, which is below the petals, to the slightly sticky receptive parts called stigmata at the upper tip. Arranged around the pistil and attached to the base of each sepal/petal are the

six thin filaments carrying on their tips the anthers, which split open to release pollen. When grains of pollen, (male parts), come into contact with and stick to the stigma, (female anatomy), pollination occurs. The grain of pollen produces a tiny tube which grows down towards the ovaries in search of an ovule, (egg), and when one is located, sperm is produced, which fertilizes the ovule and begins the development of a seed. The seeds are enclosed in a fleshy pulp, and take several months to mature, being viable (ripe) enough to germinate (begin growing) after about six months. If left on the plant, the berries containing the seeds will soften and colour up red or yellow after about ten months, and can remain on the plant, staying viable and looking attractive, for anything up to two years. (The whole purpose of the colour change is to attract birds/small animals to eat the pulp and release and scatter the seed, which is not palatable to them). Each berry can contain up to fifteen seeds, which are large and composed mostly of endosperm, (stored food), which the germinating plantlet uses as an energy source over the first few months of its life.

Vico Yellow seedling with broad reflexed petals

The mechanics of pollinating are simple, all you need to do is transfer pollen from one flower on to the stigma of another flower on another plant. This can be done with a small paintbrush, the tip of your finger, or a pair of tweezers. It is best done in the morning when the flowers have been open only a day or two, while the pollen is dry and dusty, and the stigma tip has just split into three and is still sticky and receptive to receive

the pollen. If the flowers are old, the pollen may have been killed by rain, and the stigma may have dried out so that the pollen will not stick to it.

Clivias are self-fertile to a certain extent (i.e. you can use the pollen of the same flower to pollinate it), with limited seed produced. This type of cross is called selfing. However, if two different plants are used, both sets of genes are mixed resulting in a better seed set and more vigorous seedlings, which combine characteristics of each parent. The seedlings produced from the first crosspollination between two different plants are called F1 Hybrids. Because these offspring carry a mixture of genes, a much wider selection of different characteristics will emerge in the second generation of hybrids, (F2 hybrids), as new gene combinations take place. F2 hybrids are produced by pollinating the F1 plants with themselves (selfing), or other F1 sibling plants, or back onto the original parents (backcrossing). The larger the gene pool of the parents, the more variation and diversity can be expected in the resulting seedlings.

If you want to try hybridising, look for the plant/flower characteristics that appeal to you, e.g. colour, flower shape, number of flowers per head, leaf shape etc., and select your parent plants that have these. If pollinating always try to improve the quality of plant or flower by using pollen from a plant with superior attributes to the one you are using as a pod (mother) parent. Having said that, in my experience the characteristics of the mother plant are usually more obvious in the offspring than those of the pollen (father) plant. If you have a variegated leafed plant, the variegation is only carried on the maternal side, so always use a variegated plant as mother if wanting variegated offspring. Even then do not expect more than 50% of seedlings to be variegated.

Pastels obtained by successive orange x yellow line breeding

Suppose you have three different clivias flowering, an apricot one with narrow tepals and thin leaves, a deep orange scarlet one with larger flowers and wide leaves, and a creamy yellow one. What colours would the resulting plant be if we cross-pollinated these? Without knowing the background parentage, it is impossible to accurately predict, but the chances are high that all the offspring will be varying shades of orange/apricot, as the orange colour is dominant over the yellow. The colour pigment in the outer layer of cells in the flower tepals is red anthocyanin, and the inner layers contain carotenoids, which are yellow, so that in a normal Clivia flower we look through the red onto the yellow, making the flower appear orange. A yellow flower is produced on a plant that has a genetic mutation which blocks production of the red anthocyanin pigments. Conversely a true red flower, (extremely rare), is a different mutation that results in lack of yellow carotenoid pigments. The density of the plastids, (cells carrying the pigments), determines the shade of colour. Flower colour can be determined by looking at the bases of new seedlings. Yellow or peach coloured seedlings have green, unpigmented leaf bases, whereas orange or scarlet flowered plants are produced from seedlings with a dark, pigmented base. This is only obvious in the first year or so of growth.

After picking your berries, remove the outer pulp and clean the seed, washing it in a fungicide, (dishwashing detergent does the same job of sterilization of any nasties), and let it dry for about a week before sowing it. A much better germination is obtained from fresh seed, although it can be stored in paper bags in a fridge for several months, so long as it does not dry out and shrivel up.

I sow my seed on damp sphagnum moss and cover it with more moss. It can be sown in coarse seedling mix, but must be only very lightly covered, or it has a tendency to rot.

It can be germinated in a sealed plastic bag filled with damp pine needles, or simply scattered on the ground in a moist shady place in the garden. Germination takes a several weeks and can be speeded up considerably if the seed can be given some heat. A bottom heat pad set at about 22degrees is great, or a hot water cupboard also works well. It is essential that seeds are kept just damp, and not too wet.

One leaf is produced in about four months, and at a year old, seedlings should have two leaves, and can be potted up, once again using a very coarse, free draining mix. Using a weak liquid foliar feed every month gives an extra boost. Plants will flower once they have produced 12 – 14 leaves, usually after three to four years. And with what avid anticipation we await as those first buds gradually colour up and open to reveal our own unique creation! Of course, it was worth it, but beware, hybridizing is addictive!

Ngamamaku Garden Clivias

Tony Barnes, Ngamamaku Garden, Taranaki, New Zealand.

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Clivia – Terminology of a Clivia flower

It is essential that we all use the same terminology especially when it comes to plant descriptions for registration or at shows when plants and plant parts are compared. Note: **Afrikaans terms appear in brackets.**

The reproductive system

The branch system bearing the flowers in ***Clivia*** is called an inflorescence (bloeiwyse). In *Clivia* the type of inflorescence is classified as an **umbel** (skerm). It consists of an elongated, leafless branch, called the **scape** or **peduncle** (bloeisteel) (Fig. 1, sc.), which comes from one of the leaf axils and stretches up to the point where the flowers are borne, all more or less at the same level on an extremely condensed **axis**. Each flower is attached to the inflorescence axis by means of a flower stalk, called the **pedicel** (blomsteel) (Fig. 1, pc). Then follows the **ovary** (vrugbeginsel) of the flower (Fig. 1, ov), situated below the **perianth** (periant) (Fig.1, per). The perianth consists of three outer and three inner perianth members, called **tepals** (perigoonblare). Inside the perianth, are the six **stamens** (meeldrade), each consisting of an **anther** (helmknop), containing the pollen and a **filament** (helmdraad), which is the stalk of the anther. The **stigma** (stempel) and **style** (styl), situated at the flower centre, are attached to the ovary and together the three parts form the **pistil** (stamper). The ovary in *Clivia* has three cavities or **locules** (vrughokke), each containing about eight to ten **ovules** (saadknoppe). After pollination and fertilization, each fertilized ovule will form a **seed**, and the developing seeds will stimulate the ovary wall to grow and become the succulent part of the **fruit** (vrug) (Fig 1, fr).The *Clivia* fruit is called a **berry** (besvrug of bessie), containing one to 15 seeds depending on how many of the ovules inside the ovary have been fertilised. Some of the fertilised ovules (now called young seeds) may also abort at an early stage, thus reducing the number of seeds per berry. The membranous layer covering each seed is part of the inner layer of the fruit wall or **endocarp.** The fruit wall (derived from the ovary wall), consists of three layers, namely the outer, pigmented **exocarp** (eksokarp), the fleshy **mesocarp** (mesokarp) and the inner, membranous **endocarp** (endokarp). The suffix "carp" refers to fruit.

Fig 1

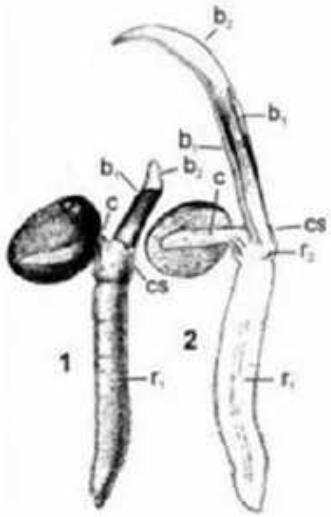

Fig 2

Please note that the *Clivia* fruit is not a pod or seed pod as so often seen in the literature. Pods are the fruit of peas, beans and other leguminous plants and the *Clivia* is surely not a legume. The *Clivia* fruit is also not a seed, since the seeds are contained inside the fruit which is classified as a berry. In future, please use the names given in bold in the above paragraph.

The Vegetative Parts

The vegetative plant starts with the germinating seed. Clivia seeds are naked since they do not have a seed coat. They are also **recalcitrant** (onortodoks), which means that they can germinate spontaneously, even in the ripe fruit; they can only be stored for a limited period of time and will die if desiccated beyond a certain point. The seed consist of the **endosperm** (kiemwit) enclosing the **embryo** (embrio) consisting of one cotyledon (c in the figure), a **plumule** (pluimpie) and a **radicle** (kiemwortel of radikula). The whole embryo is embedded in the endosperm and the tip of the radicle can be observed as a dark spot on the one end of the mature seed. During germination the cotyledon elongates to about 0,5 to 1 cm, thus pushing the plumule and radicle out of the seed, whilst the radicle starts to elongate to become the **primary root** (primêre wortel). The primary root immediately produces a collar of **root hairs** (wortelhare) behind the root tip and continues to do so as the root grows. The primary root (r1 in the figure) normally does not form **secondary roots** (sywortels). It has a limited life span and is soon followed by **adventitious roots** (bywortels) originating from the first and later nodes (r2 in the figure).

The junction of the plumule or **apical bud** (apikale groeiknop) and the primary root forms the first **node** (knoop) of the stem where the cotyledon with its cotyledonary **sheath** (saadlobskede) (cs in the figure) is attached. The cotyledon acts as a **haustorium**, (suigorgaan) responsible for absorbing nutrients from the endosperm. The first vegetative leaf (b1 in the figure), produced by the **apical meristem** (apickale meristeem) of the plumule, consists of a **sheath** (blaarskede) with a very small **lamina** (blaarskyf). In orange and red *Clivias* the sheath of the first leaf is pigmented.

Figure 2 shows a young **seedling** (kiemplant) of *Clivia miniata* (1) as well as a longitudinal section of a slightly older seedling (2). The figure was copied from R Wettstein (1935). Handbuch der Systematischen Botanik.

Courtesy of Professor Hannes Robbertse, South Africa

Clivia Activity Guide for the Year in the Southern Hemisphere

The Clivia Calendar

I have enjoyed growing clivias for twenty-five years. The following is a brief description of the cultural practices I employ. This does not mean that there are no other ways of achieving success. Indeed, there are many other ways of growing clivias as no two Clivia cranks will be unanimous on all aspects of growing their favourite plant!

The Clivia Calendar (based on Southern Hemisphere growing conditions)

ACTIVITY	J	F	M	A	M	J	J	A	S	O	N	D
HARVESTING SEED				■	■	■	■					
GERMINATING SEED					■	■	■					
PLANTING SEED						■	■	■	■	■		
PLANTING OUT SEEDLINGS	■	■									■	■
POTTING-ON									■	■	■	
DIVIDING ANDTRANSPLANTING	■	■								■	■	■
FEEDING	■	■	■							■	■	■
LOOK OUT FOR PESTS	■	■	■	■						■	■	■

Harvesting seed: Seed from the previous spring's blossoms will ripen from April to July. As soon as the berry becomes soft to gentle pressure (something like ascertaining when a peach is ready for eating) it is ready for picking. This may be while the berry is still completely green. It is not essential to postpone harvesting until the berries turn colour. Remove the skin, the gelatinous pulp and the enveloping membrane from the seed. Dust lightly with a suitable contact fungicide and store in a ventilated container.

Planting seed: I generally commence germinating my seed some two weeks after harvesting. Some growers will do so immediately after harvesting, while others will wait for several months until ambient temperatures rise in spring. The seed is placed between moist

sheets of paper towel placed in any suitable container. Follow the same procedure as in primary school when germinating beans! Place the container in a warm spot to stimulate germination. If you are really hasty for results, then invest in a heated germinator specially designed for this purpose.

As soon as the seed begins to germinate, transfer it to the seedbeds. Here I use containers at least 15 – 20 cm deep. The containers are filled with 1:1 mixture of polystyrene pellets (2 – 5 mm diameter) and sifted compost. Compact the substrate slightly, then place the germinating seed on the surface. Cover the seed with about 1 cm of the same mix with a thin layer of coarse sand on top. The sand will prevent the fine mix from being washed out of the container when watering with a hose. If the compost is properly prepared and heats up well during decomposition, most weed seeds and pathogenic fungi will be destroyed. Under these circumstances it is not necessary to fumigate the compost prior to it being used in seedbeds. If, however, you experience damping-off of the young plantlets, then resort to either fumigation or heat-sterilisation of the compost, or use specially prepared commercial substrates for the purpose. Do not delay transfer of the germinating seed to the seedbed too long, or you will damage the growing radicle (rootlet) or the root hairs which cling to the paper towel.

Keep the seedbeds in a shady place. Keep moist but not wet or soggy.

Planting out seedlings: When the first leaf of the seedlings reaches a length of five to ten cm, transfer the seedlings to individual 15 cm plant pots. I prefer the tapered to the cylindrical design as it is easier to remove the young plant and soil from the pot when potting-on into larger containers. The potting mix should approximate the medium in which clivias thrive in their natural habitat i.e.. the leaf litter found on the forest floor. My mix consists primarily of garden compost to which some milled pine bark has been added.

Clivias grow slowly and in their natural habitat are subjected to strong competition from other roots for available nutrients. In other words, they do not need a nutrient-rich medium to thrive, but rather a loose, friable medium in which to develop. If your compost heap is not invaded by roots of nearby trees which deplete available nutrients, it will not be necessary to add any slow-release fertilizer to your potting mixture. The nutrients released by the compost being converted into humus will be more than adequate for the growing plant. Many growers swear blind that foliar feeding really stimulates growth – my conviction is that this is entirely imaginary. Young plants can best be grown in dappled shade. Shade cloth with an 80% light-exclusion factor would appear to be the ideal alternative.

Potting-on: A year after planting out the seedlings they are ready to be transferred to 17,5 cm (7 inch) pots. At this stage I provide some drainage at the bottom of the pots. Crushed stone or brick is suitable, but heavy. Broken pieces of polystyrene make for less weight, but cinders are ideal in that they are light and provide excellent drainage. It can also be argued that cinders will contain traces of most nutrients (with the obvious exception of nitrogen) to supplement the potting mix in the event of a trace element deficiency.

In the potting-on procedure, disturb the plants as little as possible – hence the usefulness of a tapered pot. If plants are watered prior to transfer they will slip out of the pot more easily.

A further year on, the plants are potted-on to 20 cm (8 inch) pots and again one year later into 25 cm (10-inch pots). Clivias can be flowered in 20 cm pots, but larger plants will respond to the additional space provided by larger pots.

Dividing and transplanting: There are many old-wives' tales concerning the do's and dont's of dividing and transplanting clivias. One of these is that if you disturb a plant in any way it will not flower in the coming spring. Well, I have yet to experience this! Another is that pot-bound plants will flower more profusely than their counterparts having adequate room in their containers. There may be more substance to this claim but after twenty-five years it has escaped my observation!

I believe that- in the warmer parts of the country – clivias can be divided or transplanted at any time during the year without detrimental results. Given the choice, however, spring and summer are preferable for these operations, as the divided/transplanted plants will establish more quickly.

In the case of a single offset to be removed, disturb the plant as little as possible and gently pull the roots apart. If, however, you are dividing an old well-established plant with many growing points and the plant is pot bound as well, it is a good idea to use a jet of water from a hose to remove all the soil around the root ball, before teasing the roots apart. Where offshoots are still attached to the mother plant these should be cut off and the cuts dusted with flowers of sulphur or copper oxychloride before repotting.

Soil preparation

a) **Texture, structure and pH:** Clivias do not like wet feet, hence good drainage is essential. In the preparation of compost, a sandy or sandy-loam soil should be used. More important, however, in ensuring good drainage is an open structure of the growing medium. Adequate compost and milled bark will ensure this. The pH of this mixture should be in the region of 5.5 to 6.5 which approximates that of the leaf litter in the Clivias natural habitat.

b) **Nutrition:** As already mentioned, I do not believe in the feeding of clivias grown in a compost-rich medium. Where cultivation occurs in sand or milled bark only – where available nutrients are virtually absent, or are leached out rapidly as there are few colloids to retain them – feeding is desirable. When fertilizer is added to the growing medium a slow-release formulation such as Osmocote is recommended. Where foliar feeding is resorted to, spring applications should contain more nitrogen to stimulate vegetative growth. During summer the emphasis should be on phosphorus to strengthen growth while late summer applications should concentrate on potassium to stimulate the developing flowers. No feeding is recommended during the dormant winter months. 30:10:10, 18:18:18 and 10:20:30 or similar formulations are suggested for the progressing season.

Watering: Liberal watering should commence immediately the plants show signs of life in spring. This should continue throughout the growing season but be curtailed as temperatures drop in late autumn. Many growers discontinue watering completely during the winter months.

Where the texture and structure of the growing medium is ideal there is little danger of overwatering – even during winter. Over-watering of plants growing in a less-than-ideal medium will precipitate root-rot. When this becomes evident remove plants from the soil and permit callus-development after treating with a suitable fungicide before re-potting.

Diseases: Damping-off of young seedlings is probably the worst disease to contend with. As mentioned earlier this problem can be eliminated by using a pathogen-free germinating mix. Some plants seem to show a predisposition to fungal attack of the foliage. This problem is

best overcome by a strict selection in the breeding programme. No plant is worth constant pampering and treatment – no matter how special it is! Another problem, which may be encountered, is the appearance of rust pustules on the underside of the leaves. This will occur when particularly humid conditions prevail. Improved ventilation will remedy the situation. Treatment of affected plants with a systemic fungicide (e.g. funginex) will prevent spread of the disease, but affected leaves will remain unattractive. Occasionally in late summer plants will simply topple over and, on closer examination, will have rotted off at ground level. Only a small percentage of plants will be thus affected and, upon dusting with a suitable fungicide and callusing for a period can be successfully re-potted with minimal setback to the plant.

Pests: By far the greatest problem is the amaryllis borer. Several generations of moths will oviposit on the underside of leaves of both young and adult plants per year. If left untreated the larvae will tunnel down in the leaf and in severe infestations completely destroy the corm. From early October until late April plants should be inspected several times a week. The tell-tale sign of sub-laminar tunnels indicates immediate treatment with a suitable insecticide (e.g. chlorpyrifos or carbaryl). A full cover-spray is essential. Choose an insecticide with low mammalian toxicity, which will degrade rapidly thus limiting pressure on the environment to a minimum. As even light infestations can do considerable cosmetic damage, you have to intercept the borer at an early stage. Many growers apply prophylactic treatments throughout the summer months, but this is superfluous provided the grower is on his toes.

Mealybugs can be a nuisance and disfigure the emerging leaves, as the insects are particularly populous in the leaf sheaths. To ensure that the insecticide (eg chlorpyrifos or carbaryl) penetrates between the leaves at the base of the plant add a spreading agent, which reduces the surface tension of the spray liquid thus promoting penetration. A repeat treatment some seven to ten days later is recommended.

the Late Bing Wiese
(From Clivia Club Newsletter Volume 8, Number 2, Winter 1999)

Clivia Society of South Africa

CLIVIA BREEDING

Peter Haeusler and Ken Russell

We were most fortunate in having Ken Russell travel all the way from Dungog in New South Wales to talk at our June meeting on Clivia breeding.

Ken spoke about the importance of both taking a long-term perspective with one's Clivia breeding plans and the need to be rigorous in the selection of breeding stock. He pointed to the efforts and great success of his friend and mentor, Bill Morris, the world-renowned Clivia breeder. Bill is well known for his fine yellows, although it is 'Tango (a Picotee orange with huge yellow throat) for which he is probably best known. It took Bill 40 years to develop his yellows, and of course today when you buy seed from world-renowned breeders like Sean Chubb you will see the legacy of Bill's work continuing in their breeding programs.

Bill started off with a 'poor natural yellow' obtained from the late Mick Dower in South Africa which he crossed with a 'nice orange. It took five generations to perfect what Bill was prepared to term a 'good yellow'. This involved germinating 5000-10,000 seed each year, and then as these plants reached maturity and flowered selecting only the very best to cross back, at least initially to the orange parent. Gradually the percentage of yellows increased (such that today when crossing Group 1 yellows we can be pretty sure of getting 100% yellows...although with the extent to which genetics are now being mixed, we can get quite unanticipated outcomes). Most importantly, the quality of the yellows increased progressively, and over time it increased substantially of course.

As an aside here, those of you who receive the *Clivia News* may have read the article in the latest issue (Vol.22, Number 2) by Allan Tait **(attached at the conclusion of this article)** and his experiences with developing a particular hybrid between *Clivia miniata* 'Coromandel' and *Clivia robusta*. Alan talks about putting down 1000 seeds in 2005 but when they flowered, he ended up retaining less than 20 plants (i.e. less than 2%) which exhibited the desired characteristics. Interestingly, those that flowered at say 3 years compared with those that flowered for the first time only at 5 years tended to display different characteristics (more of one parent than the other), a further consideration it would seem when crossing species.

'Best Kept Secret' - plant and photo courtesy of Yvonne Hargreaves

Ken has continued to build on Bill's work with the yellows, especially the latter's line producing the highly regarded 'Best Kept Secret', and in turn from it 'Skychase'. Ken stressed the importance of knowing your parent plants and indeed their lineages to get some idea of what you may get — otherwise crossing and mixing strains is simply a lucky dip! This, he said, is even more the case today with the mixing of different species. While certainly producing some amazing results, we are also seeing extremely varied results in terms of plant form, as well flower form and colour, even over large numbers of seedlings. In Australia the problems and challenges are greater because of the poor early record-keeping relating to breeding efforts and the many discrepancies in these. This extends to the *Cyrtanthiflora* (sometimes referred to as the Aussie nobilis), the origins and genetic make-up of which remain unclear.

Ken suggested that DNA testing may help increase our knowledge and make for better breeding programs, but he also reminded us in the meantime of Mick Dower's aphorism, ' I rely on someone else to tell me the truth '.

Throughout his talk Ken emphasised the wealth of variation — and uncertainty — that we will all encounter when it comes to breeding clivias. In some respects, this is part of the fun and fascination of course, but if you are seeking particular ends then it may be a source of frustration, even confusion. Ken emphasised the importance of finding out what you can about your parent plants and trying to work out what it is that you want to achieve with a given cross. Also, remembering Bill Morris' experience, don't be too ambitious about what you are likely to achieve in one generation! You might only get 10 suitable plants out of every 100. But take the best and cross it back to the parent, or cross siblings. And in next generation, depending on the outcomes, undertake the same process. Furthermore, if you are crossing, say, different spedes such as a *Clivia miniata* and a *Clivia robusta* then you should think about crossing these both ways, that is, using the *miniata* as the pod parent with the *robusta* as pollen parent, but also undertaking the reverse cross. Outcomes can vary depending on which is used as the pod and pollen parent. You need to be alert to this and explore the possible effects and outcomes to get the most out of the plants that you are working with.

What you are trying to do is not only produce particular outcomes, and hopefully exciting ones at that, but you also want to work on refining your strain, achieving consistency in those outcomes. It is all well-and-good to produce some exciting new variation, but the challenge is to reproduce this and indeed to refine it. This is where you put like to like and seek to do so over generations.

Of course, clivias, like people, are not simply a product of their genes. Environmental factors such as lighting, growing medium, and fertilising regime all affect plant development, flower formation and flower colour. Ken emphasised the importance of glucose when it comes to plants growing in artificial mediums such as pine bark. Honey or molasses are being used by many growers with good results. Ken recommends molasses (which can be obtained from produce stores where it is sold for adding to the diet of livestock) at the rate of 2.5-5.0 ml/litre and applied monthly as a foliar spray.

In terms of growing medium, Ken emphasised the crucial importance of maintaining a relatively open, aerated mix. He is not an advocate of using coconut fibre (coir) in a mix as it breaks down too readily and

can lead to a mix becoming sodden, leading in turn to root rot and the onset of disease. Perlite added to a mix improves aeration, while wood chips (hardwood, redgum) and stone chips are also very useful from this perspective. Pine bark is probably the most widely used element in mixes, but care needs to be taken with PH levels, especially when using fertilisers with high nitrogen levels, to ensure mixes do not become too acidic. Dolomite or calcium carbonate can be employed to good effect to counter this potential problem.

Ken stressed the importance of a good growing medium combined with a balanced and consistent fertilising regime. The aim is to ensure that seedlings get off to a strong start; quick early development is vital to plant health. Again, he came back to the value of molasses in this regard, noting at the same time that he had also found molasses to be 'very effective' in controlling mealy bugs.

Clivia Breeding – Peter Haeusler, Melbourne Clivia Group and Ken Russell, Dungog NSW

Clivia Breeding

Gladys I. Blackbeard – South Africa

Scott's Farm, Grahamstown, Cape Province

[Reprinted from *Herbertia* 6: 190-193, 1939]
The original draft of this article was published in *Clivia* 2: 43-45.

Of the many interesting flowering plants of South Africa, the Genus *Clivia* is worthy of special mention. It consists of handsome plants with dark green leaves and strong erect stems which carry massive flower heads in brilliant shades of nasturtium red to copper and gold. Even in winter they are most attractive pot plants with evergreen leaves and brilliant red fruits.

My early interest in the genus *Clivia* was awakened by my mother, who was deeply interested in South African flowers and gardening generally – an art almost neglected by women folk at that time. Gardening brought her into contact with many flower lovers and gardeners of the old type. She was fortunate in making the acquaintance of an old English gardener, who came to South Africa. He soon saw the possibilities of exporting bulbs, etc. to England. He collected the very handsome Red *Clivia, C. miniata,* (see p. 45 E) and presented my mother with one plant. As a child I well remember the joy of seeing it bloom each year. It increased and after many years has come to be considered almost as a family heirloom. I was fortunate in securing another

IMAGE: SANBI PRETORIA

A painting by Cythna Letty Forssman of Gladyss second breeding *Clivia miniata*, the one in which the flowers are of pale apricot tint.

plant from a friend, the origin of which she could not give. The flowers are of pale apricot tint, having broader and more widely spreading perianth lobes (see page 41).* This gave me an inspiration and soon I made a cross between these two. Some five and a half to six years later the progeny flowered. The cross had considerably enhanced colour and form, from the palest to deep shades, with larger flower heads and broad petals truly a brilliant show. Year after year I made crosses from the best plants and today those early crosses have multiplied to a family of some 2000 plants, from flowering plants to year-old seedlings.

Branching out, from this family and making a fresh cross, I took again as my pollen parent the pale apricot one, and as the seed parent, a species that is indigenous to this part, *Clivia nobilis* (see page 43). The flowers of this species are tube like and hang down in a massive cluster, being supported by a strong peduncle. This is in nature a very hardy and robust species – growing under various conditions in shaded moist kloofs some thirty-six miles away from the sea, down to within a few hundred feet from the sea shore, on the slopes of the hillside, in part shade from the tall tree Euphorbia on the banks of Bushmans River in the eastern Cape Province. In this particular spot *Clivia nobilis* has survived the damaging effects of man. Whereas most of the undergrowth has faded out with the advance of civilization the *Clivia* has persisted.

The flowers of *Clivia miniata* var *flava* are erect or sub-erect whereas those of *C. nobilis* droop or hang their flower bells. The hybrids in this cross are somewhat varied in shade and form. The shades vary from dark to light

Photo: Gwen Rissik

A selfed seedling of *Clivia miniata* 'Blackbeard's Yellow', recently donated to Sean Chubb's Heritage Collection.

apricot pink. They flower out of season, that is to say my general collection flowers in the spring, late August to September, whereas the *C. miniata* var *flava* – *C. nobilis* hybrids flower in May and a few in July, the flowering period having completely changed. If this will continue season after season is yet to be proved. This may be of immense value for making crosses with other related plants that bloom at this time.

From the time the seeds start to form, the capsules or fruits gradually develop to the size of a large cherry, but pear shaped. As they ripen they turn to brilliant scarlet and have a handsome appearance. It takes from ten to twelve months for them to ripen and they would remain on the plant much longer, but I prefer to remove the seeds as soon as possible before other flower buds appear. The seed may be gathered as soon as the fruits show any red colouration. After

* It is probable that this is *C. miniata* var *flava* Phillips, which was figured and described for the first time in 1931 *Flowering Plants of S. Afr.* t. 411. It was discovered in North Natal about 1888 and a number of plants were distributed from the originals.

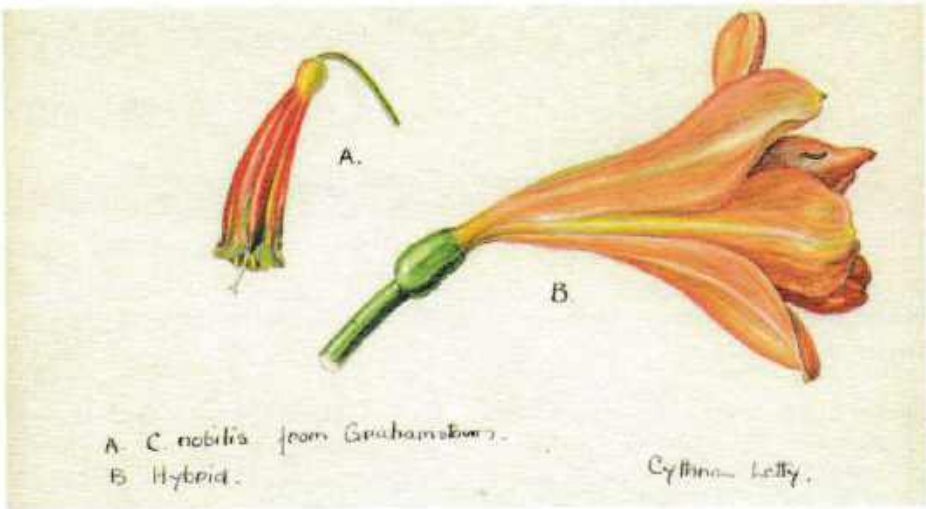

IMAGE SANBI PRETORIA

A painting by Cythna Letty (Forssman) of Gladys's *Clivia nobilis* from the valley of the Bushmans River, together with what appears to be one of Gladys's complex interspecifics, based on this species.

removing the pods I leave them for about ten days to two weeks after which I peel them and remove the seeds. The fruit contains an average of 5 to 7 seeds. One should not leave the seeds in their fruit pods too long for they will probably start growing and the delicate shoots may be broken off when removing the seeds.

When planting the seeds I use flat pans or boxes with moss at the bottom as drainage and then fill up with a light mixture of one part each of sand and leaf mould to two of good light garden soil, well mixed. Place the seeds in rows one inch apart, cover them with soil and give the seed pans a tap down by lifting up a little and dropping on the bench. Tap down at least twice. This settles the seeds into position. The pans or boxes can be their home for some time up to eighteen months or two years. When transplanting never give the seedlings much pot room, and never transplant until the roots are pressing above and over the side of the pot. They will flower well in 9 inch pots. Never "over-pot" *Clivia* plants as they will not flower, but only increase in leaf and root system. The secret of flowering them is rather to starve the plants than to over feed them. The general cry from most people is "my *Clivia* will not flower in spite of the fact that I keep potting it on." I always reply "Starve it." To enhance the bloom, when buds show, sprinkle round each plant a little well decayed mixture of horse and cow manure. This is all I have ever done for mine. For cultivation I have a "bush house" with flat roof, but before flowering it is advisable to put the plants under more shelter such as a glass house or verandah to protect the blooms from damage. Plants can be broken up and subdivided.

It must be remembered that all details given in this brief summary are purely the result of my own personal experiments, unaided in any way. Therefore my experiments have not advanced as rapidly as I should have wished. However many things have small beginnings, and the joy and keen interest shown in my collection has more than repaid me.

Clivia caulescens and its Hybrids

Helen Marriott, Australia

Until recently I had been wondering what to make of *C. caulescens*. Charl Malan had earlier described *C. nobilis* as being the "Cinderella" of *Clivia* species (Clivia 7, p.45) but where did that leave *C. caulescens*? It does not commonly appear on the various publicly-available seed lists and we hardly ever hear of anyone discussing a particularly superior form of it. In contrast to *C. gardenii*, *C. robusta*, *C. nobilis* or even *C. mirabilis*, it has been unusual to hear reference to variation in the colour of *C. caulescens*, flower count or flower shape. The prominence given to *C. caulescens* in the recent Clivia News 16:1 was therefore most welcome, especially the cover photograph of Fred van Niekerk's spectacular specimen from the Blyde River Canyon, with 54 flowers. This reference followed the naming and publication of the natural hybrid from Bearded Man Mountain involving *C. caulescens* and *C. miniata*, *C.* x *nimbicola*, in Clivia 8 (2006). The natural hybrid at the Kirstenbosch National Botanical Gardens in Cape Town is shown at the end of this article.

Local and overseas participants on the 2002 and 2006 Caulescens tours organised by James and Connie Abel (cf. Clivia 5, 61-62; Clivia News 16:1, 14-17) observed considerable variation in the growth habit of plants across the different *C. caulescens* populations (*see The Caulescens Tour and Bearded Man articles in this issue*), even if many plants were not in flower at the time of the tours. In the case of this species, the tall stem that sometimes displays considerable elongation is a notable characteristic, and is one that also occurs in the intermediate forms of *C. miniata* found in the same area in the Bearded Man Mountain.

Despite relatively little discussion of the colouration of *C. caulescens*, from time to time reference is made to a yellow-flowering form that appears to have been found in at least several different South African locations (including God's Window and the Soutpansberg area). One major South African grower has made offsets available for sale in recent years. However, the breeding outcomes of hybridization of this yellow form with Group 1 or 2 yellow-flowering *C. miniata* are reportedly unknown at this stage. Crosses by George Mann have produced seedlings with pigmented bases, but as we know with other interspecific hybridisation, this may not be indicative of the flower colour.

In an earlier period of his breeding, Yoshikazu Nakamura used *C. caulescens* in his interspecific hybrids and produced many exquisite F1s and F2s. One of his own favourites is *C.* 'Tricolour', the name chosen in reference to the three colours of orange, yellow and green

Photo: Helen Marriott

'Gay Delight' shows the potential of *caulescens* crosses

Photo: Helen Marriott

A yellow form of *C. caulescens*

found on the flower's broadish tepals. *C.* 'Day Dream', bred from (orange *C. miniata* x yellow *C. miniata*) x (*C. caulescens* x yellow *C. miniata*) is an elegant, semi-pendulous flower from Nakamura's breeding. Despite *C. caulescens* being only one of the four plants used in its background, 'Day Dream' is a large and vigorous plant that flowers twice yearly. 'Mandala' is a recently named *C. miniata* x *C. caulescens* of Nakamura.

Photo: Shigetaka Sasaki

A Nakamura interspecific 'Mandala'

In much of his breeding, Nakamura has commonly used orange and yellow forms of *C. miniata*, his notion being that use of different species and colours in combination could give rise to new mutations, including colour mutations.

Among other collectors who have accessed seed of *C. caulescens* from various areas of South Africa and also used them in their breeding programs, is Keith Hammett from New Zealand. An example of *C. caulescens* growing in his garden is shown in the photo below. Hammett has meticulously kept records of his hybridization, something all serious breeders must do. Using *C. caulescens* either as the seed or pollen parent, he has produced a range of F1 and F2 generation crosses. For instance, shown

Photo: David Olsen

C. caulescens growing in Keith Hammett's garden

below is an F1 *C. caulescens* x *C. miniata*, where the latter parent was a pale yellow *C. miniata* received as seed from Kevin Walters (Australia). Hammett then made sibling crosses. From this population, a seed grown and named by Rex Williams is

Photo: Keith Hammett

C. caulescens x *C. miniata*

Photo: Rex Williams

'Delilah' ((*C. caulescens* x yellow *C. miniata*) x self)

'Delilah'. An F2, 'Golden Nugget' consisting of ((*C. caulescens* x *C. miniata*) x self) is another recent naming. Hammett reports on segregation of forms with increased *miniata* flare emerging in the F2 populations. At the same time, he has observed more tubular flowers arising in the F2 generation, along with some yellow flowering forms as well.

Photo: David Olsen

'Golden Nugget' ((*C. caulescens* x *C. miniata*) x self)

Shigetaka Sasaki has made a number of observations about *C. caulescens* interspecific hybrids. Firstly, he notes that due to hybrid vigour, *C. miniata* x *C. caulescens* seedlings grow quickly, and that the seed actually germinate quicker than any other hybrid (so much so that they often germinate in the berry without being peeled).

Secondly, in relation to flowering, Sasaki reports that while *C. miniata* require six new leaves in order to produce a flower, like *C. nobilis*, *C. caulescens* require only four leaves, and that this pattern is also found in the interspecific hybrids of *C. miniata* x *C. caulescens* and in *C. miniata* x *C. nobilis*. Consequently, if the *C. miniata* x *C. caulescens* hybrid makes eight to 10 new leaves in one year, two flowers typically appear, sometimes in mid-summer and in mid-winter.

Thirdly, Sasaki says that to flower under normal conditions in spring, *C. miniata* needs a cold treatment of about one month (5-10 degrees C), and that if this cold treatment does not occur, the flower stem often does not elongate but flowers down low between the leaves. He also thought that in South Africa, because the flowering period for *C. caulescens* is soon after that of *C. miniata*, it too would need a sufficient cold treatment for it to flower and to produce an adequately long flower stem. However, he observes that *C. miniata* x *C. caulescens* hybrids produce a flower stem of the same length and with a similar number of flowers, whether it flowers in winter or in mid-summer. To him, this fact indicates that *C. miniata* x *C. caulescens* hybrid does not require a cold treatment in order to flower but, rather, that it is the number of leaves which is important for flowering. If it is the case that *C. caulescens* does not require any cold treatment, then in places such as Hawaii, it could be enjoyed as a pot plant.

As a fourth point, Sasaki stresses that *C. miniata* x *C. nobilis* hybrids also flower twice a year, but when they flower in early summer or autumn the stem may not elongate well, or the flower appears down low between the leaves or even sometimes rots. This suggests that a strong cold treatment is necessary for the flower stem of

C. miniata x *C. nobilis* to extend. As a plant which does not require a cold treatment, which flowers twice a year, and which produces a flower stem that is much longer than for any other hybrid, the *C. miniata* x *C. caulescens* hybrid is eminently suitable for the cut flower market.

Most importantly, for breeding purposes, Sasaki reports that even small differences among habitat species (for instance, *C. caulescens* or *C. gardenii*) can result in a big range of variation when used in breeding. For instance, Nakamura has frequently used a small *C. caulescens* flower that has roundish tepals in his breeding, and when combined with *C. miniata* has resulted in very round tepals in the interspecific hybrid. While a majority of *C. caulescens* flowers are rather straight, some are slightly flared at the tips, with this feature becoming more pronounced in the interspecific cross.

Photo: Rex Williams

Note the tendency toward rounded tepals

Among those who have grown numerous Nakamura interspecific hybrids of *C. miniata* x *C. caulescens* x self from seed, Laurens Rijke (Melbourne, Australia) has selected out a number of superior plants from this F2 generation, many of which he has named. There is considerable variation in the shape and colour of the flower, but a large proportion of the plants that he has grown are highly attractive. 'Clementina' was one of the early ones to flower for him (*Some of these can be seen in Yearbook 8*). Nick Powell (Queensland, Australia) has named another Nakamura interspecific as 'Moulin Rouge', while Geoff Wilson (Melbourne, Australia) owns a yellow interspecific, also from Nakamura's *caulescens* breeding. In addition to frequently selfing his F1 *C. miniata* x *C. caulescens*, Nakamura has also sometimes backcrossed his F1s to yellow *C. miniata*.

Photo: Helen Marriott

'Moulin Rouge'

These interspecific hybrids typically flower around August in Melbourne, overlapping with early *C. miniata* flowers, or just before them, and then may re-flower in early summer; however, occasional flowering seems to occur throughout the whole year.

Variegates of *C. caulescens* in the habitat seem to occur only very rarely, but two were seen by some Caulescens Tour spotters in 2006 (cf. Clivia News 16:1, 15). Interspecific variegates are also uncommon to date, but include the exquisite plant bred by Chris Welgemoed using variegated *C. miniata* "Tipperary peach strain" x *C. caulescens*.

As with the majority of other interspecific hybrids, it has been common to utilise *C. miniata* as a parent, typically as the seed parent. However, breeding among the

Photo: Keith Hammett

C. nobilis x *C. caulescens*

pendulous species themselves has produced some outstanding hybrids. Using plants given to him by Nakamura in the early 1990s, Hammett has crossed *C. nobilis* x *C. caulescens* to produce a very attractive interspecific, with strong *nobilis* characteristics observable in the leaves, colour of flower stem and the floriferous character of the umbel. Hammett has also grown from Nakamura seed a very vigorous hybrid, *C. gardenii* x *C. caulescens*, which he has called "Woodland Glory" (a collective, not a cultivar name, *see below*). He reports that this hybrid produces flowers throughout the year, which, in turn, give rise to fruit at all stages of development. Its leaves are long and relatively broad, and could therefore be used in floristry.

Photo: Keith Hammett

From the 'Woodland Glory' Group

John Winter's recent cross of *C. caulescens* x *C. mirabilis* (*see this volume*) has produced vigorously growing seedlings, with observable median stripes coming from *C. mirabilis* as the pollen parent, and we look forward to the flower with much interest.

By combining the pendulous species themselves in his breeding, in early 2007 Rudo Lötter produced *C.* 'Pink Baby', bred from *C.* 'Pink Sensation' F2 (((*C. miniata* x *C. gardenii*)) x ((*C. nobilis* x *C. gardenii*))) x *C.* 'Ballerina' F1 (*C. miniata* Giddy yellow x *C. caulescens*). Lötter observes that while still semi-pendulous, this new hybrid has inherited the flower shape of the Giddy yellow and the salmon pink flower colour from 'Pink Sensation' on the outside of the tepals and cream white on the inside. (cf. http://users.iafrica.com/c/cl/Clivia/Gallery.htm photo no.26).

Rijke used one of Nakamura's F1 (*C. miniata* x *C. caulescens*) and crossed it with the Australian yellow/cream *C. miniata* 'Aurea'. From this cross, he has obtained a number of excellent plants, with larger, shapely flowers which display considerable variation.

Photo: Helen Marriott

'Patsy' ((*C. caulescens* x C. miniata) x 'Aurea')

While the seed count from *C. caulescens* and its interspecific hybrids may be lower than in some of the other species and hence make it less commercially profitable, by flowering twice annually, extra seed can be obtained. Furthermore, with these and other interspecific

Photo: Helen Marriott

'Madeline'

hybrids in our collections, buds or flowers can be found throughout the full year.

This text is an enlarged version of a contribution to the NZ Clivia Club Newsletter 5.1 Summer 2007. My thanks to those who have contributed content, photos or both.

'Princess'

Photo: Helen Marriott

Photo: Claude Felbert

The beautiful peachy pink hue of a natural hybrid from the Bearded Man.

1943

Clivia caulescens

Dyer, R.A. (1943) *Clivia caulescens*. *The Flowering Plants of South Africa*, 23: t.891.

Clivia caulescens

Transvaal

AMARYLLIDACEAE

Clivia caulescens *R. A. Dyer*, sp. nov. affinis *C. nobili* Lindl. et *C. Gardeni* Hook. f. ab illa floribus paucioribus ab hac floribus minoribus ab ambabus caulibus usque ad 45 cm. longis productis differt.

Caules non-nunquam basi ramosi usque ad 30 vel 45 cm. longi, 3-5-4 cm. crassi. ***Folia*** plus minusve 15, disticha, lorata, 30-40 vel usque ad 90 cm. longa, 2-5-5 cm. lata, rigida, demum decidua. ***Scapus*** circiter 30 cm. altus, usque 1-5 latus, compressus, plano-convexus, solidus, apice circiter 15-20-florus. ***Pedicelli*** 1-5-3-5 cm. longi. ***Perigonium*** 3-5 cm. longum, tubo 4-5 mm. longo, segmentis apicem versus leviter recurvatis, segmentis exterioribus usque ad 7 mm. latis elliptico vel spathulato oblongis, segmentis interioribus 1-1-2 cm. latis. ***Stamina*** summo tubo inserta decurrentia, plus minusve periauthio aequilonga. ***Ovarium*** circiter 5 mm. longuin; stylus filamentis aequilongus. ***Fructus*** subglobosut), circiter 1-5 cm. diametro.

Description :—***Stems*** sometimes branched from the base up to about 45 cm. tall, 15-5-4 cm. diameter, becoming leafless below with age and transversely ringed by leaf-scars at intervals of 0-5-1-2 cm. distance, with a tuft of about 15 leaves at the apex. ***Leaves*** dark green, lorate, distichous, but the blades spreading somewhat spirally, usually about 30-40 cm. long and 3 cm. broad, but may be up to 90 cm. long and 5 cm. broad, widening very gradually from the base for about 5 its length and thence narrowed gradually to the apex, ultimately withering and falling. ***Peduncle*** compressed, sharply 2-edged, unequally convex on the surfaces, about 30 cm. long, 1-5 cm. broad at the base, narrowed to 1 cm. under the umbel. ***Spathe-valves*** 4, membranous, unequal, more or less lanceolate, 4 cm. long. ***Umbel*** about 15-20-flowered. ***Pedicels*** 1-5-3-5 cm.

A red *C. caulescens* on Mariepskop.

Previous page: *Clivia caulescens* painted by Barbara Jeppe.

long. ***Perianth*** deep salmon, with the lobes green tipped with yellow oil the overlapped margins, 3-5 cm. long, with a tube 4-5 mm. long and lobes slightly spreading at the tips; the outer lobes elliptic to spathulate-oblong, 7 mm. broad; the inner lobes 1-1-2 cm. broad. ***Stamens*** about equalling the perianth-lobes in length, inserted at the throat of the perianth-tube and the base of the filaments projecting over the mouth of the tube and fitting closely round the style. ***Ovary*** about 5 mm. long; style extending about the same distance as the anthers. ***Fruit*** a berry, subglobose about 1-5 cm. in diameter.—R. A. Dyer.

Transvaal: Barberton district: in woods, summit of Saddleback Mtn., 4000-4650 ft., Oct., *Galpin* 1102 ft; Pilgrims Rest district; MacMac, 4500 ft., *Van der Merwe in Nat. Herb.* Pretoria, 26,511 (type); near Graskop, 5000 ft., Nov., Reynolds 3037; Pietersburg district: Politzi, Oct., *Repton*, 311.

C. caulescens at God's Window in the early sun.

Red *C. caulescens* en masse near the summit of Mariepskop (1947 metres).

The Pinnacle at God's Window with *C. caulescens* growing exposed on the top.

A mature *C. caulescens* at God's Window. A misty area as evidenced by the moss.

Clivia caulescens has been under observation for several years without being definitely identified. It has been collected several times in the eastern Transvaal, and plants have flowered in October and November at the Division of Botany and Plant Pathology during the past few years. The specimen figured was collected by Dr. F. Z. van der Merwe at MacMac near the margin of forest, usually with its roots in leaf-mould. When the species was first studied there was some doubt as to the justification of separating it specifically from *C. nobilis* Lindl. and *C. Gardeni* Hook. f. Both these are stemless plants; the type specimen of the former, from the eastern Cape Province, is characterised by a dense umbel of comparatively small flowers; while the latter, from Natal, has fewer and larger flowers. Baker, in Flora Capensis 6, 228 (1896–1897), included in *C. nobilis* plants from Natal and Transvaal. Whether the Natal plants are correctly placed is open to doubt, and the specimen, *Galpin* 1102 from Barberton cited by Baker, is here referred to *C. caulescens*. Galpin collected the flowering material in October 1890 and stated on the label "Stem 12–18 inches".

C. nobilis and *C. Gardeni* were illustrated under figures t.2856 and t.4895 of Curtis's Botanical Magazine, in 1828 and 1856 respectively. Our plant is intermediate in the number and size of flowers between these, and differs from both in the produc-

Red *C. caulescens* on Mariepskop.

tion of a stem up to 45 cm. long, which is considered sufficient justification for specific separation.

Besides the above-mentioned species there is only one other described, namely *C. miniata* Regel, illustrations of which are to be found on t.4783 of Curtis's Bot. Mag. and Plate 13 of this work and variety *flava* on Plate 411. The flowers are large and attractive.

Clivia miniata and *C. nobilis* were used in artificial hybridisation work soon after the discovery of the former about 1854, and the number of hybrids and segregates in cultivation to-day is very high. Prominence to *Clivia* hybrids has been given in several horticultural works, notably in Herbertia, the Journal of the American Amaryllis Society.

C. caulescens at God's Window with a stem nearly two metres long. Many plants at this locality grow on top of large rocks which are covered in moss.

Clivia caulescens drawn and painted by ME Connell.

Biographical notes

Compiled from: Glen, H. F. & Germishuizen, G. (Compilers). 2010. Botanical explorations of southern Africa. Edition 2. *Strelitzia* 26. Pretoria: SANBI.

Frederick Ziervogel van der Merwe

Frederick Ziervogel van der Merwe (1894-1968) born in Stellenbosch, died in Claremont, Cape Town. Various medical qualifications from Trinity College, Dublin, Liverpool University and the University of the Witwatersrand. He travelled South Africa widely as Medical Inspector of Schools, which lent opportunity for him to pursue his botanical interests, particularly in Aloe and Merwilla (then Scilla), of which he described a number of new species.

(Glen & Germishuizen, 2010: 431).

Ernest Edward Galpin

Ernest Edward Galpin (1858 12 06 – 1941 10 16) born in Grahamstown, died in Mosdene near Naboomspruit, Limpopo Province (then Transvaal). He was a banker by profession and botanised as a pastime. In 1888, after meeting with and encouraged by GF Scott Elliot, on visit to South Africa, and William Tyson in the eastern Cape, he started a private herbarium. When in 1889, after a brief period in Johannesburg, he was appointed bank manager in Barberton he was fascinated with the little-known flora of this region and made carefully preserved and meticulously labeled specimens with several duplicates, these distributed to Kew, Bolus, Medley Wood, MacOwan and Zurich, these novelties soon making an international impact. Here he met DF Gilfillan, to become his brother-in-law, through their marriage to the two sisters, he to Marie Elizabeth de Jong, who was fond of the outdoors and shared his botanical interests, accompanying him on most of his expeditions and painting some of the flowers he had discovered. In 1892 he was transferred to Queenstown where he spent the next twenty-five years. In 1916 he donated his herbarium, comprising some 16 000 sheets, to the National Herbarium in Pretoria, and when, in 1921, they were housed in a new building opened by General Jan Smuts, he described Galpin as 'the Prince of Collectors'. In 1917 he retired to Naboomspruit and resumed botanizing in earnest, assisted by his wife until her heart attack on one of their trips to the eastern Transvaal, and subsequent death in Durban in 1933, and then his son, EA Galpin.

(Glen & Germishuizen, 2010: 181–184).

Dr Robert Allen Dyer

Dr Robert Allen Dyer, who described *Clivia caulescens* as set out above, collected by Dr FZ van der Merwe from the MacMac forest margin, was born on 21 September 1900 in Pietermaritzburg. Here he did both his schooling and completed his university education, obtaining his DSc in 1937 for a botanical survey of the Grahamstown and Bathurst district, of interest to us as the habitat of the *Clivia nobilis*.

He started employ in the sugar-fields of Zululand where he contracted malaria. In 1925 he was appointed to the Albany Museum Herbarium in Grahamstown, where he spent six productive years, including his field-work on the succulent *Euphorbiae*.

From 1931 to 1934 he was South African Liaison Officer at the Royal Botanic Gardens, Kew. On his return to South Africa he was posted to the National Herbarium, Pretoria, where, in 1944, he became Chief of the Division of Botany. He agitated for better facilities, resulting in the new headquarters building in the Botanic Gardens built in the 1970s. He was responsible for founding the National Botanical Gardens in Pretoria.

He retired in 1963, but remained active in the world of Botany, being awarded the South African Association of Botanists first gold medal in 1971, as the "doyen of South African botanists".

Some interesting aspects of his personality emerge in the Obituary prepared for *Veld & Flora* (March 1988, pages 31–2, on which this article is based) by P. Vorster of the department of Botany, University of Stellenbosch. Besides his many publications, he was instrumental in obtaining subscription for those by others, including W. Reynold's *The aloes of South Africa*, and Cynthna Letty's *Wild flowers of the Transvaal*, in which the *Cliva caulescens* is illustrated, as well as Auriol Batten's *Flowers of southern Africa*, which has the *Clivia miniata* illustrated. He was tenacious when the occasion demanded it. He insisted being included as second author to Alain White in exchange for his own research towards the monograph *The succulent Euphorbiae*.

As a person he was a patriotic South African, which created difficulties during the Second World War, as his staff held widely divergent political views. His wit showed when he named *Encephalartos cupidus* as record of the removal to his own premises by the collector of the almost entire known population, hence recording for posterity "a passionate desire to the extent of greed or lust".

He was a photographer, gardener – priding himself on his production of artichokes and African Marigolds, of which he hybridised the biggest and most spectacular in Pretoria – collected the mown grass from the Botanic Gardens as bedding for his fowls, and tested many untried fruits as jellies.

While not a collector of earthly goods, he had a fondness and respect for books. He died in Pretoria on 25 October 1987.

(Glen & Germishuizen, 2010: 160–161).

Clivia Culture Notes

prepared for BURWOOD NURSERY
by Kenneth R Smith

I can only guess that the Clivias you are familiar with are Clivia *miniata* types, possibly the broad-leaved hybrids. It really doesn't matter as the four species and the many hybrids available all require similar conditions. I will outline some details from my experience growing and breeding Clivias.

Position:

Clivias require a shady position in the garden. Whilst they will grow in a sunny spot, the foliage will burn and the emerging flowerhead is damaged by the sun before the beauty of the flowers can be seen. Being potted plants you can easily move them to a suitable spot, perhaps on the patio or verandah. I grow the majority of my collection in a shade cloth covered structure, which not only protects from sun but also gives them the frost protection they need. An established clump of Clivia damaged by frost is a sorry sight. Generally there will be regrowth from the base of a frost burnt plant. Variegated forms need special attention.

Pot Size:

Don't over pot Clivias. It is better to pot them on to a slightly larger pot every couple of years. The reason for not putting them in an oversize container is the potential root rotting that can occur from the excessive potting mix. Clivia are hardy plants and extremely drought tolerant. **Over watering will kill them more than lack of water.** I grow in 150mm (6") & 200mm (10") pots, and have larger specimen clumps in the larger tubs. Once they have been potted into the larger tubs they can grow happily for many years.

Potting Mix:

It must be free draining! Remember the root rotting. Most of the mixes on the market that are composted pine bark are okay. Cymbidium orchid mix and a potting mix 50:50 would be fine. There is no need for a peat-based mix: indeed these mixes may hold too much water. Adding washed, coarse river sand (maybe n 1/3) or even very small pea gravel or blue metal chippings is a good safeguard. **I can't stress the drainage aspect too much.** It is very disappointing to repot a choice plant and then have the plant collapse due to basal rotting. Garden compost is fine for plants in the ground, either dug in at planting time or used as mulch, but is **not** satisfactory in pots.

Watering:

When potting up, water in. During spring and summer, water perhaps weekly. Allow the plant to remain drier (not completely) during the colder winter months. Having said all this, I leave it up to your judgement of the prevailing conditions. Be aware that it is sometimes better not to water the Clivia.

Fertiliser:

A small amount of organic fertiliser such as blood and bone or Dynamic Lifter mixed into the potting mix is good. Not too much. Generally the mix is fairly organic anyway. I have used slow release fertiliser like Osmocote as a top dressing to the pot, just a teaspoon or two. Liquid seaweed fertilisers are great. I am very keen on them. They are safe for use on seedlings to mature plants. Any of the seaweed extract or fish emulsion fertilisers will do. Spring application of the dry feeds or several liquid feeds during the growing season will do the trick. Iron Chelates is good for Clivias. Makes the foliage a dark green. Dark green foliage is better able to photosynthesize. Take care not to over stimulate the plants, just aim for steady growth.

Flowering:

Clivia miniata "sets" the flowers in the colder winter months. The flowerheads will emerge during spring and early summer. Watch for snails at this time, especially under the large leaves as well as in the pot

It is best if different plants are used, but it is not essential. The ovary will swell in due course if fertilization has been successful. Fruit will develop through to the following late winter/early spring. It changes colour to red when ripe. The seeds are easily cleaned of the fleshy covering and can be sown into a "typical" potting mix for Clivia. If seed production is not required it is best to remove the flowerstalk at the end of the flowering period. They generally pull out easily. Pull up and also downwards at the same time, if you know what I mean. The hybrids that are being developed will produce flowers at different seasons. The Clivia miniata x Clivia gardenii hybrids are late autumn/winter flowering. The fruit colour of the various Clivias also varies from the red of the orange Clivia miniata, Clivia *caulescens* and Clivia *nobilis*, to yellow fruits for the cream flowered Clivia miniata forms. The fruits of Clivia *gardenii* turn pink colour when ripe.

Pests and Diseases:

Snails

Check regularly and remove, particularly at flowering time. Bait if required. Check under the large leaves as well as in the pot. Also inside the flowers of the tubular types!

Mealy Bug

These can be a problem if the plants are grown on a sheltered verandah or in glasshouses. They thrive in dry conditions. The insect is found in the leaf axil of the new growth. A cotton bud dipped in surgical spirit will kill them on contact. Toothpicks can also be used to hook them out. Sprays or dusts can be used but don't overdo it as damage to the growing point may occur. I have used Confidor with great results.

Soft Rot

This crown rotting bacterial disease is so frustrating. A seemingly healthy plant will just fall over. If all rotten material is cut out (and discarded) the plant can be dusted with Flowers of Sulphur to dry the exposed parts. Regrowth generally occurs from the basal clump. If there is enough stem on the top piece, it will probably re-root also. Plant it into a pot of river sand. This problem is caused by over wet potting mix or too much compost in the mix. So, add more sand and ease up on the watering. Earthworms in the mix can block drain holes, which will lead to wet potting mix.

Leaf Spot

Most Clivias I have seen have this disease. Goes with the territory. I generally remove the yellowing/damaged leaves from my plants on a regular basis. These I discard. I will also trim damaged portions from leaves. A spray programme with a systemic fungicide will help.

Sun Scorch

Excess yellowing of leaves or drying of the leaf margins/tips. Move plants to a shadier spot.

Thrips

These can be a problem on the pale orange and yellow flowered forms. A spray programme will be required as thrips can cause considerable damage. Foliage should be sprayed also, as they will feed on it. Silvering of the leaves is a telltale sign.

Happy Clivia Growing, If these notes have created more questions, feel free to write to me :

Ken Smith, Clivia Society (Australian Contact),
593 Hawkesbury Rd, Winmalee NSW 2777,
or phone 02 4754 3287, or email <cliviasmith@ldx.com.au>

Clivia gardenii – a new dawn

Francois van Rooyen – South Africa

Clivia gardenii was discovered and collected by Major Robert J. Garden in 1855, while stationed in the colony of Natal with the 45th Regiment. In the collection of Major Garden's paintings, there are quite a few representations of the KZN Table Mountain area. In his diary of his campaign in Pondoland he seems more interested in the indigenous people and their use of plants. Therefore it is fair to suggest that the live specimen collected came from the Table Mountain area near Pietermaritzburg. This live specimen, presumably collected there, was packed in a Wardian case with other living plants, and sent to the Royal Botanical Gardens, Kew in London, UK. In 1856 when flowering for the first time the new species was named by Sir W. Hooker in honour of the collector.

I was first made aware of *C. gardenii*, when we were phoned by a local doctor friend of ours about some flowers he had collected on our farm the year before. We knew about the *C. miniata* that grew there and the amazing flush of orange flowers that bloomed in September. According to the doctor the *Clivia* he collected looked different and sick. Needless to say these plants were *C. gardenii*, and yes, they did look sick. Plants with narrow untidy leaves and short peduncles with only a few hanging flowers. A lot has changed since then. Below I will discuss the diverse, wonderful beauty and potential of this pendulous complex of Kwa-Zulu Natal and Pondoland.

Kwa-Zulu Natal, northern Pondoland (Transkei), have three pendulous *Clivia* species. Although *C. gardenii* (Ngome) is still seen as a form of *gardenii*, hopefully it will in future be recognized as a new species. The traditional *C. gardenii* [*C. gardenii* (sensu stricto) or the Midlands form] consists of the most incredible variation in leaf, shape, size and colour. I think the distribution of this species is much larger than originally thought. Then lastly three other forms/species occur, swamp *C. gardenii*, *C. robusta* and *C. gardenii (maxima* form). These three forms/species are probably the most controversial and confusing, due to its DNA make-up, but definitely the most interesting.

This article is to introduce you to a plant that is amazing, beautiful and filled with talent. It is a 'must have' in any collection to be able to create new and exciting things as well as a beauty on its own.

Clivia gardenii (Ngome)

This is visually one of the most attractive *Clivia* species. The 'onion-like' base is quite unique, and grows bigger with age. The proud, strong peduncle stands high above the plant, making it ideal for interspecific breeding. The colours are very different from any other pendulous species I know – yellow, yellow-blush, pink, luminous orange to predominantly green with a faint blush. I have also seen two blood-red forms, very rare.

C. gardenii 'Gem's Hobbit'.

Clivia gardenii (Ngome) has also got one of the neatest arrangements of leaves, perfectly fan shaped and balanced. Leaf width varies but I have seen plants with a leaf width of 70 mm – ideal for breeding. The original description says 20 – 35 flowers but I've seen plants in collections with 45 to 60 flowers.

I think as a display plant and a garden plant, *C. gardenii* (Ngome) is a must. As a breeding plant to create world class inter-specifics, it's an absolute necessity.

Clivia gardenii (Midlands)

These plants never cease to amaze me. Probably the *Clivia* species that has been criticized the most, but hopefully no more. This species has the most variation in size, leaf and colour. Plants were observed with the size of *C. robusta*, with leaves up to 80 mm wide. Then another with a leaf length of 20 cm, and a leaf width of 20 mm.

The colours are truly amazing: creamy white, yellow, blush to pink, peach, pastel, orange, red, bronze, and predominantly green. Then there are colours that even the colour chart does not capture. The flower count also far exceeds what was originally thought. Umbels with 40 flowers are not uncommon and I have seen some with up to 50 flowers.

Clivia gardenii flowers first of all the pendulous species, in April/May. Its vast colour range makes it a must for every collection. Its breeding potential for creating inter-specifics makes it invaluable. A little more patience will be needed as the best results will be in the F2 generation.

C. gardenii Ngome Yellow.

C. gardenii 'Ngome Blush'.

C. gardenii Ngome.

C. gardenii Ngome Bronze.

C. gardenii salmon.

C. gardenii watermelon.

C. gardenii.

C. gardenii Orange-Red.

C. gardenii Orange-Bronze

Swamp *C. gardenii*, *C. robusta* & *C. gardenii* (maxima)

Of all the *Clivia* species, this complex of plants is the most mysterious and intriguing. I have seen plants 2 m high and a leaf width of 90 mm; also some with beautiful variegation. Medium size plants with olive green leaves, others with dark bluish leaves similar to *C. miniata* (Mzamba). Lately, I have been fortunate to have seen mature plants standing only 35 cm high. The variation and "unknown factor" in these plants, makes them exciting for future cross breeding.

The colours also vary substantially, from cream, blush, pink, orange, red and bronze.

PHOTO: SEAN CHI

C. robusta '50'.

PHOTO: SEAN CHI

C. robusta 'Munster Peaches & Cream' ex habitat.

PHOTO: SEAN CHUBB

C. robusta 'Notched leaf' - ex habitat.

PHOTO: SEAN CHUBB

C. robusta 'Pink Blush' - ex habitat.

The flower count in some of these plants can also be extremely high, up to 75 per umbel.

Visually swamp *C. gardenii*, *C. robusta* and *C. gardenii* 'Maxima' are a definite for your collection and in your garden. For crossbreeding with other *Clivia* species, a big yes, you cannot do without.

In conclusion, the heritage of *C. gardenii* or to put it simply, what we are going to inherit, is what we do with *C. gardenii* from now, into the future. How we look at them, select them and partner them with other *Clivia* species will be the essential key to creating a masterpiece. A new dawn has arrived.

Clivia robusta? ('Maxima') ex habitat.
Fred van Niekerk's collection.

PHOTOS: ROGER FISHER

Clivia robusta? ('Maxima', yellow form) ex habitat.
Fred van Niekerk's collection.

Clivia gardenii – Autumn's Delight

Brian Tarr, South Africa

History

Clivia gardenii was discovered and collected by Major Robert J. Garden of the 45th Regiment. He collected specimens while stationed in the Colony of Natal and sent them to the Royal Botanic Gardens at Kew. It was here that Sir W. Hooker named the new species *Clivia gardenii* when it flowered in 1856, in honour of the collector.

Distribution

Clivia gardenii occurs in the forests and forest patches of Pondoland and KwaZulu-Natal from near the coast to an altitude of 1200 m on south- and southeast-facing slopes in shale or sandstone-derived soils. From personal observation, it is possible to identify four main areas where *C. gardenii* occurs:

- Durban / Pietermaritzburg / Stanger
- Southern KwaZulu-Natal and Northern Pondoland
- Eshowe
- Vryheid / Louwsberg

C. gardenii is one of six species of *Clivia* found in South Africa, the others being: *C. miniata, C. nobilis, C. caulescens, C. mirabilis* and the most recently described *C. robusta*, previously known as the 'Swamp *gardenii*'.

C. gardenii is concurrent with *C. miniata* in all regions. It is often confused with (and sometimes sold as) its more southern sister, *C. nobilis*, the main differences being in the arching, soft, pointed leaves in *C. gardenii* as opposed to semi-erect leathery, notched leaves in *C. nobilis*.

Flowering time for *C. gardenii* is from early to mid winter when heads of 10-25 pendulous or semi pendulous green- or, infrequently, yellow-tipped flowers appear. The overall colour is variable, ranging from pale yellow to deep red.

Courtesy SANBI collection

Clivia gardenii from Ngome Forest by Cythna Letty from *Flowering Plants of Africa* 42, (1972).

Durban/Pietermaritzburg/Stanger

This region comprises Stanger, Hillcrest, Pietermaritzburg, Karkloof, Greytown and and is generally referred to as the 'Midlands'. The plants here are 900mm – 1200mm tall with lax, deep-green pointed leaves loosely clasping

Photo: Brian Tarr

'Green Ivory' from KZN Midlands.

the base. They seldom develop significant, taller, stems and can occur in large colonies in moist as well as dry habitats. Flower colour is variable in this region from red with green tips in the Greytown area, blush yellow and green around Harburg and pale red and green in the Hillcrest area. The flowers are held semi-erect on the umbel and are well spaced with between 15-25 per head.

Photo: Brian Tarr

'Green Blush' from Ngome Forest, Northern KZN.

Southern KwaZulu-Natal and Northern Pondoland

Two pendulous forms are found in this area, both flowering in early to mid-winter. Both were previously regarded as being forms of *C. gardenii*. Their habitats are quite different.

One form, known for many years as the 'Swamp *gardenii*', is significantly the larger and has recently been named *C. robusta*, the sixth *Clivia* species. It is always found in or near swamp forests, certainly not far from water. Its flowers come in a range of colours from cream to red.

The other form is smaller, and is found in drier areas, usually amongst rocks. Unlike *C. robusta*, with its range of colours, the flowers of these

Photo: Brian Tarr

Pink form from Southern KZN.

plants are generally only a brick red with green tips. No other colour forms have been found.

They also differ in several respects from the geographically closest *C. gardenii* form, the 'Midlands' form. The leaves have a rounded tip as opposed to the acutely pointed tip of the 'Midlands' plants. A plant collected in the Port St Johns area has leaf tips with a distinct indentation, similar to those of *C. nobilis*. The leaf colour tends towards a grey-green to light green and tightly clasps the stem. Also, the flowers do not have the flared tepal tips found in the Midlands form, nor do they have the range of colours.

Photo: Brian Tarr

'Bongie' from Southern KZN.

On the face of it, these plants seem to me more like a form of *C. gardenii* than a form of *C. robusta*, though Hammett *et al.* state that *C. gardenii* occur only to the north of the Durban area, and that

Photo: Brian Tarr

Leaf tips from Southern KZN.

the plants in southern KwaZulu-Natal and N. Pondoland are all *C. robusta*. In my view, more field work in this area could prove rewarding.

Photo: Brian Tarr

'Harburg Blush' from KZN Midlands.

Photo: Brian Tarr

A good colour form from KZN Midlands.

Eshowe

Plants from this region tend to be somewhat smaller than the 'Midlands' form, ranging in size from 300mm-500mm and averaging 10-15 flowers per umbel. The flowers are held sub-erect and are brick red with flared green tips. With further exploration of the region it is likely that populations of *C. gardenii* could be found in the Lebombo Mountains.

Vryheid / Louwsberg

Plants from this region are distinct in that they have a growth form which differs from the norm in that a well defined 'stem' is formed by the leaf bases tightly clasping the rhizome, giving the young plant an "onion-like" appearance. The plant develops a stem similar to *C. caulescens*. The leaves are 700mm-900mm long, with a pointed tip, less acute than the 'Midlands' form. Flower colour is predominantly a yellow/rose pink with green tips although green tipped

Photo: Brian Tarr

C. gardenii var. *citrina*.

pink/red flowered plants have been found. The plant bears large umbels of between 20-35 sub-erect flowers. The umbel is held well above the

Photo: Brian Tarr

'Jade Ivory' from KZN Midlands.

Photo: Brian Tarr

Red form from Ngome Forest.

leaves. Yellow-flowered plants from this region have recently been described and published as *Clivia gardenii* var. *citrina*.

Conclusion

C. gardenii, rather like *C. nobilis*, is viewed as very much the poor relation behind its more flamboyant sister *C. miniata*. Undoubtedly there are poor forms of *C. gardenii* but nevertheless it has much to offer both the enthusiast and the gardener in that it flowers at a time when colour in the garden and shade house is in short supply, there are a number of colours and forms to add variety, and it is not as susceptible to lilyborer attacks. It is a plant that deserves a place or two in every collection and garden and we look forward to a time when *C. gardenii* shows are held throughout South Africa.

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Photo: Brian Tarr

'Greeney' – from Ngome Forest

1856

Clivia gardenii

Hooker, W.J. (1856). *Clivia gardeni*. Curtis's Botanical Magazine, series III 12: t. 4895.

Clivia gardeni

Major Garden's Clivia

Nat. Ord. AMARYLLIDACEÆ – HEXANDRIA MONOGYNIA

Gen. Char. ***Perigonium*** superum, corollaceum, tubuloso-infundibulare, 6-partitum, irregular, deciduum; tubo brevi, tereti; laciniis imbricates; exterioribus lineari-lanceolatis; interioribus paulo longioribus, spathulatis ex his inferiore magis product, apice leviter recurvate, ex illis superiore breviore, convexo-curvata, cæteris rectiusculis. ***Stamina*** sex, summo tubo inserta, decurrentia, erecta; petalina paulo longiora, parum exserta. ***Filamenta*** filiformia. ***Anthera*** oblong, dorso supra basin bifidam affixae, erectæ (versatiles, *Lindl.*). ***Ovarium*** inferum, subovatum, obsolete trigonum, triloculare; ***ovula*** 6–7 in quolibet loculo, angulo interno affixa, biseriata, hemianatropa. ***Columna*** stylina filiformis, teretiuscula, erecta, stamina superans. ***Stigma*** trifidum; laciniis patulo-recurvatis. ***Bacca*** abortu monosperma (sub-6-sperma, Hook.) ***Semen*** adscendens, subgloboso-compressum; testa carnosa, areolata; hilo et chalaza lateralibus, raphe brevi elevata conjunctis. ***Embryo*** axilis, albumine carnoso dimidio brevior, extremitate radiculari hilo parallele contigua infera. – ***Herba*** *acaulis, Capensis.* ***Bulbus*** *imperfectus; fibris fasciculatis, carnosis, tuberoso-incrassatis.* ***Folia*** *crebra, disticha, lorata, rigida, persistentia.* ***Scapus*** *plano-convexus, solidus, apice umbellato-multiflorus.* ***Spatha*** *polyphylla, marcescens.* ***Flores*** *pedicellati,*

In the Ngome forest a distinct form of *C. gardenii* occurs, often bearing yellow and pastel orange flowers.

Previous page: *Clivia gardenii* painted by Barbara Jeppe.

Clivia gardenii type illustration from Curtis's Botanical Magazine, series III 12: t. 4895.

A variety of *C. gardenii* in habitat, showing the diversity of colour and shape of the flowers.

*bracteolis linearibus distincti, nutantes, luteo-crocei, apice virescentes. **Semina** sæpe in fructu germinantia. Kunth.*

CLIVIA *Gardeni*; foliis obtusiuscule acuminates, umbella sub-14-flora, floribus falcato-curvatis, sepalis apice patentibus.

Clearly a species of *Clivia*, Lindl. (Imantophyllum, *Hook.*), and perfectly distinct from the only hitherto known species of this African genus, figured at our Tab. 2856. The leaves are longer, and they taper gradually into an acuminated but not sharp point; the umbel has fewer flowers, but these flowers are twice the size of *C. nobilis*, and more brightly coloured, very much curved or falcate, and the apices of the sepals, instead of being incurved so as to form a very contracted mouth, are spreading, thus forming an infundibuliform corolla. *Clivia nobilis* is an inhabitant of the Albany Tracts, near the Great Fish River, South Africa: *C. Gardeni* was discovered in the Natal Colony by our excellent friend Major Garden, and by him introduced to the Royal Garden of Kew. Treated as a greenhouse plant, it flowers finely in the winter months, and continues for several weeks in blossom.

DESCR. ***Root*** exactly as in *C. nobilis*, of several stout, fleshy ***fibres***. Leaves distichously inserted, numerous, all radical, the bases sheathing; the blade one and a half or two feet long, gradually tapering towards the extremity into a rather blunt point. ***Scape*** erect, very much and ensiformly compressed, flat on one side, slightly rounded (subsemiterete) on the other. ***Bracts*** few, small, membranaceous, among the pedicels. ***Umbel*** of about fourteen flowers. ***Peduncles*** two inches or more long, erect or erecto-patent, curved upwards. ***Flowers*** full two inches long, independent of the ovary, very much falcate or curved downwards, of a dull orange or brick-red colour, gradually passing upwards into yellow, and that again into the green of the upper extremity: their shape is infundibuliform, curved: the ***sepals*** (united only at the base) overlap each other for their whole length, except at the apices, which are patent, and thus give their flower a very different appearance from that of *C. nobilis*. The ***stamens*** are inserted above the base of the perianth, longer than it: the ***filaments*** white, curved: ***anthers*** oblong, yellow. ***Ovary*** subglobose, but three-lobed or angled. ***Style*** longer than the stamen, much inserted beyond the sepals. ***Stigma*** trifid.

C. gardenii on a favoured rocky slope with unripe seeds.

Clivia gardenii Hook. Collect: L.E. Codd. Locality: Ngome Forest. Nat. Herb No: 29814. Artis's No: C. L. No. 718 PNGB. Flowered Bhekintaba. Sept 1965.

Some biographical notes on Robert Jones Garden

Edited and expanded from: Leverton, BJ. 1977. Garden, Robert Jones. In HSRC. Dictionary of South Africa Biography, Volume III. Pretoria: Tafelberg for HSRC.

Garden, Robert Jones (•United Kingdom, c. 1820 – United Kingdom, after 1853), British soldier and artist of whose parentage nothing is known, joined the British Army as an ensign in the 45th Foot Regiment in June 1839. He was promoted to the rank of lieutenant in April 1842 and captain in August 1848 and retired from the army in 1854. G. arrived at Simonstown with his regiment in 1843 and took part in the Seventh Frontier War (1846–47). He marched against Shiloh and for some while served under Major W. Sutton against other chiefs, and was commended for his work.

In 1848 G. came to Natal and for most of his time there was stationed at Pietermaritzburg. With H. F. Fynn he unsuccessfully tried in 1851 to raise a force of Bantu levies in response to an appeal from the Governor of the Cape Colony for assistance on the eastern frontier. In the winter of 1853 he endeavoured with T.W Fannin to find a new way through the Drakensberg for a shorter road to Bloemfontein, but could not find a suitable pass. In that year he was sent on a mission to Pondoland to bring to heel a recalcitrant chief. A heavily built man, Garden possessed little sense of humour. He quarrelled with most of the Natalians, including his own commanding officer, and on this account he was very much disliked in the colony, particularly as he was most critical of the Natal people (both English and Boer emigrants) and of the missionaries, wagon drivers and Bantu. During his sojourn in Natal G. made numerous journeys, both official and private, and with an easy pen recorded most of what he saw and heard, historical, botanical and ethnologic al. On Bantu matters his main informant was H. F. Fynn and the story of the Boer emigrants in Natal he obtained from J. J. Uys.* From the latter he received an account of the battle of Blood River (16.12.1838) and it was G. who drew the first map of the action.

G.'s account of the colony of Natal is preserved with the Garden Collection in the Natal Archives, Pietermaritzburg. His account narrates several excursions inland and along the coast in 1851 and 1852. Among the collection are also sketches and anecdotes of chiefs, and accounts of Bantu tribes (with Whites residing among them) and of Zulu battles. A description of the country and its wild animals as well as reports on Boer immigration are included. Several of G.'s drawings in black and white and his water colour paintings, which show that he was an artist of some merit, are preserved in the Killie Campbell Africana Library, Durban.

In 1853 G. went to Durban to command a detachment of troops there and in November of that year he left for England to retire and publish his writings on Natal, but this was never done.

Editors' note:

John van der Linde, in his piece Four 19th Century Clivia explorers (Clivia 9, pp.20–24) remarked:

As for his Clivia, all that we know is that it was found somewhere in Natal. Annoyingly, he did not record where he found it. We know from army records that he served for a short time in Pondoland, which is swampy Clivia robusta country. Who knows, maybe the plant he found and took to London was a *C. robusta* and not a *C. gardenii*! This piece of information has always piqued me, and I wondered if by perusing the Garden papers and watercolour depictions held at the Killie Campbell Africana Library in Durban I might find something revealing. I have also read in his biographical information in Gunn and Codd that he sent a Wardian case (in effect a miniature glasshouse named for its creator) of living plant material, a novelty for the time, to Kew Gardens. I have, as yet, no clarity on the matter, but amongst the papers (which are typed transcriptions) are letters regarding donations of plant material by collectors. Also, his notes on Pondoland seem more focused on ethnology and ethno-botany, with no mention of plant collecting. This all needs to be further and more thoroughly researched. [RCF]

Yellow *C. gardenii* growing happily on rotting vegetation over a stream in Ngome forest.

Clivia Genus

In September 1815 the first scientific collection of a clivia was made near the mouth of the Great Fish River in the Eastern Cape Province by the intrepid explorer and naturalist William Burchell. Similar plants were collected from the same area a few years later in the early 1820's by James Bowie and sent to England, where in 1828 Kew botanist John Lindley described them as *Clivia nobilis* in honour of Lady Charlotte Florentine Clive, Duchess of Northumberland.

Clivia is part of the Amaryllid family (Amaryllidaceae; Haemantheae).

There are at present six described species of *Clivia*:

(to view press down on Ctrl on keyboard then click on each name. This will bring you to a new window on your screen)

- Clivia nobilis
- Clivia miniata
- Clivia gardenii
- Clivia caulescens
- Clivia robusta
- Clivia mirabilis

Species Comparison Chart

	C. mirabilis	C. nobilis	C. robusta	C. gardenii	C.caulescens	C. miniata
Date described	2002	1828	2004	1856	1954	1854
Distribution	W escarpment	SE coast	E coast	E escarpment	NE escarpment	E escarpment
Habitat	Arid humic sandstone scree	Sandstone slopes to coastal sand dunes	Swamp forest in wet sand, drainage at cliff ledges	Humic scree on sandstone	Epiphytic on sandstone / trees in moss, humus on sandstone	Humic scree on sandstone, rhyolites, dolerite
Flowering time	October to mid-November (late Spring)	August to January (Spring – Summer)	late March – early August (Autumn – Winter)	May to July (late Autumn to mid-Winter)	September to November (Spring)	August to November (Spring – early Summer)
Peduncle colour	?	Green	Reddish then green	Reddish then green	Green	Green

	C. mirabilis	C. nobilis	C. robusta	C. gardenii	C.caulescens	C. miniata
Perianth shape	pendulous tubular	pendulous tubular	pendulous tubular	pendulous tubular	pendulous tubular	upright trumpet
Perianth width		11 mm		10 mm		50-70mm
Perianth length		25-40mm		40-70mm	35 mm	
Flower colour	Bicoloured orange/yellow turning orange-red with age, with green tips fading as it opens	Dark orange with green tips, but varies from pinkish yellow to dark red	Orange-red with green tips	Orange-red with pronounced green tips; but varies from yellow to brownish red	Orange-red with green tips	Orange with white or yellow throat; but varies from almost white through yellow to dark red
No of flowers	20-48	20-50	15-40	10-20	14-50	10-40

	C. mirabilis	C. nobilis	C. robusta	C. gardenii	C.caulescens	C. miniata
Stigma & style	Not exserted	protruding 6 mm		Exserted > 7mm	protruding 6mm	various
Fruit shape	Irregular glebulose-gongyloid	Round to teardrop	Round	Round to oblong	Round	Round to pointed, slightly irregular
Fruit ripens	February – April 4-7months	winter 9months		winter 15months	winter 6months	winter 9months
Ovary colour	Orange-red then green	Sometimes red then green				Rarely red then green
No. of seed in fruit	(1)2-4 (-7)*	1-2(-6)	1-2(-4)	1-2	1-4	1-4 (-25)
Seed size	±10mm	±9(6-1)mm	10-18mm	9-18m	±12(9-13)mm	±12 mm

	C. mirabilis	C. nobilis	C. robusta	C. gardenii	C.caulescens	C. miniata
Seed membrane colour	colourless	purplish red	colourless	colourless	colourless	colourless, rarely reddish
Seed radicle		radicle produced by the germinating seed is very thin, about 1.5 mm thick		3 mm	3 mm	3 mm
Stem	non-aerial	non-aerial	aerial to 450 mm with buttress roots when growing in swampy conditions	non-aerial	aerial, up to 3 m in mature specimens	slightly aerial with age

	C. mirabilis	C. nobilis	C. robusta	C. gardenii	C.caulescens	C. miniata
Leaf length (mm)	600-1200	300-800	300-1200	350-900	300-600	400-900
Leaf width (mm)	30-50	25-50	30-90	25-60	35-70	25-70
Leaf median stripe	Pronounced	Moderate to weak	Weak to none	None	None	None
Leaf substance	Stiff	Stiff	Soft	Soft	Soft	Soft
Leaf texture	Rough	Slightly rough to smooth	Smooth	Smooth	Smooth	Smooth
Leaf margin	Smooth	Rough	Smooth	Smooth	Smooth	Smooth
Leaf apex	Rounded point	Indented	Rounded	Pointed	Pointed	Pointed

	C. mirabilis	C. nobilis	C. robusta	C. gardenii	C.caulescens	C. miniata
Leaf base	Pigmented purple red	Non-pigmented	Non-pigmented	Non-pigmented	Pigmented red to non-pigmented	Non-pigmented

*Explanation: minimum 1 seed, 2 to 4 on average, 7 maximum

Clivia in Australia

By Kenneth R. Smith

A compilation of notes given at the 3rd International Clivia Symposium…
The Huntington Gardens USA….March 2005

Australia has seen a major upsurge in Clivia interest since Nick Primich began sending out his "Clivia Club" newsletters in 1992. More and more are happening in Clivia circles each year and the Clivia scene is rapidly changing.

Early Australian records show that Clivia were listed in nursery catalogues in 1866. The species listed was Clivia (sic) nobilis. Whether or not this was the true species remains a mystery, as there is still much confusion about C. nobilis today. The garden magazines have depicted Clivia miniata photographs captioned as C. nobilis for many years. It is still occurring.

By far the most widely planted and grown species is Clivia miniata. We in Australia know it as a narrow foliage plant, that produces narrow segment flowers of a pale apricot colour, or at least that is how it is most often described. This particular type is extensively planted in the Botanic Gardens and home gardens. It is first choice for planting in a shady garden. I, like most other Australians studying horticulture, was taught that it represented the species miniata, but I have come to realize that the variety to be found within miniata is still being uncovered. This pale flower, narrow leaf miniata plant, along with the so-called C. nobilis,

"Cowlishaw"

are widespread up the eastern seaboard of Australia, in South Australia, and also in the SW corner of Western Australia. Many people are aware of the "common" miniata of gardens and the broad leaf "improved" miniata that are available from nurseries. They have been part of the nursery marketplace in Australia for many years. When it comes to our "nobilis", it is a bit more confusing. The plant is widespread but not often seen in nurseries. It is referred to as Clivia nobilis or Clivia x cyrtanthiflora, depending on who you speak to. It may well be a cyrtanthiflora type, but the origins are lying somewhere in the pages of a Botanic Gardens register.

Within the many garden plantings of "nobilis", some slight variations are to be found. Some are paler some are darker. Our "common" miniata on the other hand is very consistent in form. The situation is changing now that imported hybrids are being sold and planted amongst the more common miniata. Maybe we will get back to the diversity that is found in the wild? There is documented evidence that Arthur Yates & Co. imported the "improved" Veitch's hybrids in 1923. They may have been used by one of our earlier Clivia breeders, **Mr. G. Keith Cowlishaw**. Every so often I come across anecdotal information about our early Clivia breeders, but the picture remains unclear as to the fate of their stock. We know that the Cowlishaw material is in the hands of a few enthusiasts. The two cultivars that we know of from Mr. James Dearing, 'Ailsa Dearing' and 'James Dearing', are also safe in collections.

It is questionable whether all the "named" material from Mr. Dearing is the actual clonal material, as some seedlings may have inadvertently been distributed. The cultivars developed by Mr. Duncan Sinclair are in a couple of enthusiast's collections to my knowledge, and hopefully more are grown elsewhere, but the stock is certainly not well known. 'Salmon Queen' and 'Giant No 3' have been mentioned in past Yearbooks. I am yet to trace the complete history of a yellow clone called 'Golden Age'. It is said that two plants, a yellow and an orange Clivia were given to Percy W Dyson in 1900.

"Golden Age"

Percy named the yellow 'Golden Age', and it remained in the Dyson family for the next seventy years before being sold. Just where this clone fits in to the yellow Clivia story in Australia remains to be seen, but the search is on. Marie Jordan, a South Australian enthusiast, is selling this clone and she has named the second orange plant 'Lillian Lucy', after her mother. It is a lovely soft orange. There are two gentlemen known to us that have done a lot to popularize Clivias. **Mr. Bill Morris** is well known to Clivia Society members through his thoughtful articles in the newsletters. Bill's development of a yellow strain is documented in various journals and he is continually improving it through careful selection of breeding stock. It has taken over fifty years of growing, selecting and learning about the plants to achieve the quality he has today. The many yellow seedlings on the Australian market in recent years are probably from Bill's stock. As well as working on yellows, Bill also has a diverse collection of plants from breeders around the world. These are grown both for interest as well as development.

There are many lines of improvement that come under the careful eye of Bill. He has grown variegates for many years. He has interspecific hybrids in various shapes and colours. His Australian hybrids show development of reds, pastels, bicolours, and a range of nobilis, gardenii and caulescens hybrids? Two very fine yellows developed by Bill have been named 'Best Kept Secret' and 'Skychase'.

"Tango"

Another named plant of Bill's is the bicolour 'Tango'. Bill's daughter Judith is taking over the reins of the Morris Clivias now that the property at Medowie has been sold and Bill will be retiring to Queensland.

Mr. Kevin Walters has produced an array of beautiful forms, many of them named, from his breeding work covering the past forty odd years. Many collectors Australia wide covet the cultivars developed by Kevin: that is if they are lucky enough to secure an offset. His clone 'Relly Williams' is well known in Clivia circles. The flower form of cultivars like 'Valerie Martin Supreme' and 'Daphne Lodington' show the broad petal flowers typical of the Walter's material.

The seedlings from some of Kevin's material hold the promise of exceptional flower forms. His broad petal yellows and rich oranges are truly beautiful. He is always ready to help promote Clivias in Toowoomba, along with the support of other Clivia Society members, particularly Jeanne Marten who holds a display each year in support of the Toowoomba Hospice. There are greater Clivias to appear yet from the work Kevin started many years ago. Quite a dedicated group of Society members live in Toowoomba

and shows are organised at private residences, shopping malls and local nurseries. They are playing a major role in popularizing the newer forms of Clivia.

There are collections expanding all over Australia as enthusiasts grow more and more plants. They are enjoying their breeding work, the flowering season being sufficient reward for them. Other members of the Society are developing their own strains, perhaps to swap with other enthusiasts, perhaps with the view to commercial sales. Members that are nursery operators are growing Clivia now in the thousands, much of the seed stock being imported from around the world. By far the majority of nursery sold Clivia in Australia is the broad leaf hybrid type. These are generally produced in Queensland nurseries.

"Cowlishaw" Deep Colour

They have always been popular as potted specimens and they sell well in flower, to be enjoyed for the duration of the blooms and then perhaps to be planted in the shady garden. I have seen the impact of this within the Sydney Botanic Gardens, where the purchased plants are used to fill in the bare spaces in the garden beds, only to add to the "cross pollination potential" of the Clivias. Whether these nursery sold plants are Belgian Hybrids, European Hybrids, Sahin's Twins, or in more recent times, Japanese, American or New Zealand material, the result is the same, a complete mixing of forms. There is little

consideration given to names, or flower colour; in fact, most are referred to as "Belgian Hybrids" whether they are or not!

The situation in Australia of growing Clivias in shady gardens, irrespective of what name it has or where it came from, has been going on for over 100 years. The situation in the last decade has changed dramatically. The generosity of Mr. Yoshikazu Nakamura has seen a wealth of forms flowering in the collections of some enthusiasts. Now the "name" of the cultivar is all-important, and the flower colour description has taken on a new meaning. Special clones like 'Vico Yellow' and 'Vico Gold' are sought, and found, sometimes correctly named, most times, not. The rare yellows that were selling for hundreds of dollars several years ago are not so rare now.

The clone that we know in Australia as 'Aurea' has been on the market for many years. Now there are many nurseries offering yellow seedlings, but sales have flagged a bit in the last few years. There is plenty of opportunity to breed or select different yellow flower forms with so much seedling material on the market at reduced prices. The gardening public is questioning the origins of the material and they expect a certain flower shape and colour. shape and colour. They can afford to ask around. It appears that "the rare cream Clivia" is not so rare anymore.

"Tango"

Red flower forms are in demand, but what is a red Clivia? Certainly, selection for the deeper orange-red is warranted but I note that different people see the same Clivia flower as a different colour. Red can be orange and orange can be red. There are plants in the hands of enthusiasts that are from "redder" stock, but most nurseries treat the "Belgium Hybrids" as being the red Clivia, whether the plant for sale has flowered or not. Variegated foliage Clivias are also part of "the new range" being offered in Australia.

It is not uncommon to find a variegated specimen in a batch of green leaf plants at a nursery. These are purchased at the "normal" price, if you are lucky enough to spot one. Now there are nurseries offering various variegated Clivias at prices that range from $120 to $1500. Not too many get sold unless it is to a serious collector. Some nurseries are even offering seedlings at high prices. The variegated Clivia population is now much larger due mainly to the importation and sales of Chinese seed. Everyone wants to have an evenly striped, broad leaf plant with short leaves. The Light of Buddha cultivar group is also on the increase, although not as keenly sought as the striata type. Growers are now selling their seedlings on eBay.

Then there are the peaches. Anyone who has looked through the wonderful photographs in the Clivia Society Yearbooks will know what impact the peach forms have on them. Peaches and Pastels; very tempting indeed! There is confusion within Australia as enthusiasts want the peach forms and actively search them out. Unfortunately, some sellers use the term "peach" or "pastel" for a pale orange that has no link to the peach Clivia mutation found in South Africa. Some stunning plants are coming out of Queensland, namely 'Vannery Imam', 'Esmond Jones' and 'Andersons Peach'.

Plant importation of named peach clones is one way to ensure flower colour quality and a few of our Society members are obtaining selected material this way. Other nurseries are investigating plant importation and tissue culture as a means to increase their stock, with varying success. So, we have the well-accepted use of Clivia for the shady gardens and now the new found enthusiasm for special forms. How do we get those special forms if plant importation is too expensive? Buy seed. A noticeable

appearance on the gardening scene in Australia over the past few years is the increase in Clivia specialists advertising plants in the gardening magazines.

"Kevin Walter" Yellow

These newer nurseries are offering a vast array of material. The plants on sale are generally, one or two year old seedlings with fantastic names, names that don't mean much unless you have seen a seed list from overseas. Quite often the list just gives the seedling cross with no guarantee of flower colour. All of these plants hold promise, but most won't be what is stated. For an enthusiast that might not matter much, but for the gardener, several years wait might end in disappointment. This is an area where the marketplace needs to do some reflection. It is pleasing to report that several enthusiasts have been importing very large numbers of seeds that they plant, grow and plan to evaluate when the flowering starts in years to come. It is a learning curve.

Sales of plants via eBay are also impacting on the way Clivia is distributed in Australia. Everything from the common garden Clivia to Chinese seedlings is being sold. And we now have two new species to contend with, namely Clivia mirabilis and Clivia robusta. They will greatly enhance the gene pool in collections as enthusiasts cross their plants in the hope of creating a new flower.

But, whatever the name of your Clivia, I know you will enjoy it! Thank you.

Ken Smith, Honorary Life Member, Clivia Society of South Africa.

CLIVIA IN NEW ZEALAND – Part One

New Zealand has often been called "A Nation of Gardeners", and there are several obvious reasons why.

By far the majority of N.Z.'s colonising settlers came from the British Isles during the mid to late 1800s, many of them from working class rural backgrounds seeking a better life with opportunities for improvement. There were also, however, members of wealthy families who bought huge tracts of land and built large country houses and surrounded them with large gardens, importing the plants they were accustomed to remind them of home. So the British love of plants and gardening, and the idea that it was an art form and part of their culture, was brought to NZ, while those with money, accustomed in their former homeland to having access to the wealth of new plants being discovered and introduced to the West at this time, continued to seek these, and bring them into their new country.

Stretching between 35- and 46-degrees latitude, NZ generally enjoys a temperate maritime climate with the majority of the country seldom experiencing summer daytime temperatures higher than 26 C or below 10 C in winter. Corresponding night-time temperatures are 15 C and 0 C. Rainfall is regular and year-round, with the wetter west coast of both islands receiving between 2500mm and 1500mm annually, while the drier east coasts receive about 750mm. We have a very high uv light intensity, lots of sunshine year-round, and fairly good soils, tending slightly to the acidic in most places.

So, for coastal parts of the South Island, and much of the North Island except the mountainous central area, summers are moist but not too wet and humid, and winters are mild and often frost free. Even within cooler parts of the country, most gardens have a sheltered, warm north facing spot with a microclimate that enables relatively tender plants to be grown. I have seen Clivia gardenii growing happily outside on a north facing slope in Dunedin, despite the fact that Dunedin receives brief winter snowfalls a couple of times a year. And Clivia miniata has been growing happily outside for decades against a north-eastern wall of the palm house at the Christchurch Botanic Gardens, suffering only light frosting of leaves in some cold winters.

In short, it is easy to garden in NZ, with a very benign climate, few extremes of either temperature or rainfall, reasonably good soil, and a history and love of gardening in our ancestry, along with the urge to be adventurous and try something new.

The first record I have been able to locate of Clivia being offered for sale in NZ is in an 1892 nursery catalogue of David Hay, whose Montpelier Nursery in Remuera was Auckland's leading nursery for many years. Hay was an excellent plantsman, and also frequently corresponded with the great American plant hybridiser Luther Burbank, of Santa Rosa, California, from whom he may well have sourced plants.

"Clivia nobilis. A splendid bulb for pot culture. Produces a profusion of large crimson flowers. Highly recommended. 2/-"

Listed under "bulbs and tuberous rooted plants", it is interesting to speculate exactly what this plant was. The word "bulb", and the "large crimson flowers" description are slightly off putting when thinking of clivias. My guess is that it was actually the miniata x nobilis hybrid Cyrtanthiflora, which has been sold in NZ for decades as C. nobilis, the misidentification only being recognised and rectified in the last twenty or so years.

Another reason for thinking the plant listed was in fact Cyrtanthiflora is that in Remuera/Parnell, the affluent suburb of Auckland where Hay had his nursery, very old clumps of both miniata and Cyrtanthiflora are relatively common. Miss Harrison-Smith, a 93-

year young gardener and member of our NZ Clivia Club, lived the first half of her life at her grandfather's property in Remuera, close to where Montpelier Nursery was. She clearly remembers the nursery on Shore Road, and also recalls well established plants of both Miniata and Cyrtanthiflora in their garden when she was a child. I have found these two varieties in large old gardens, both public and private, in Tauranga, Hawkes Bay, Taranaki, Wanganui, Wellington, Nelson and Canterbury.

To the best of my knowledge, C. nobilis was not actually in NZ until imported by Keith Hammett and Terry Hatch, about twenty years ago. Lyndale Nurseries of Auckland imported seed of C. nobilis from Cape Seed and Bulb Co in South Africa in 1998 and sold approx. 1000 2yr plants to various growers around NZ. As far as I am aware, this crop is the only quantity of nobilis that has been sold commercially in NZ. I have never seen mature plants of nobilis growing in gardens, they have always proved to be Cyrtanthiflora, or occasionally gardenii.

The most widespread clone of miniata, both here and in Australia, is a narrow leafed, fairly rapidly clumping form, with soft apricot-orange flowers that have rather narrow gappy petals. It is undeniably attractive, but as the saying goes, familiarity breeds contempt, and it is often scathingly referred to by Clivia enthusiasts as "C. crappiata". This form, along with Cyrtanthiflora and possibly gardenii, probably reached our shores via Australia over 100 years ago and would have been spread around the country largely by divisions swapped between keen gardeners.

Interestingly, the 1899 catalogue of David Hay did not list Clivia again, and in fact despite searching literally dozens of old nursery catalogues dated between 1895 and 1930 I have not located any other listings of Clivia. This would seem to suggest that they were not readily available, or greatly esteemed. Perhaps, because they are a slow growing and slightly tender evergreen perennial, they did not easily fit into the production techniques of either of the two main types of nursery (i.e. tree and shrub, or hardy bulbs and perennials). Maybe the fact that Clivia had lost popularity in Britain and Europe had something to do with it, or even because of their ease of cultivation in NZ they were not considered enough of a challenge to grow.

With gardening listed as the country's number one pastime from the 1920s right up until the 1990s,(when walking took over as No 1), every rural and urban community was awash with horticultural and gardening clubs, all holding seasonal shows where members vied enthusiastically with each other to win the cup for the biggest, brightest, healthiest and best grown chrysanthemum, dahlia, gladiolus, daffodil, iris, aster etc. People WANTED plants and flowers that they could lavish time and effort on, which would reward the grower with bigger better blooms. Clivia simply didn't fit the bill.

So, for most of the 20th century Clivia lurked in dark corners of old gardens, forgotten and neglected.

R.E. Harrison's bulb and perennial nursery was established in Palmerston North in 1920, and he was respected as NZ's leading expert in this field for almost 50 years. His comprehensive " Handbook of Bulbs and Perennials for the Southern Hemisphere", published in 1953, mentions miniata, nobilis, and "a most desirable yellow-flowered variety, deeper in colour at the throat, that is known as C. miniata 'Aurea' " Was this form already in NZ or had Mr Harrison seen it overseas, or perhaps simply read about it? It would seem the latter, as in his pictorial companion volume "Know Your Garden Flowers...Bulbs and Perennials",

published in 1967, he states..."Clivia miniata is usually found in this part of the world in the salmon-apricot-coloured form, but a range of other shades from pure yellow through orange to deep red is also grown abroad".

The October 1950 and June 1955 issues of The NZ Gardener magazine contained articles about them, the latter, more comprehensive one authored by R.E.Harrison, who encouraged the importation by airmail of different coloured forms by importing seeds from US and UK catalogues..

A few passionate plantsmen scattered around the country, such as Dr Ray Freeman, and Max Goodie of Auckland, imported seeds from Schenkel in Germany, and caulescens from Gordon McNeil, about 30 years ago, while Felix Jury and Jim Schumacher of Taranaki and Stevens Nurseries of Wanganui appear to have done the same in the late 1950s or1960s. Donald Odering of Oderings Nurseries in Christchurch tells me that he was importing seed from Hurst Seed Co in London during the 1960s, but that because they were slow plants to grow, and demand was not large, they didn't do many, and few of his nurserymen colleagues could be bothered with them. Dave Austin of Kaitaia and David Thorns of Nelson both imported seed from Santa Barbara in California in the 1960s, and hybridised and sold plants locally for many years.

Clivia were seldom offered for sale (an old gardening friend in Taranaki, Mrs Gwen Masters, recalls purchasing her first three miniata plants from Pettigrew's Nurseries in Stratford in the early 1940s), but tended to be swapped and exchanged among interested plant friends more as a curiosity than a plant of any value or real use. However, as society changes, so do peoples' tastes in plants.

During the 1960s, 70s and 80s Dow Seeds of Gisborne, were importing seed from European growers, Antonia nurseries in California, and various sources in South Africa. At a similar time, Ken White of Parva Plants was obtaining Californian seed for his mail order plant business. Ken mentions going over to visit his Clivia breeder, who was very sick, and being given all sorts of "special" plants. However, Ian Duncalf, who bought Parva Plants from Ken a few years later, saw these plants and doesn't recall them being anything special. Ian was given two plants, a red called "Volcano", which flowers low in the plant, and a green throat.

Peter Lees, working for Barry McKenzie's Topline Nurseries in the mid-late1980s, was importing up to 50,000 seeds a year for a short time from Miyaki in Japan, and these were shared with North Shore Nurseries (Bryan King) and Model Nurseries (John Davies) of Auckland. These were broad-leafed, deep orange/red, and sold around NZ as Clivia "Grandiflora" when 2 years old. They were retailing at between $15 and $20 which most gardeners considered expensive at the time for a smallish plant. John Davies tells me that a couple of batches of variegated seed were also brought in, but germination was poor, and none were offered for sale.

Topline closed down soon after, but Peter Lees tells me that North Shore Nurseries have continued to source seed from Miyaki right up to the present, to provide plants for the Kings Plant Barn chain of garden centres New Zealand experienced a gardening boom and frenzy from the mid 1980s to the late 1990s, with three weekly gardening programmes on television, several gardening magazines, and a myriad of new nurseries opening to supply the seemingly insatiable demand for plants. Many plants that had been traditionally difficult to propagate,

and hard to obtain were tissue cultured, and suddenly available in large quantities. Everyone had to have a garden, even those who till now had not been remotely interested in knowing the difference between a protea and a pansy!

Keen gardeners began to break away from the historical European temperate style of gardening, seeking new and different plants, pushing the limit with subtropical plant types, and generally being more adventurous with plant associations and garden design. At last New Zealanders were developing a style of their own, fusing traditional plants and designs with the much brighter, luxurious and often flamboyant flora that would grow in our warmer conditions.

It was about now that nurserymen and plantspeople began to take a real interest in Clivia, especially the hybrid forms offered by overseas nurseries. I believe this happened more because they were not widely known or grown, and so regarded as "new", than for their intrinsic beauty and easy care qualities, which have only really come to be appreciated about a decade later, after the bubble of gardening enthusiasm burst, and people realised that they'd been conned - gardens DID entail some work after all. Drat. Let's forget the roses and pansies and look for plants that take care of themselves. Clivias!

It was at this time, too, that the clone named "Redgrove" appeared on the NZ market, one of the few named varieties to be marketed in NZ and also the first to be tissue cultured. There is a story attached to this, but for now let's just say the planned release coincided with the demise of Topline, and that "Redgrove" was not a particularly noteworthy variety, merely one of the best available at a time when there wasn't much around.

At this stage of the story many different people enter, and integrating the strands becomes tricky, rather like weaving a tapestry, or hybridising a line of plants. I think for clarity's sake, (and my sanity), I will outline the broad picture, then tell you in greater detail later about individual Clivia personalities involved and where their stock came from. In the first part of this article (The Gardener's Journal Issue 2) we looked at the history of Clivia in NZ, and how these beautiful South African plants were relatively unknown and unappreciated.

We continue the story at a time when their beauty and easy-care qualities are becoming recognised and generating a worldwide resurgence of interest and demand. Yellow Clivia were first offered commercially in quantity by Bruntwood Nurseries, who were supplied with plants by Ian Duncalf of Parva Plants. These were basically Solomone yellows, imported from Joe Solomone, California, USA. They hit the market in 2001.

Around the same time Keith Hammett began marketing his "Moonglow", "Fireglow" and "Sunset Glow" strains, launching an ambitious growing and marketing strategy partnership to ensure a plentiful supply to meet the rising demand, Terry Hatch of Joy Plants had Clivia available, and Tony Barnes was selling a few hundred reds and Australian yellows annually from his Taranaki garden, Ngamamaku.
Suddenly Clivia were the "in" plant, gaining good media exposure, and the gardening public were scrambling to obtain them.

When the NZ Clivia Club was formed, many other addicts who had been playing with their Clivia in isolation emerged. There was a focal point now, and these scattered individuals linked up and pooled knowledge and enthusiasm. Only since the Club's inception, and with the help from the South African Clivia Society, have the gaps in our knowledge about the

plant been filled, and expanded. The club has been very active, bringing overseas speakers out to NZ, holding non-competitive shows in different parts of the country, initiating and funding some research into flower pigment, doing displays at various horticultural shows, organising social events and generally promoting and building up awareness of Clivia to the gardening public.

The NZCC has at present just under 200 members, and I don't foresee this increasing dramatically soon as our population is small, and to the uninitiated Clivia do offer limited variation. However, this may change as interspecific hybrids become available, spreading the flowering season, and range of flower shape and colour.

I estimate that currently there are about 60,000 Clivia sold annually in NZ, with seed still being imported from South Africa, Europe, and USA as well as utilising NZ sourced material. Seed is generally sown in June, and seedlings sold by liner nurseries in 5cm pots at ten months old, for $1.20. At retail level, a 2-year plant in a 2-litre pot sells for about $12.00. Some plants are grown to flowering size, retailing at $25, but premium priced product is not in high demand.

There is currently a glut of Clivia available, brought about by overly optimistic estimates of the size of the market. While yellows were new, obviously demand was high, but there is now little premium for yellow plants as the novelty is gone, and large sales numbers have declined accordingly. Commercial nurseries need to work on space rental economics, and currently it is simply not profitable to grow Clivia to flowering size when the public are not prepared to pay a realistic price. Perhaps when the 2-year flowering strain from Belgium is introduced this may change.

The general public merely want a plant that looks pretty, or one that will do a job. They are not interested in breeding or background, and don't seem to like orange, preferring red. There is general interest in pastels, peaches, green throats and variegates, but these are not yet available in retail outlets, and the few offered by specialist growers/breeders are quickly snapped up by collectors. Rare and novel plants are in demand, but the connoisseur market is extremely small, and not lucrative.

A few years ago, two yellow clones were successfully put into tissue culture by Sandra Simpson of Multiflora Laboratories. She found that good pupping varieties also multiplied well in tissue, but that others were very slow. Plants ex tissue had to command a high price, which was economic briefly, but now that demand for yellows has dropped, and the price of seed is also low, it is far more economic to grow from seed than tissue. Opportunity still exists to tissue exceptionally good plants, but only if there is a strong demand for that particular clone.

There is little enthusiasm among Clivia breeders and growers here to formally name plants. Because demand is not great, and clonal division would be so slow, it is not considered worth doing. I personally believe that unless a plant or flower is not different enough from others like it to be noticed from the back of a galloping horse, it does not warrant a name.

Who knows what the future of the Clivia is? Things will change radically within the next five years due to the huge increase of diversity in the gene pool. Seeds have been sourced by enthusiasts from all around the world, and amateur hybridists are frantically cross pollinating here just as they are in Australia, Japan, USA, South Africa and UK. Undoubtedly some

wonderful material will emerge from all these places, and yet the popularity of these glorious plants still depends upon the whim of the public at large.

The busy, instant, technological society of today is detrimental to general horticulture, and all the specialist plant societies are fading away. Folk don't have time to garden any more, and many don't have space either. Children find television, computers, mobile phones, and Ipads more interesting than plants. They are not taught or exposed to the simple satisfaction and pleasure of growing things and being close to the natural world, because parents themselves have become too busy to garden. Very sad for society, but very good for the long neglected Clivia. A plant that is non-demanding, looks tidy and attractive all year, doesn't quickly outgrow its allotted space, has beautiful flowers, and is a survivor. Perfect for the low maintenance garden of the future. Yahoo!! The Clivia makes a comeback and this time, I think, is here to stay!

Because of its favourable growing climate, New Zealand now has a number of introduced plants that have "escaped" from cultivation and established themselves in the wild to become serious noxious weeds. Many of them were originally ornamental garden plants, such as Agapanthus, and Tradescantia (commonly called Wandering Jew). Until recently it was relatively easy to import plant material into NZ, despite a strict quarantine requirement. This enabled a steady flow of new material to enter the country, and NZ plant breeders have a history of developing new plant varieties, many of which have generated great income for the country's economy, e.g. Kiwifruit and Zantedeschia (Calla) lily tubers and flowers.

Courtesy of Tony Barnes, Taranaki, NZ. Email: tony.john@xtra.co.nz
www.ngamamakugarden.co.nz September 2006. Reviewed March 2020

C.miniata Red

All that changed in 1998. The Environmental Risk Management Authority, (ERMA), a newly created government body whose job is to manage and assess the risks all introduced organisms may potentially have on the NZ environment, created a plant register which they thought contained all plants known to have been introduced into NZ. If a plant was on their list it could be imported into NZ. If it wasn't, then tough luck, unless you were prepared to front up with around $50,000 to pay for the assessment while the plant was still contained in quarantine. This has virtually destroyed the importation of anything new into the country and had serious ongoing effects for the horticultural trade.

While done with the best of intentions, such is the paranoia of these bureaucrats and our Conservation Department that even Clivia themselves were for a brief time considered to have noxious plant potential, and almost put on the banned plant list. Only prompt representations by Dr Keith Hammett to the Minister of Conservation avoided this happening. Clivia nobilis, miniata and gardenii appeared on the list, but not caulescens, (which has been in NZ for about 40 years), or, of course, the recently named robusta and mirabilis. Keith provided proof that caulescens and robusta were imported into NZ prior to the restrictive list becoming enforced, and these have been added. Fortunately, also, ERMA is being more reasonable and open to requests that are based on common sense rather than high handed legalese. The NZ Clivia Club has been successful in having their submissions fast tracked to have the very recently discovered Clivia mirabilis added to the register. Normally this process would take some years, but within eighteen months of initial application seeds and/or plants of these other Clivia species can be legally imported.

Dr. Keith Hammett, plant breeder of Auckland, has probably done more than anyone else to promote Clivia in NZ. In 1973, the year Keith moved to his present property, his appetite was whetted by an article about Clivia written by Kevin Walters, and two years later Keith obtained two seeds and an offset of yellows from Kevin. These took five years to flower. They were selfed, crossed with Belgian reds and oranges, then backcrossed to recover the yellows.

One of Keith's basic guiding principles in breeding plants is "if you acquire cultivars from one breeder, cross them with the plants of another breeder". i.e. use separate gene pools. In line with this, Keith has gone to great trouble to gather from all around the world a very wide gene pool diversity, and know its source, so that now his collection would be among the best in the world.

A foundation member of the South African Clivia Society, he travelled there in1994, taking with him photos of Solomone yellows, which created great interest. Keith had met Joe Solomone via Eddie Walsh, in NZ the same year, and visited him on the way to the Clivia Conference in Pretoria. Seed was gathered from habitat populations, and many other collectors and breeders, including Yoshikazu Nakamura. Keith has been involved with chromosome study of Clivia species, and the naming of Clivia robusta.

With Alick McLeman, Terry Hatch, Lisa Mannion and Cindy Barnes, Keith organised a Clivia display at the Auckland Botanic Gardens, and from there the New

Zealand Clivia Club was formed, with Keith as Chairman. He has initiated and helped club funded research into flower pigment. His property in Auckland grows many thousand Clivia, both wild accessions and hybrids, and has been used on several occasions for club events. Keith has always freely given of his experience and knowledge of Clivia and is at present Club Patron and Technical Advisor.

Terry and Lindsay Hatch, of Joy Plants in Pukekohe, are two of our country's most respected plantsmen, and as plant collectors have been selling Clivia for many years. Terry's original plants were from nurseries growing seeds sourced from Dows (originally Belgium and Californian) and Topline (Japanese). Their garden is built around a remnant of native rimu, kahikatea and totara forest, and underplanted with great sweeps of established Clivia, which thrive in perfect conditions. Terry is convinced that these native trees, related to South African trees, produce a soil michorryaza that is symbiotic and beneficial to Clivia.

In 1984 Terry swapped a bulb of the very rare blue Worsleya (value approx 150 pounds) for an offset of a yellow Clivia belonging to Lord Aberconway. This wide leafed plant took three years to flower, and when it did it was crossed with pollen obtained from Jim Holmes and also with one of Keith Hammett's early yellows. The progeny were flowers with notched petals, and a plant of the next generation has flowered with keeled petals.

Terry has been selling mostly red and yellow flowered plants, and more recently a pastel range, the result of red/yellow crosses. He has made various interspecific crosses, and also has an interesting plant found at the home of the Archbishop of NZ, in Parnell, Auckland. This flowers pale orange, very different to our usual common form of miniata. Apparently in the early part of last century there was a South African Bishop of Auckland, and he may well have brought this plant with him.

Ian Duncalf, a consummate plantsman was until recently owner of Parva Plants, one of NZ's oldest and most respected plant mail order businesses. Ian met Joe Solomone at an International Plant Propagators conference in NZ in 1994. Joe was promoting his yellow Clivia, and Ian, always on the lookout for something rare or new, imported 100 flowering sized plants ($US 35 each) and 100 offsets ($US 6.50 each). They left USA on 7th Nov 1995 and were released from NZ quarantine in May 1996, having flowered and been pollinated while in quarantine. This seed was grown on to flowering size for confidence that the progeny would be true yellow. They all were. The original plan was to produce plants for sale clonally, by offset, but as there was considerable variation, it was decided this was not feasible. Ian gave some of the big ones to Keith Hammett, Peter Goodwin, and Eddie Walsh of Massey University. The rest were kept as stock plants for a further few years, then sold off in 2001, keeping only 15 of the best.

One of these was a relatively compact, broad leafed plant that consistently produced striped seed berries. Seed of this was kept separate, but offspring did not have the stripe. However, the most compact, broadest leafed of these seedlings were kept and intercrossed, and this was the nucleus of his "Yellow Tiger" strain. Ian also imported yellows from South Africa, which flowered the year after his Solomone stock, but they were not as good.

CLIVIA IN NEW ZEALAND – Part Two

Ian's overall plan was to develop seed strains, going with the obvious differences in plants he had, and developing these. This he has done, now selling "Solomone Yellows", "Yellow Tiger", and "Yellow Spider" Strains. These names are not registered, basically for his own reference. He still has hopes for a good red strain, and a true breeding wide petalled peach.

In return for a favour, Ian was sent seed from Japan of a "Fuyaki" strain, which he was told was very good. It is very compact, fairly wide leafed, and flowers a deep orange/red. He suspects it to be of Belgian origin. Diane, Jude and Sharon are the best three of a Cyrtanthiflora/miniata cross done about 10 years ago. None of them have been dispersed, but they have since been crossed onto yellows and good orange/reds, and seedlings sold. Delilah is a good deep red, semi-pendulous miniata/caulescens cross. Ian has sold seed to Diggers Nurseries and Green Hill Liner Nurseries in Australia, and also Lyndale Nurseries in Auckland.

Tony Barnes planted his first Clivia at Ngamamaku in 1986, which were plants sold by Topline and North Shore Nurseries, ex Japanese seed. He obtained an Australian yellow via Bill Dyk in 1995, and then for the following few years imported seed of cream and cream crossed with orange from Lois Hurley in Australia, and also some seed from Bill Morris via Peter Goodwin. He was also fortunate to be encouraged and given plants of orange/red by Alan Gray, an orchid breeder who had made some crosses and selections from plants bought at local Taranaki garden centres.

Tony has been crossing his darkest coloured plants to obtain a deep red, and in the opposite direction the softest pastels, which are crossed again with yellow to lighten them still further. Of course, a large portion of seedlings are non pigmented yellows, which are sold, and only the pigmented seedlings kept and flowered. Stem pigment on the reds is quite a deep purple, and now into the third generation the pastels are generally showing only light pigmentation. Tony's health has been indifferent for the last few years, and many of his recent seed crops were not harvested or sown. However, things are looking brighter now, and he's planning to soon be right back into clivias and his garden.

Lisa Mannion's affair with Clivia began in 1985, when she was given seed by John Lesnie, who grew Belgian seeds imported from Germany by Dow Seeds and made some selections of his own. In 1995 Lisa met Keith Hammett, and did pollinating for him, in return being generously given 25% of the yellow/orange split seed. She also imported Walter's Yellow and Twins strain seed from Ken Smith as well as other material from South Africa and Japan. But it was the wide leafed plants of the Belgium Hybrids that really caught her eye, and she has transferred this wide leafed characteristic over to her yellows and continues to breed for that. Her "Great Wide Yellow" strain was very imaginatively promoted at the Ellerslie Flower Show, and these now consistently come true with leaves 100 - 120mm wide. She sells her wide leafed reds and yellows mostly to Auckland landscapers.

Alick McLeman joined the South African Clivia Club in 1992 and met Keith Hammett at the Pretoria conference in 1994. Alick had already established a large collection when he and Frances decided to immigrate to NZ , so when the move was

made in 2000, they carried 600 plants with them, 35 mature specimens, the balance 1 and 2 year old seedlings, mostly habitat collected, Frances's personal luggage had to follow in the shipping container!

These plants, surviving 5 months of MAF's totally indifferent care in quarantine, formed the basis of Alick's breeding and sales stock, and have certainly boosted the range of Clivia plants available to enthusiasts here. Some of us have been able to purchase offsets and even flowering size peach plants rather than growing them from seed. Alick describes himself as "basically a hobbyist, playing with peaches, Wittig's Pink, and green throats."

David Brundell is a plant nutrition scientist who has worked for many years in food and crop research, mostly with cut flowers. He has gathered a wonderful collection of rare and exotic bulbs and plants, and was fortunate to meet Sir Peter Smithers in 1986, and be given a piece of the original Vico Yellow plant (see Clivia 7 page 80). This has formed the basis of his breeding programme, which aims to produce commercially viable strains in orange and yellow shades that are the best in the marketplace, with blooms that are bigger, bolder, brighter and better in all ways.

David grows all his plants under cover on a fertigation system, and believe me, they are bigger and better! He believes that NZ's climate hovers around the area that induces flowering in Clivia, and that by removing the extremes of hot and cold, wet and dry, and providing ample nutrients, he has found that many of his plants will produce a flower every five or six months. He has not formally registered any varieties, but has named 5 selections Heaven Scent, Honeymoon, Happy Sun, Apricot Sun and Mighty Sun.

Peter Goodwin, of Waikanae, assures us that Clivia are the most therapeutic plant he knows, and that many young students were saved from his wrath during the 18years he was a secondary school headmaster because he de-stressed while tending his clivias! Obtaining plants from Topline in the early 1980s, Peter also imported 3000 seeds from Miyaki in Japan, and being a compulsive pollinator, crossed them onto the common apricot form to increase vigour and deepen flower colour. This was a rather hit and miss affair, as there was no literature available at the time. However, he joined the South African Clivia Society, to whom he feels eternally in debt as the early bulletins were a huge help. He would love to meet Nick Primich.

He obtained seed of yellows and variegated daruma from Nakamura in the early 1990s, and Ken Smith and Bill Morris in Australia, who were very helpful, and also Lois Hurley in Australia in 1997, plants which flowered pale yellow or cream. The last seed lot of Belgium strain from the Cape Bulb and Foliage Co. in S.A. has yet to flower. Peter hopes he has enough time left to see this happen! Using the "broad-brush" approach to pollinating, and selling broad strains, Peter feels a little guilty for being so "sordidly commercial". However, the fact that he also grows variegates redeems him, and proves that he does in fact love the plant and is not entirely capitalistic!

Selling mostly direct to landscapers in Auckland, as well as small liner plants to commercial nurseries, this finances his racehorse interests. Peter sends a message that

if there are any rich suckers in this audience, he always has a place for you in one of his racehorse syndicates!

Di Smith, first Secretary of the NZ Clivia Club, worked tirelessly to spread knowledge, increase membership, raise funds, make overseas contacts to import seed, organise club events and activities and generally encourage members to grow, cross and show. She resigned her position in 2006.

Rex Williams, originally an orchid and palm man, obtained his first Clivia about 15 years ago at an orchid show, and was seriously smitten with "cliviaitis" six years ago. He is currently still gathering a large diverse range of plants from China, South Africa and U.S to assess for future breeding. While loving everything, he is particularly interested in variegates and dwarf forms, and wants to breed good quality pinks and interspecifics. He is very organised and methodical, and along with his wife Dee creating a wonderful large bush garden in the Waikato foothills. Watch this man, he will become one of the leading Clivia breeders of NZ in the future.

Peggy Pike sold her tissue culture lab in South Africa in 1999 and came to NZ to live, having spent a couple of years here previously. As part payment, Peggy received a considerable quantity of seed of Holmes yellow, an arrangement she was happy with, having noted a shortage of Clivia in the NZ market during her earlier visit. Although growing mostly Disa orchids, the Clivia seed was grown to flowering size, and sold locally in the Auckland and Waikato area. Peggy will concentrate on Disas now, and when all her Clivia are sold, does not plan to continue with them.

Around 1990 Craig Benson traded Sandersonia tubers for 1,000 Clivia seeds of F1, F2 and F3 crosses done by Jim Holmes. The F1 were mainly light shades of orange and red, while the others were early yellow crosses, done before Jim had really made his better selections. Craig grew these to flowering size, and also invited Jim to visit NZ, but unfortunately, because of personal circumstances, this trip did not eventuate, and Craig also had to sell and disperse his entire collection of plants.

In 1987 Barry Ferguson, a New Zealander living in New York, visited Sir John Thoron's home in Connecticut, and was given an offset of his yellow Clivia by the Head Gardener. When it flowered a few years later, it was selfed by Barry, who sent seeds to his friend Murray Gow in 1991 and 1992. Murray has used these to cross with various other plants he had and has also imported large numbers of seed from assorted South African breeders. Keith Hammett also imported an offset of Sir John's original plant.

Cynthia Giddy visited the Jury Family of Taranaki in mid 1985, on cycad business, and on the way called on Keith Boyer of Auckland, another adventurous gardener working with lots of unusual plants. She had brought with her a plant of her yellow Clivia, originally intended for an Australian friend. However, it was given to Keith, along with some seed, which was grown on. Plants of these were given to Bruce Hookum in Taranaki, and David Brundell and Eric Walton. Keith has never sold any of his Giddy's Yellow on the open market, and still has the original, now an extremely large clump.

CLIVIA IN NEW ZEALAND – Part Two

Gordon Julian, a New Zealander who lived many years in Toowoomba had gathered a considerable number of Clivia when he decided in 1992 to return to NZ to live. The plants, all yellows ex Kevin Walter's stock, were sent on before him to Bill Dyk, a specialist bulb grower in Tauranga. Gordon and his wife Bev changed their minds and went to Tasmania instead, getting more plants from Kevin before they left, and leaving the original ones with Bill Dyk. Bill sold a small number of plants via his mail order business, and it was one of these that Tony Barnes obtained in 1995. These plants were the "Flowerdale" Strain named "Aurea" in Australia, and generally thought to have been brought from England to Rippon Lea, the garden of Sir Benjamin Nathan in Victoria, in the early 1920s. (See Clivia Yearbook 2 page 50).

Eric Walton, a plant scientist working for Hort Research in Auckland, is a keen plantsman and avid collector of the rare and unusual. He sells his surplus, discreetly, to fund his garden. Between 1984 and 1990 Eric imported yellow seed from Les Hannibal, an Amaryllid collector in California, and Gordon Julian in Toowoomba, Australia. He was also given a plant of Cynthia Giddy's yellow, from Keith Boyer. Ian Duncalf bought all Eric's spare yellows, to corner the market until his own plants were released via Parva Plants and Bruntwood.

I would like to thank all the living people mentioned in this article, and others I have spoken to while gathering data, for their help and willingness to pass on to me, and hence you, the readers, their knowledge, enthusiasm, and love of Clivia. In particular I thank Dr Keith Hammett, Ian Duncalf and Terry Hatch, and also Ross Fergusson of Hort Research Library Auckland, Sue Davison of Auckland Botanic Garden Library and Barbara Brownlie of the Alexander Turnbull Archives Library, Wellington.

Courtesy of Tony Barnes, Taranaki, NZ.
Email: tony.john@xtra.co.nz www.ngamamakugarden.co.nz
September 2006. Reviewed March 2020

Ngamamaku Clivia

Clivia miniata 'Coromandel' X *Clivia robusta*

By Allan Tait

In May 2004 I embarked on a hybridization project whereby I used *Clivia miniata* 'Coromandel' which was named after the farm where they were produced. 'Coromandel' could presumably be seen as a Belgium hybrid strain. This was used as the pod parent. The robusta form was a type with a very high bud count and a good flower quality.

May might sound to be a strange time, but coincidently, a whole bunch of these miniata were in bloom and there was a robusta in flower too. A selection of the *miniata* plants with most varied flower shapes and colours was selected and the crosses made.

In early 2005 about 1 000 seeds were sown and they grew rapidly and during March 2006 the seedlings were transplanted into 2 Litre containers. Hereafter they grew fast and the first few flower spikes emerged during June 2007. During 2008 this number had rapidly increased and by 2009 about 70% had flowered, with the remaining ones flowering in 2010 and 2011.

Some of the observations that were made during these trials were as follows:

Flower season starts in May and last till mid August, giving a prolonged period of flowering.

The plants that flowered first showed more characteristics of the pollen parent, namely more rapid offset formation and tubular flowers that resembled the pollen parent. Those that followed in the next seasons showed characteristics resembling both parents and the last ones had fewest offsets but the biggest widely flared open flowers, resembling the *miniata* plants or pod parents.

All plants show good vigour and broad foliage

PHOTOS BY ALLAN TAIT

in a fairly uniform manner, though some plants have markedly shorter leaves than others.

Flower colour is fairly constant with little variation but in some the green tips and centre lines are more profound, giving the effect of bronze flowers. Of the initial 1000 seeds grown, less than 20 plants have been retained, thus giving less than 2% of plants exhibiting characteristics that I had hoped for.

My aim now is to grow plants with these superior floristic characteristics but in a far more varied colour range. A few of these have already flowered and the results look promising! All breeding programs should always aim for quality, not quantity. ▼

1854

—

Clivia miniata

Imantophyllum miniatum

Brick-coloured Imantophyllum

Gen. Char. IMANTOPHYLLUM*. ***Perianthium*** superum corollaceum, 6-partitum, patenti-campanulatum, tubo brevissimo, laciniis late obovato-lanceolatis subæqualibus, 3 int. paulo majoribus. ***Stamina*** 6. ***Filamenta*** crassa, subulata, patentia, summo tubo inserta, ***perianthii laciniis*** subbreviora. ***Antheræ*** versatiles, brevi-oblongæ. ***Ovarium*** inferum trigonum, 3-loculare, ***loculis*** oligospermis, ***ovula*** subsex in quolibet loculo biseriatis, angulo interno affixa. ***Stylus*** crassus, decurvato-adscendens, perianthio longior. ***Stigma*** 3-fidum. ***Capsula*** carnosa, indehiscens. ***Semina*** (abortione) in singulo loculo solitaria, bulbiformia, rugosa, subpulposa, magnitudine seminis *Fabæ vulgaris* (horse-bean).—Herba *acaulis*. ***Radix*** *e fibris numerosis fasciculatis carnosis crassis*. ***Folia*** *radicalia ampla lorata disticha, basi latissima amplexante.*

Previous page: *Clivia miniata* near Mponde Falls, Pondoland, 25 October 1981. Painted by Auriol Batten and completed 21 July 1983.

Typical *C. miniata* in bloom at Umtamvuna.

Scapus *plano-convexus, latus, apice umbellato-multiflorus.* ***Spatha*** *polyphylla, marcescens, colorata.* ***Flores*** *ampli, miniati, unicolores, pedicellati, bracteolati;* ***bracteolis*** *linearibus, longitudine fere pedicellorum.*

IMANTOPHYLLUM? *miniatum.*
VALLOTA? miniata. *Lindl. in Gardeners' Chron.* 1854, *p.* 119; *and at p.* 149, *observations by Mr. Backhouse.*

*[Not *Imatophyllum* (more correctly *Imantophyllum*) of ourselves, at Tab. 2856. It was unfortunate that that plate of *I. Aitoni* appeared on the same day on which the same plant was figured by Dr. Lindley in the 'Botanical Register' as *Clivia nobilis*. The name may, we think, thus with propriety be transferred to the present genus, a near ally of, but certainly distinct from, *Clivia*, Lindl.]

[We have ourselves also received living plants of the same direct from Natal.]

Greig Russell notes on his website [http://pennypoint9.itgo.com/clivia/bosse/miniatum.html]: "Plate 4785, a plate of the orchid species Coelogyne testacea, was published on the 1st June 1854. It was followed by a description which had at its end a piece of open space, in which Hooker published the following short note: ... at Tab. 4783 there should be no note of interrogation after the word "Imantophyllum". It is obvious from this that the question mark should not be included in any reference to this work – and I will make a point of deleting it wherever I have made mention of it. The reference to this would be: Hooker, W.J. 1854a. At Tab. 4783 .... Curtis's Botanical Magazine 80: sub. t. 4785.

A flowering specimen of this fine Amaryllidaceous plant was exhibited at a meeting of the Horticultural Society in February of the present year; and in the following month the Messrs. Backhouse, of the York Nursery, who imported the plant from Natal, obligingly forwarded from their greenhouse the specimen here represented. Dr. Lindley noticed the plant doubtfully as a *Vallota*: it wants the peculiar duplicature of the faux of the corolla of that genus, and it has not a bulbous root. Mr. Backhouse agrees with us that it is nearer *Clivia* than *Vallota*: so near, that I am not sorry to transfer one of the two generic names which that plant has borne to the present. Mr. Backhouse alone has imported ripe fruit; and the seeds which he describes are in appearance similar to the so-called bulbiform seed of other Amaryllidaceous plants, *Crinum* for example. We shall conclude this article with a description from the living plant, by Mr. Backhouse , which accompanied the specimen.

DESCR. "After removing the flower-stem, the plant was taken out of the pot, and the earth thoroughly washed from it, so as to allow a complete investigation of its root. This was done with a view of relieving the plant from the encumbrance of a ball of exhausted hard earth. The vertical ***root-stock*** is about four inches long, cylindrical, and truncated; the lower two inches are bare and like a section of a broomstick, about an inch in diameter. From the upper two inches protrude numerous whitish branched ***fibres***, about the thickness of a goose's quill, clothed with a short pubescence on their younger portions. The ***leaves*** on our

C. miniata growing along the steep banks of the Qwantinga River.

oldest plant were twenty-three in number, in opposite rows, the widened base of each leaf embracing that of the opposite one; and in this respect, as well as in the root, resembling *Clivia*. The leaves of our plant are not linear nor rigid, like *Clivia*, but are linear-lanceolate and stout, and exhibit not only the longitudinal nerves, but some of the stronger transverse partitions; like those of *Clivia*, they are perennial. In strong plants they come up from the centre in series of four to five at once, quickly succeeding each other; and about the time that the first of the new series is matured, the flower-stem is protruded between the outer one of these and the last of the next older series. The new leaves are of a rather brighter green than the old ones. The ***flower-stem*** is flattened, about a foot long, and supports an umbel of twelve to fifteen pedunculate flowers, at first enveloped in a sheath, composed of membranous and membranous-margined bracts.

A rare yellow *C. miniata* growing amongst typical oranges.

The ***stamens*** and ***style***, when the flowers begin to open, are decidedly declining; but the expansion of the flowers carries the upper stamens a little out of this position, and spreads the whole of them. So far as we have seen, but one ***ovule*** in each cell swells. Once, one in each of two cells was matured, and the third was abortive. In two other instances only one in one cell matured, and those of the other cells were abortive. I did not examine minutely the original number of rudimentary ovules. The seeds, being valuable to us, were not cut, so as to examine their internal structure; but their size was that of a smallish horse-bean, and, though less rugged than those of *Crinum*, decidedly 'bulbiform,' at least so both William Wood and myself considered them. They were sown immediately, under the idea that they would not keep, and they quickly pushed up each a leaf. The ***capsule*** turned of a brownish colour and became soft, and the integument of the seed was moist; and on a portion of the exterior being accidentally rubbed off, a silvery membranous coat, like that of the bulb-seeds of *Crinum*, was exhibited. Our old plant has for the last two years produced fresh leaves and a flower-stem about every four months. It has sent off several suckers from the portion of the root-stock which produces the fibres (if so the thick roots I have described may be called). If the flower-stem be kept in water, possibly some of the capsules may swell a little, so as to exhibit the number of the rudimentary ovules. The ***corollas*** are deciduous, as in *Clivia*, to which I certainly think the plant nearer than to *Vallota*. The flowers expand about two at a time daily, or in two days or longer periods, but remain so long as to form, along with the others also expanded, a fine head for from two weeks to a month, according to temperature."

A sympathetic domestic planting.

An attractive habitat scene at Umtamvuna.

Clivia miniata painted by Kathleen Lansdell in 1914.

Some biographical notes on James Backhouse

Extracted, edited and expanded from K[arstens], M[ia] C. 1968. Backhouse, James in De Kock, W. J. (Editor-in-chief). Dictionary of South African Biography Volume 1. Pretoria: HSRC. Pp. 31–32

Expanded from notes by Peter Davis of the Durham County Local History Society, Selected Biography No. 5 'The Backhouse Family – Bankers and Horticulturists'

James Backhouse, born in Darlington, England on 8.7.1794, the fourth child of James Backhouse, a banker at Darlington, and Mary Dearman, of Thorne, was to become renowned as a Quaker minister and missionary, nurseryman and botanist. In November 1822 he married Deborah Lowe (1827), daughter of the Rev. Richard Lowe, of Worcester. They had three children.

As a child he showed a great interest in religious matters, and in later life, after attending a Quaker (Society of Friends) boarding-school at Leeds, he became assistant to two Friends at Darlington in a grocery, drug and chemical business. For reasons of health he spent the summers farming, during which time he studied botany, helped by relations well versed in various branches of natural history – a great-uncle, Stephen Robson, who had published a British flora on Linnaean lines in 1777, and his uncle, Edward Robson, known as an enthusiastic botanist.

In these early years, he and his son, James, frequently visited Teesdale, west of Darlington, with its limestone and alpine flora, and made certain botanical discoveries. It was his love of botany that led him to gardening. He went to learn his business at Norwich, staying there for about two years, and making the acquaintance of Sir William Hooker, with whom he sometimes went botanizing. In partnership with his brother Thomas, he took over the well-established nursery business of J. and G. Telford at York, this being the start of the Backhouse Nurseries, renowned as suppliers of alpine plants, and in clivia circles, for the introduction of the Clivia miniata as a horticultural plant in England in 1854.

Though by profession a nurseryman and seedsman, he felt called to devote his life to the ministry, noting that:

In the study of Botany, as well as in other things, I found it necessary to keep ' to the limitations of the Spirit of Truth,' lest these things should gain an undue place in my mind, and become as idols, drawing my attention from that love and service to God, which was needful to my growth in grace, and due from me to the Author of all the mercies I enjoyed.

One of his engagements was a mission with his friend, George Washington Walker, to Australia, Mauritius and the Cape Colony, sailing for Australia with Walker on 3.9.1831 being primarily for preaching to colonists and convicts, and of visiting penal settlements, gaols, schools and other public institutions to suggest improvements and to promote temperance. Leaving his two children and his business in the hands of his brother, they stayed there for the next six years.

They spent the first three years (1832–34) in Van Diemen's Land (Tasmania) proceeding to New South Wales (1835–37) and Backhouse sent a valuable herbarium of inland species to Kew gardens. After a return visit to Hobart in 1837, they left at the end of the year and, after visits to Melbourne, Adelaide and Perth, left for Mauritius in February 1838.

After a three-months stay on this island they sailed in the schooner Olivia for Cape Town, entering Table bay on 27.6.1838. They set out on their journey into the interior by ox-wagon on 27.9.1838. During two and a half years in the country, they travelled 6,000 miles in the interior of the colony, visiting the various mission stations. B. also taking a keen interest in the indigenous vegetation. The route covered was as follows: Swellendam, Grootvadersbosch, the Little Karoo ('Kannaland'), Riversdale, Mossel Bay, George, Knysna, Plettenberg Bay, Essenbosch, Bethelsdorp, Port Elizabeth, Uitenhage, Grahamstown and Fort Beaufort. They left their ox-wagon on the banks of the Kat River and departed for Kaffraria on horseback. They travelled beyond Butterworth, by way of King William's Town and Bethel. Then they returned to the Cape Colony, picking up their ox-wagon at the Kat River. On their return journey, which took over a year, they visited Bechuanaland, Basutoland, Griqualand West and Little and Great Namaqualand.

They reached Cape Town on 11.5.1840, James sailing for England on 9 December, arriving in London on 15.2.1841.

C. miniata shown in a typical habitat of rocks and rotting vegetation.

In England he kept in touch with the colonies, sent books to Africa, and raised money for Robert Moffat's Tswana translation of the Bible. He published two large octavo volumes on his journeys, A narrative of a visit to the Australian colonies (London, 1843) and A narrative of a visit to the Mauritius and South Africa (London, 1844), which give full accounts of his activities, experiences and observations and include etchings and wood-cuts by his second cousin, Edward Backhouse. Although he writes in his introduction "The descriptions in this volume do not, however, pretend to much scientific nicety; they are rather designed to give, in few words, general ideas of the objects described," his second Narrative (1844) contains countless botanical records. The plants are given their scientific names, with, often, their common names. These notes on trees and shrubs, succulents and bulbous plants in great variety, orchids and many other plants, give a vivid picture of the vegetation of the various regions visited. The etchings illustrating the work include a plate showing the camel-thorn with the nests of weaver birds and community finches, and other depictions of South African plant life.

Backhouse was also interested in South African fauna, various mammals, birds, reptiles and insects being mentioned in his book. His contributions to the knowledge of the flora are based entirely on his own observations as a field botanist. He had an herbarium of Australian, but not, unfortunately, of South African plants. He, however, became the joint author, with W. H. Harvey, botanist and colonial treasurer, of a South African genus of the Iridaceae: Schizostylis. When the widely-distributed type species, *S. coccinea*, with its showy crimson flowers, was first identified and named, it formed part of a batch of plants received from the Backhouse Nurseries at York; the bulbs had originally been collected near rivers such as the Keiskamma, in the eastern Cape, although the name of the collector is unknown. Backhouse collected fungi in 1838 in the Albany Division; in the Cape peninsula he went on several excursions with Harvey. His Narrative is also important from an ethnographical point of view, as it gives detailed information on the way of life and the customs of various tribes, and an eye-witness account of the freeing of the slaves in Hankey.

Continuing his business in York, with his son, James, who was also a gifted naturalist, Backhouse travelled extensively in England on botanical expeditions, and paid three visits to Norway in connection with his religious work. He wrote tracts and short lives of prominent Quaker associates, and published a biography (with Charles Tylor) of his companion in Australia and South Africa: The life and labours of George Washington Walker (London, 1862).

His writings display his sense of humour, genial good nature and practical sense. Backhouse was an agreeable companion, plain of dress, with no pretensions, a strict Quaker in his daily conduct, but tolerant towards all, and one with the marked gift of moving with friendly ease among all conditions of men.

He died 20.1.1869 at his home, Holdgate House, in York.

J.F.W. Bosse and *Clivia miniata* – A question of question marks?

Greig Russell

The author of *Clivia miniata* was generally given as Regel alone, this having been the case from the latter part of the 19th century and onwards for the first three quarters of the 20th century. The reason for this appears to be that some of the earlier descriptions of this species had question marks associated with the given names – and most early taxonomists considered these names to be thus invalid. Prof. Piet Vorster formerly of the Botany Department of the University of Stellenbosch, and a man with a great interest in clivias, addressed this problem in a paper published in 1991 in the SA botanical periodical *Bothalia*. He pointed out that "Clearly *Vallota miniata* is validly published in terms of Art. 34.2 which states that 'a name is validly published when published with such a question mark or other indication of taxonomic doubt, yet published and accepted by the author'". He thus corrected the authorship, saying: "The correct author citation is therefore *Clivia miniata* (Lindley) Regel, based on *Vallota miniata* Lindley."

The International Code of Botanical Nomenclature (Vienna Code of 2006) says the following:

34.1. A name is not validly published

(a) when it is not accepted by the author in the original publication;

(b) when it is merely proposed in anticipation of the future acceptance of the taxon concerned, or of a particular circumscription, position, or rank of the taxon (so-called provisional name), except as provided for in Art. 59;

(c) when it is merely cited as a synonym;

(d) by the mere mention of the subordinate taxa included in the taxon concerned. Art. 34.1(a) does not apply to names published with a question mark or other indication of taxonomic doubt, yet accepted by their author.

52.2. Note 1. The inclusion, with an expression of doubt, of an element in a new taxon, e.g. the citation of a name with a question mark, does not make the name of the new taxon nomenclaturally superfluous.

Aside from Lindley's *Vallota ? miniata*, the original material of which can been examined on the website http://pennypoint9.itgo.com/clivia/, Hooker's "*Imantophyllum? miniatum*", usually said to contain a question mark, was an illegitimate name (see my 2010 article "*Imatophyllum*? ... Tut-tut, Dr Hooker." – *Clivia* **12**: 5–12.). I have recently discovered that it was not Hooker's intention for that question mark to be printed. See my page on the original material related to this name, as well as the note from Hooker. And then there is Bosse's ?*Clivia miniata* – too many question marks?

Various botanists have accepted this latter name as the first valid transfer of '*miniat-*' to the genus *Clivia*. There is no reason not to accept this name. The ICBN says the following:

33.2. Before 1 January 1953 an indirect reference to a basionym or replaced synonym is sufficient for valid publication of a new combination...

An examination of Bosse's entry regarding this species will readily show that he directly referred to Lindley's basionym *Vallota ? miniata* (this name rendered in full, including the question mark), as well as Hooker's illegitimate *Imantophyllum miniatum* (as "Imatophyll. miniat. *Hook.*"); so we cannot be in any doubt as to which plant he had in mind. Bosse's new combination saw the light five years before Regel published his notes on the species – and thus Bosse has priority.

Bosse may have had his concerns regarding the placement of the species in *Clivia*, but he did it, and did not offer any alternate option in his work; eg. he did not also place it under *Imatophyllum* – the other genus name he published in his work, from which entry he simply referred the reader to the genus *Clivia*, giving no other notes. Rafaël Govaerts of Kew, England, the Prince of Monocot botanical nomenclature, has accepted Bosse as the author of the combination, as "*Clivia miniata* (Lindl.) Bosse", on his World Checklist of Selected Plant Families (WCSP) (based upon my research). In my opinion Rafaël is the premier world authority in his field.

These four photographs show some of the variation which can be observed in *Clivia miniata* in habitat at a single location.

I am quite delighted that we are able to discard the work of Regel; it is just so shoddy and poorly researched that it was never worth much.

Julius Friedrich Wilhelm Bosse (1788–1864) was a German landscape gardener, horticulturist and botanist, who was the Curator of the Ducal Gardens at Oldenburg, Germany. He was of the fourth generation of the Bosse family who had all been deeply involved in German horticulture, his father being the more famous Carl Ferdinand Bosse (1755–1793). In 1807 J.F.W. finished his apprenticeship at the Royal Botanical Gardens in Berlin and then worked in the parks of Potsdam and from 1810 in the Karlsaue in Kassel. From 1812 to 1814 he worked, like his ancestors, in Lütetsburg; and then took care of Oldenburg Castle Gardens of Duke Peter Friedrich Ludwig for 42 years, eventually as curator (Grossherzoglich garten-inspector). J.F.W. Bosse added to the work of his predecessors in designing the palace gardens as 16 acres of garden art in the English style of the early 19th Century [his father having worked in England with the famous Lancelot (Capability) Brown]. This garden is said to look like a walk-in painting.

Bosse's major work was his *Vollständiges Handbuch der Blumengärtnerei, oder genaue Beschreibung fast aller in Deutschland bekannt gewordenen Zierpflanzen, mit Einschluß der Palmen und der vorzüglichsten Sträuche und Bäume, welche zu Lustanlagen benutzt werden, nebst gründlicher Anleitung zu deren Cultur, und einer Einleitung über alle Zweige der Blumengärtnerei.* (which translates as *Complete Guide to the flower garden, or a clear description of almost all known ornamental plants in Germany, with the inclusion of the palms and the principal shrubs and trees, including those plants which serve to delight, along with thorough instructions for their cultivation, and an introduction to all branches of flower gardening.*) ed. 1, 1829, 2 Volumes; ed. 2, 1840–1842, 3 Volumes; ed. 3, 1859–1861, 3 Volumes; Hannover : Hahn'sche Hofbuchhandlung.

I have prepared a translation of the applicable Clivia entry from the 3rd Edition, which was printed in Fraktur Gothic font (which offered me a great learning curve), and this may be downloaded in PDF at http://pennypoint9.itgo.com/clivia/bosse/.

The original pages concerning Clivia and *Imatophyllum* from the 3rd Edition of Bosse's Vollständiges Handbuch der Blumengärtnerei are also available here.

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Clivia mirabilis and its water balance

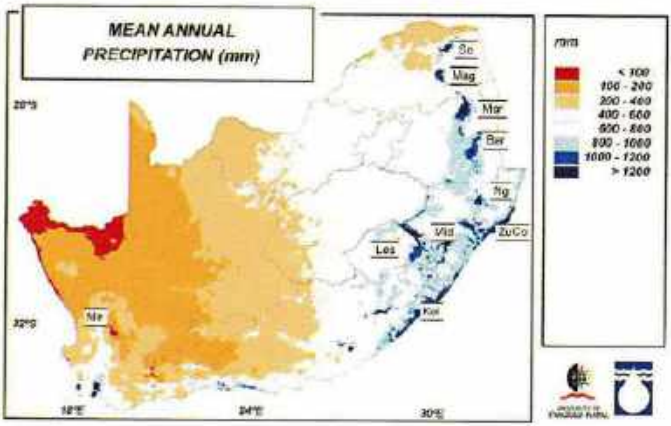
By Connie & James Abel

Clivia in their habitats have always ranked high in our interests. The habitats are invariably in very scenic areas and one can but puzzle over their complex inter-relationships with climate, topography, soils and companion vegetation. Some years ago, on the internet, we came across the attached SA rainfall map from the University of KwaZulu-Natal. It is striking how in the summer rainfall region on the right, the dark blue 1 000+ mm per annum rainfall areas give an accurate image of the location of the five eastern *Clivia* species. From the north, the positions of such well-known habitats as Soutpansberg, Magoebaskloof, Mariepskop, Barberton, Ngome, Midlands and Kei Mouth are indicated by appropriate lettering. Several of these areas are commonly referred to as being "in the mist belt". Exceptions in this region are the too-cold high Drakensberg escarpment on the Lesotho border (east of 'Les') and the too-hot Zululand coast (centre right). Also striking is the habitat's temperature related inverse correlation of latitude and altitude, with the latter dropping steadily from 1800 m in the north to sea level in the south.

The description in 2002 by John Rourke in

Bokkeveld escarpment map

Clivia Yearbook #4 of a new species *C mirabilis* from the Northern Cape was exciting news for all *Clivia* enthusiasts. This was from the Bokkeveld escarpment in the Oorlogskloof Nature Reserve in the Northern Cape (see 'Mir' on map). The existence of a few more populations in the vicinity has subsequently been reported. Two major surprises were, firstly, that this new species was found more than 800 km distant from the closest of the eastern species and, secondly, in an "arid Mediterranean climate with a winter rainfall of just 414 mm pa". Rain was stated to start in April and fall mainly between May and September. Ian Coates reports having been soaked during October and November visits, and Mandy Schumann says "mist and some rain do continue through the



Knersvlakte and Oorlogskloof map

On the flats, approaching the escarpment. A feature here is the cloud encompassing the escarpment. Photo Ian Coates

C. mirabilis habitat leading up to the sandstone cap in the background. Photo Ian Coates

summer months. The Bokkeveld Plateau is considered a transition zone of the summer and winter rainfall areas, so we also receive some of the summer thunder storm downpours. For example, this year in January, the Hantam National Gardens, just south of the town [Nieuwoudtville], recorded 54 mm for January".

Two major climatic adaptations of *C. mirabilis* are the very rapid maturation of its seed, to fit in with the different rainfall pattern, and its thick roots of about 20 mm where the mass of dead velamen cells provides an excellent storage mechanism for any surplus moisture.

With regard to origins, Felix Middleton has written: "So far it seems as if *nobilis* and *mirabilis* are very closely related. Both have, and segregate for, unique traits such as the leaf median stripe, the V shaped cross section of the leaf, the notch on the leaf tip, a mostly large flower count, darker red flowers as well as serration on the leaves (I observed a *C. mirabilis* with coarser serration than any nobilis that I have ever encountered). Although some of these traits have been reported for the other species, the occurrence is very low. My opinion is that you have two types of *Clivia*, the rough *mirabilis-nobilis* types and then the sissy soft leafed types that grow in moist forests. Which group is closer related to the ancestor I do not know. Many botanists regard the group with more diversity as indicative of the origin of a group, whilst those with less variation are spinoffs trying to populate a niche environment. Of all the species,

mirabilis has the most variation of all, so it could be closer to the predecessor. On the other hand, most of the Amaryllis family are bulbous, showing that the family originally developed within a semi-arid environment. *Clivia* do not have a pronounced bulb and therefore could have developed further, to grow in moisture rich environments. *C. mirabilis* may therefore be a species trying to re-colonise arid environments. Just food for thought".

With initial perceptions of the "aridity" of the area, from 2010 our attention was drawn to five other potential sources of moisture besides measured rainfall, namely fog, dew, plant interception, escarpment effect and the sandstone aquifer. This started with reading the research paper "Fog and Dew in the Succulent Karoo" by Matimati I *et al* in September 2010 in *Veld & Flora*, pp 140-141.

The map on page 68 shows the Oorlogskloof Nature Reserve (situated between 538 and 915 meters above sea level) on the edge of the Bokkeveld escarpment (right), about 100km from the Atlantic (lower left). The research was conducted in the Knersvlakte flats (top centre), between the escarpment and the sea at approximately 200 m altitude. The flats are well known for the dense fogs that arise from the onshore winds from the cold Benguella current in the nearby ocean. The research site has a rainfall of 149 mm pa. Use of appropriate equipment and procedures included:

- weighing lysimeters for accu-

Mist overhanging *C. mirabilis* habitat and escarpment. Photo Ian Coates

Contrasting vegetation on opposite sides of the Oorlogskloof. Photo Roger Dixon

Another "wet slope". Photo Felix Middleton

racy, and
- isotopic analysis of stem xylem moisture to distinguish whether it originated from rain, fog or dew.

Matimati and his colleagues found that:

Fog and dew: On quartz-gravel soil, fog and dew precipitated an additional 253 mm of water for a total of 402 mm pa, an increase of 170%.

Plant interception of fog and dew: On quartz-gravel soil with plants of the dwarf succulent *Agyroderma pearsoni*, the additional precipitation was 460 mm for a total of 609 mm pa, an increase of 308% of moisture.

Clivia, with their leaves funnelling run-off to the centre of the plant, are certainly "waterwise", although we are not aware of any quantification of their water interception ability.

Copies of Matimati *et al*'s paper are available on request by email from jcabel@absamail.co.za.

Escarpment or rain shadow effect: As prevailing onshore winds of moisture laden air rise over land, pressure and temperature drop and relative humidity rises towards saturation, resulting in the formation of clouds and the precipitation of mist (synonymous with fog), dew and rain. This is the escarpment effect which increases all of the above three forms of precipitation, in this case firstly over the flats and then over the Bokkeveld escarpment, home to *C. mirabilis*. This is the origin of the fog for which the west coast is so well known. The deeply incised re-entrants into the escarpment in *C. mirabilis* country are well illustrated in the Google Earth view on page 67, and ideal for "milking the breeze". The populations described by John Rourke

C. mirabilis habitat below the escarpment on a western aspect.
Photo John van der Linde

Wetland in the Oorlogskloof Nature Reserve.
Photo Mandy Schumann

C. mirabilis at the base of the sandstone cliff.
Photo Ian Coates

were "under the eastern cliffs", i.e. on western aspects facing the sea breezes.

Mandy Schumann's statement that "mist and some rain does continue through the summer months" has further relevance here. There will be days of mist without rain, and those days will extend the "wet season", through the mechanisms highlighted by Matimati *et al.*

Sandstone aquifer: Lena van der Merwe first pointed out to us that the cap of the escarpment is a 30 m thick layer of Peninsular Formation Sandstone, which serves as a massive aquifer. The sandstone has a porosity or water capacity, if saturated, of about 20%. Over-simplistically, this is equal to 6 000 mm of water or 15 times annual rainfall!

The effect of this aquifer has been summarized by Roger Dixon as follows:

"*C. mirabilis* grows at the bases of sheer sandstone cliffs, in the afro-montane forest. They grow associated with *Haemanthus, Zantedeschia* and other plants which like to have moisture, but can tolerate a few dry spells. The

A flowering *C. mirabilis* on the edge of a raging torrent after rain. Photo Ian Coates

sandstone talus at the base of these cliffs acts as a moisture trap, and, although it may be dry on the surface, the wicking moisture percolating upwards keeps the humic sandy soil cool. The sandstone layers here are semi-horizontal, and water percolating through the layers encounters joints along which it can flow, so a lot of water which is collected on the escarpment can find

A flowering *C. mirabilis* enjoying a humid environment against its mossy backdrop. Photo Ian Coates

In contrast, a *C. mirabilis* in a dry river bed. Photo Felix Middleton

its way out horizontally into the talus at the base of the cliffs".

John van der Linde has sent us a photograph of a *C. mirabilis* habitat on the western aspect of the valley. He says "One *mirabilis* location was owned by the late Mias Volgraaff, whose occupation was drilling for water. As such he had geological knowledge. He pointed out to us that the *mirabilis* were concentrated on a specific part of the hill side, not to the left and not to the right. He said that was where the underground water flowed down".

A benefit of the underground water will be that, beyond rainfall, seasonal moisture availability will be extended as seepage steadily takes place.

It is clear from the above that *C. mirabilis*, in terms of its water balance, benefits from these factors in terms of both volume and length of season, and it may well join the over 1 000 mm pa band of its cousins. However, their moisture availability will also be greater than just rainfall, due to some or all of the above factors.

The above has been sketched with a broad brush, and for the Oorlogskloof there has been no quantification.

C. mirabilis standing proud in the slanting rain. Photo Ian Coates

A *C. mirabilis* seedling on a typical rough seedbed, showing the top of its thick root. Photo Ian Coates

A feature of *Clivia* populations in habitats is that they are usually limited in size (less than a hectare) and their boundaries are surprisingly abrupt. The reason for these boundaries is not evident to casual observation, and must be due to undetermined micro-environmental factors, perhaps soil, climate, aspect or other subtle influences.

Consequently any accurate quantification of *C. mirabilis*'s natural moisture regime will long remain beyond our reach.

With appreciation to the many *Clivia* friends who have contributed in discussion, and with special mention of the local knowledge freely shared by Mandy Schumann, detailed specialist advice from Felix Middleton and the experienced guidance and photos of Ian Coates who, incidentally, first featured in our Clivia publications in the Clivia Club Newsletter #2.1 January 1993, edited by Clivia Society founder Nick Primich.

Note: The despicable actions of some self-proclaimed "enthusiasts" who have blatantly stolen plants from the habitat, sometimes with the excuse of "saving them" [in their own collections!], are and will continue to be a serious threat to the survival of *C. mirabilis* and other *Clivia*. For this reason, we have avoided any directions to specific habitats.

Clivia mirabilis Hybrids

John Winter, South Africa

The discovery of *Clivia mirabilis* in the Mediterranean climate of the Northern Cape in 2001 rates as a major botanical find, considering that the distribution area of this new species occurs 800kms west of the previously known distribution of the genus. Although not the most spectacular of the species of the genus *Clivia* it is unique for a number of reasons.

Clivia mirabilis has adapted well to winter rain and dry summers with vegetative growth occurring during the winter months. The rapid development of the seeds within 4 months in early autumn allows for germination to take place when the winter rains commence. Two distinguishing features are the prominent white stripe on the upper surface of the leaf of some plants and the carmine-maroon base of the leaves that form the leaf sheath.

In September/October of 2002 orange and yellow forms of *Clivia miniata* were pollinated with pollen from *Clivia mirabilis*. Later that year *Clivia caulescens* was also pollinated. The seeds matured in 4 months and were sown in March/April 2003.

Typical of hybrids, the young seedlings grew well displaying vigour. These hybrids have been re-potted regularly each year to encourage rapid growth. In September last year some of the orange *Clivia miniata* crosses flowered for the first time. None of the other crosses have flowered as yet.

The majority of the hybrid seedlings are easily distinguished by the deep carmine-maroon coloured stem-base. The leaves of some of the plants do display a faint white stripe down the centre of the upper side of the leaf.

Photo: Claude Felbert

Even mature *mirabilis* hybids have a pigmented base.

The peduncle is strong and supports the inflorescence of 22-26 pendulous flowers set well above the leaves. The colour of the flowers range from orange to dark orange as can be seen from the illustrations.

With the flowering I have pollinated these hybrids with *C. miniata* plants ranging from dark to light orange, yellow, multi-tepal as well as pollen from one of the hybrid siblings. Reverse crosses have also been made using pollen from *C. mirabilis* hybrids onto various *C. miniata* plants.

Considering what Mr Nakamura has achieved with interspecific *Clivia* breeding another species in the mix will certainly provide us with exciting expectations for the future.

Photo: Helen Marriott

Note the yellow throat and green tipped tepals

Photo: Mick Dower

Above: *C. miniata* (orange split for yellow) x *C. mirabilis*
Below: *C. miniata* (orange) x *C. mirabilis. First flowering*

Photo: John Winter

Clivia Mirabilis in the Western Cape

Hein Grebe, South Africa

Naturally-occurring *Clivia* in the Western Cape, growing in an area where you find an abundance of wild flower bulbs, are seriously endangered. Fossil discoveries show that the dry areas of the Western Cape and Namaqualand were once rich in flora and fauna. But with continued climatic change over the millennia many of those flora and fauna could not adapt to survive the long dry summers of the Western Cape. *C. mirabilis* now barely survives, truly a relict of a long lost world.

***Clivia mirabilis* survives in austere conditions**

Only a few isolated populations, hiding in small pockets of mountainous forest of less than one hectare, have managed to cling onto a precarious existence. I am inviting you to visit some of these populations to give you an idea of the conditions under which they survive and how their numbers are dwindling each year. I first wrote about these populations on private farm land in my article, "In search of *Clivia mirabilis*" in CLIVIA 7.

Most of the pictures in this article were taken on a farm in the mountains outside Vanrhynsdorp. This town lies some 50 km to the south-west of Nieuwoudtville, the nearest town to the Oorlogskloof Nature Reserve in the Northern Cape Province, where another population of *C. mirabilis* was discovered in 2002. John Rourke wrote about these plants, and the naming of the new species, in his article, "The miraculous clivia" in CLIVIA 4. Oorlogskloof is now closed to the public.

On the farm to which I have access the plant habitat changes from semi-desert to succulent to grassland and mountain forest as you go up the steep route to the farmhouse. From there it is a further drive on 4wd terrain to a river, and then a couple of km by foot all along a riverbank before the *C. mirabilis* suddenly and miraculously appear before you. Some grow in the open, some near the river, while others are partially sheltered in trees and many grow between rocks.

Those that grow in the open are the most vulnerable. They are open to attacked by the sun's scorching rays, insects and wild animals that chew on anything green during the hot dry summers when the only green plants around are the *mirabilis*.

***Clivia mirabilis* in the wild is not easily accessible**

It does not take long to notice that the continued weather change has had an adverse effect on the trees that are there and which rotect the *C. mirabilis*. Year after year more and more trees and bigger shrubs die, leaving the *C. mirabilis* more exposed and unprotected and in even greater danger from fire, as many of them are surrounded by dry wood.

Despite the harsh climate we see that *mirabilis* can produce striking and beautiful blooms

The only relief during the long summer months comes from short thunderstorms that bring clouds and rain to this region. During autumn, fogs rolling in from the Atlantic provide moisture and cool the plants down for a few hours before the sun's rays attack them again. During these long hot months *mirabilis* is in a struggle for survival against the forces of nature. Some plants lose all their leaves due to the scorching sun; others get uprooted by frustrated baboons and porcupines looking for food. Few seedlings, if any, make it to adulthood.

By July everything changes into the colourful wonderland that has made Namaqualand famous. Everything is green, and flowers of all colours and shapes are everywhere in abundance. In July, August and early September the *C. mirabilis* companion bulbs such as *Zantedeschia* and *Eucomis* are in flower. As soon as the winter rains cease, those *mirabilis* plants that have managed to

recover from the dreadful summer months with sufficient energy stored in their system begin to push flowers. It is seldom that a *mirabilis* will flower in two consecutive years. This can be seen from the fact that any green flower stalks of the previous year are still intact. Most *mirabilis* flower within a very short period of around 4 weeks. Out of season flowers are unheard of. The earliest flowers are usually seen in mid-September and the last in the last week of October. Those flowers that bloom late have a short life due to the heat. It is not uncommon to measure 30° C at midday in the middle of winter - after freezing nights! - and 40° C and more in the shade in November.

The flower colours are amazing and are usually the hard-to-find colours on the colour chart; neon-like colours such as red, orange-red, orange, watermelon, papaya, salmon pink, etc. The lightest shade is a type of yellow blush and the inside of the flowers is peach. The pollen quickly dries out due to the heat and dry air. Small ant-like insects move up and down the tubular flowers. Occasional flying insects that look like a cross between a fly and a bee also visit a flower here and there. Sunbirds are believed to be the main pollinators. From the scratch marks on the flower petals one can speculate that wind may also play a role in the pollination process. Only 30% of the flowering plants will end up with seeds, and then with only one or two seeds per plant. It looks as though some plants abort the seed-forming process by not feeding the flower stalk, which shrivels up after a couple of weeks.

The seed-forming process is much quicker than that of the other *Clivia* species and *mirabilis* seed is ripe by the end of February. Little of the seed known to be set is eventually found. It appears that some creatures, which no one has yet seen, remove the seeds and carry them away. In 2005, after two days' search of three populations fewer than 50 seeds could be found after a thunderstorm. In 2006, ripe seeds disappeared just as mysteriously from a *mirabilis* plant in a garden.

The leaves of *C. mirabilis* come in various lengths and widths. On some the median stripe is missing while on others it is more prominent and almost white. A few plants discovered this year have more than one stripe. In 2004 I discovered a *C. mirabilis* plant with *nobilis*-like notched leaves.

After this discovery I spent hours with my *nobilis* plants at home when they were in flower to take photos and to compare the two species. There are so many differences that it is actually amazing. Scientific research has shown that the difference in genetic make-up between these two different *Clivia* species is greater than the difference between man and ape. Does this mean that there might be another elusive *Clivia* species or two, intermediate between *mirabilis* and *nobilis*, waiting to be found – if they have not already become extinct? In my view, the breeding possibilities with *mirabilis* are endless.

From nature it looks as though *mirabilis* is very slow-growing, like the surrounding succulent and desert plants. It could thus be better to use it as a pollen parent. The problem is the limited number of flowering plants, most of which produce almost useless dry pollen. In 2005, I mixed this dry pollen with sugar water and placed it on the stigmas

Clivia nobilis to compare with *mirabilis*

Clivia mirabilis – note the differences from *nobilis*

of 15 flowering *C. miniata* plants. Of these 15 plants only seven produced seed heads. Some of these seven produced only one or two seedpods each. It will be interesting to see the difference in the seedlings. I am hoping to create new colours with these crosses in the second generation. Hopefully the neon-like colours and inside peach of the *mirabilis* will play a role.

Although the *C. mirabilis* seed looks similar to that of *C. miniata*, *C. caulescens* and *C. gardenii*, a long thin radicle grows and appears similar to that of *C. nobilis*. At the end of the radicle a tubular root is formed and later a small leaf. During the dry summer months the small plants become dormant and new leaves only appear after the winter rain. My guesstimate is that it can take up to 10 years for a *mirabilis* to flower in the wild.

The future of *C. mirabilis* in the wild looks bleak. Plants seldom produce offsets and from my observations I cannot see that small plants make it to adulthood. On many occasions I have seen plants uprooted or destroyed in the wild. Luckily the farmer has shown an interest in protecting this rare species on his property. He has built a shade house where he nurses damaged plants and where he grows young plants from seed.

Many enthusiasts now have *mirabilis* seedlings grown at Kirstenbosch from seeds collected from the population at Oorlogskloof. With others showing an interest in growing plants from seed that I have been able to distribute, collected from the other populations on private land, the future of *C. mirabilis* under domestication – in contrast to the plants in the wild - fortunately seems assured.

Above : *Clivia mirabilis* with notched leaves similar to *nobilis*

Left : Green tipped *mirabilis* flowers and a very dark peduncle

Photographs by Hein Grebe

2002

Clivia mirabilis

Rourke, J.P. (2002). Clivia mirabilis (Amaryllidaceae: Haemantheae) a new species from Northern Cape, South Africa Bothalia 32: 1–7

Clivia mirabilis (Amaryllidaceae: Haemantheae)

a new species from Northern Cape, South Africa

J.P. ROURKE*

Keywords: Amaryllidaceae, arid Mediterranean climate, *Clivia* Lindl., new species, Northern Cape

Abstract

Clivia mirabilis Rourke is a new pendulous tubular-flowered species from Oorlogskloof Nature Reserve in Northern Cape. Its distribution area is some 800 km outside the Previously accepted range of the genus *Clivia*. This sun-tolerant species is adapted to an arid Mediterranean climate, producing vegetative growth in winter and maturing its seeds rapidly in late summer/early autumn to synchronize with the arrival of winter rains.

Introduction

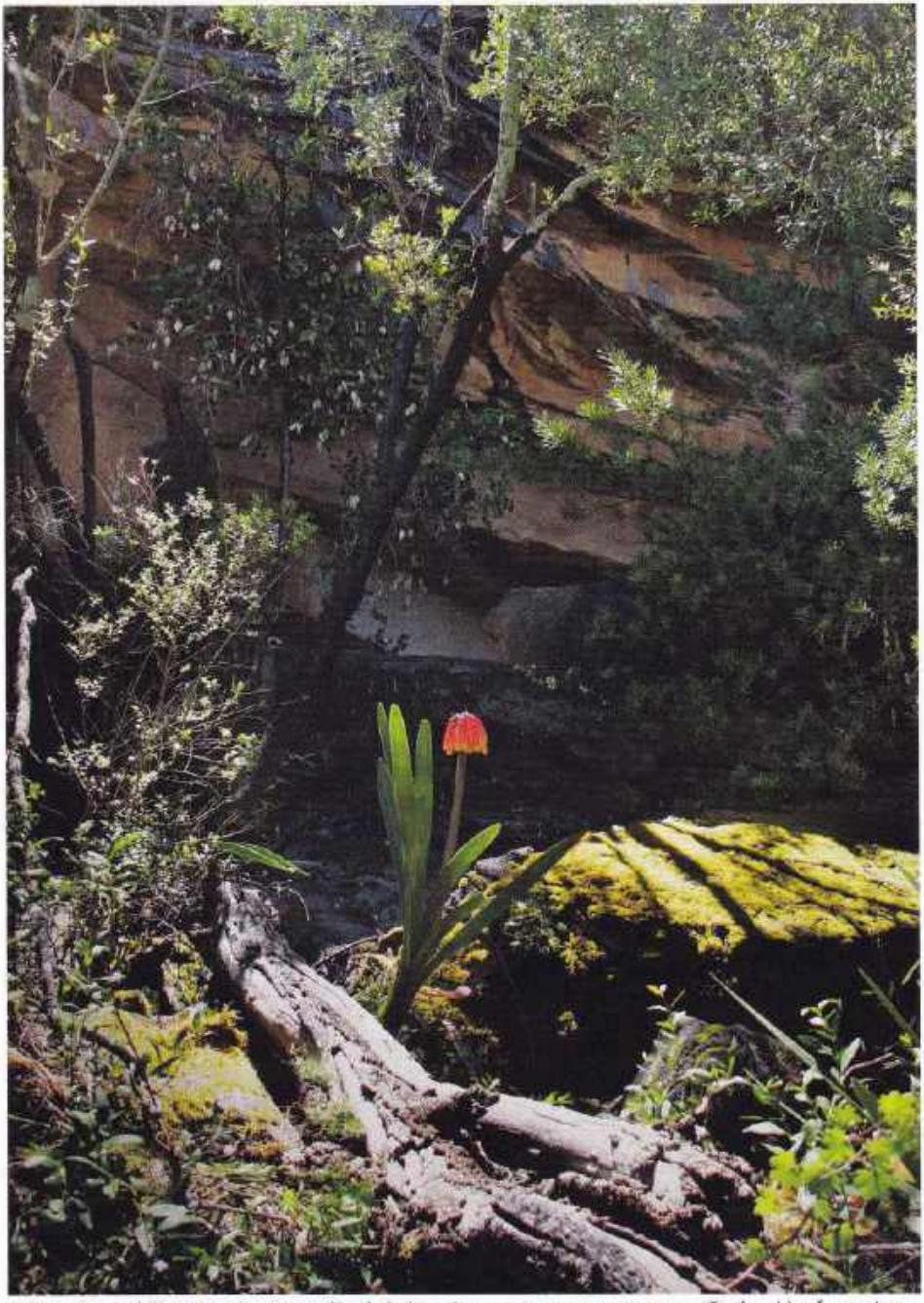
The genus *Clivia* Lindl., consisting of four currently recognized species, *C. nobilis* Lindl. (1828), C. miniata (Lindl.) Regel, *C. gardenii* Hook. (1856) and *C. caulescens* R.A.Dyer (1943), is presently considered to be endemic to southern Africa (Vorster & Smith 1994; Snijman 2000). These species occur in coastal and inland Afromontane forest from Eastern Cape through KwaZulu-Natal, Swaziland and Mpumalanga to the Soutpansberg in Northern Province. Rumours of the occurrence of *Clivia* in Mozambique have not yet been confirmed by accurately localized herbarium collections.

Left: *Clivia mirabilis* painted by Leigh Voigt.

Clivia is an evergreen, rhizomatous genus in the Amaryllidaceae, characterized by distichous strap-shaped leaves, umbellate solid scapes and red subglobose berries containing one to few cartilaginous, pearly-white seeds embedded in soft yellow pulp.

In February 2001 material of a further species was submitted to the Compton Herbarium for identification in a batch of herbarium specimens from the Oorlogskloof Nature Reserve near Nieuwoudtville, in Northern Cape, collected by the nature conservation officer in charge, Mr Wessel Pretorius. The author confirmed this astonishing discovery during a site visit to Oorlogskloof on 22 February 2001 when two fruiting populations were examined. The new species is here described as *Clivia mirabilis*. Rarely can such an extravagant epithet as mirabilis be confidently applied, yet in the case of this extraordinary *Clivia*, so unusual in its distribution and characters, its usage seems entirely appropriate.

Clivia mirabilis *Rourke*, sp. nov., a speciebus affinibus, corollis actinomorphis rectis tubularibtis bicol-oribus (miniatis/luteis); pedicellis cernuis, 22–40 mm longis, miniatis per anthesin (demum viridibus post anthesin); foliis lineamentis medianis albis et apicibus acutis, distinguitur.



A lone *C. mirabilis* greets you immediately below the escarpment as you enter Oorlogskloof, growing between Peninsula Formation Sandstone boulders. These plants grow where the scree is kept moist by underground seeps or springs.

Rhizoma perenne solitarium, erectum; caespite foliorum 0.6–1.2 m alto. ***Folia*** disticha, rigida, erecta, 0.6–1.2 m longa, 30–50 mm lata, glabra, coriacea, lineamentis medianis albis; margines cartilagineae, plerumque laeves, interdum leviter scabra; apices acuti. ***Scapus*** 300–800 mm longus, carmineus, late ancipitius. ***Inflorescentia*** umbellata, 20–48 floribus; spathae 5–7, cymbiformi-acutae, papyraceae, 35–50 mm longae, 10–15 mm latae. ***Pedicelli*** cernui, graciles, 25^40 mm longi, miniati per anthesin, abrupte viridescentes post anthesin. ***Perianthium*** rectum, tubulosum, 35–50 mm longum, dilatatum versus orem; miniatum sed viride ad apicem per anthesin, tandem flavescens distale. ***Antherae*** 6, basifixae, leviter exsertae; filamenta 30 mm longa, basaliter adpressa circa stylum. ***Stylus*** 40–45 mm longus, trilobatus; apices subtiliter penicillati. ***Ovarium*** ovoideum, nitidum, miniatum per anthesin; viride post anthesin; loculi 3–4 ovulati. ***Baccae*** pendentes, irregulariter ovoideae, glebulosae; (1)2–5(–7) semina continentes, pericarpium maturum scarlatinum. ***Semina*** irregulariter ovoidea, ±10 mm in diam., alba.

TYPE.—Northern Cape, 3119 (Calvinia): Nieuwoudtville, Oorlogskloof Nature Reserve, eastern margin of Oorlogskloof Canyon at Agterstevlei Farm, (-AC), ± 900 m, 18–10–2001, *J.P. Rourke 2220* (NBG, hole; BOL, K, MO, NSW, PRE, iso.).

Stout, rhizomatous, solitary, evergreen perennial, 0.6–1.2 m tall; stem reduced to a vertical rhizome, up to 250 mm long terminating in a tuft of leaves. ***Root system*** massive, up to 0.7 m diam., horizontally spreading; roots perennial, very stout, fleshy, up to 20 mm diam., outer surface covered in a corky, velamen-like layer. ***Leaf sheath*** prominent, flushed deep carmine (RHS 183A greyed-purple). ***Leaves*** long-lived, stiffly erect, distichous, strap-shaped, 0.6–1.2 m long, 30–50 mm wide, flattened to slightly V-shaped with a distinct pale whitish grey striation in the midrib area on upper surface, striation becoming less distinct in older leaves, coriaceous, glabrous, deep dull green, flushed carmine-maroon at base, apex obtuse-acute; margins entire, cartilaginous, usually smooth, occasionally irregularly scabrous, becoming slightly revolute in old, mature leaves. ***Scape*** 300–800 mm long, broadly ancipitous, longitudinally ridged, 10–14 mm wide, glabrous, carmine-flushed. ***Inflorescence*** umbel-like, 20–48-flowered, subtended by 5–7 brownish/carmine, papyraceous spathe valves, narrowly cymbiform-acute, 35–50 × 10–15 mm; pedicels drooping, slender, 25–40 × 1.2 mm, orange-red, abruptly turning green in post-pollination phase. ***Perianth*** straight to imperceptibly curved, tubular, becoming progressively flared towards apex, 35–50 × 5 mm below ovary, 10–12 mm diam. at mouth, orange-red (RHS 32B) proximally, green-tipped (RHS 145A) distally on opening, the green changing to yellow (RHS 22B) distally, entire perianth becoming deep orange-red (RHS 33A) after anthesis; tepals fused distally to form a tube 10–15 mm long, outer tepals narrowly oblong, apices acute, inner tepals slight-ly wider, apices obtuse, outwardly flared. ***Stamens*** 6, dorsifixed, 2 mm long, very slightly exserted at anthesis; filaments 30 mm long, attached to tepals 10 mm above ovary; inwardly bowed proximally, adpressed around style at point of attachment forming a 10 mm long nectar well above ovary. ***Ovary*** ovoid, shiny, greenish yellow in bud, becoming orange-red at anthesis, changing to bright green in post-pollination phase; ovules 3 or 4 in each locule; style 40–45 mm long, terete, glabrous, tapering distally, included

A variety of colours and forms found over three *C. mirabilis* sites. In general, the more sun they get, the redder they are.

at anthesis, later elongating and becoming exserted 5–8 mm in post-pollination phase; stigma trilobed, lobes 0.4–1.0 mm long, penicillate at apex. ***Fruiting heads*** with 25–35 pendent berries. ***Berries*** irregularly oblong to ovoid, 10–30 × 10–15 mm, glebulose to submoniliform, often narrowed to a distinct neck above pedicel, apex often tapering to an eccentrically angled beak, containing (l)2–4(–7) gongyloid seeds projecting prominently and irregularly through thin pericarp; pericarp glossy, pale apple green, maturing through yellow, orange to pinkish red; mature berries red (RHS 40B eventually becoming RHS 45B). ***Seeds*** somewhat ovoid, slightly faceted, ± 10 mm diam., pearly white; embryo green. (Colour references according to Royal Horticultural Society colour chart.) Figure 1; Plates 1&2.

Diagnostic characters

Clivia mirabilis is distinguished by its straight, actinomorphic, bicolored (orange/yellow) tubular corolla, long drooping pedicels, 25–40 mm long, that are orange-red at anthesis and green when fruiting; the distinctive single median white striation on the upper surface of the leaves with smooth cartilaginous margins; and irregularly shaped glebulose-gongyloid berries. The basal part of the leaves forming the leaf sheath is flushed a deep carmine maroon, unlike any other *Clivia* except *C. nobilis*, which occasionally produces similarly coloured leaf bases. The orange-red coloration of the pedicels in this species during anthesis is a unique character in the genus *Clivia*.

Distribution and habitat

Apparently confined to the Oorlogskloof Nature Reserve in Northern Cape (Figure 2), *Clivia mirabilis* is restricted to a small area on the eastern margin of the Oorlogskloof Canyon. Populations are known to occur just north of Eland se Kliphuis adjacent to Agterstevlei Farm and a little further south around the Driefontein Waterfall. The distance between these sites is ± 5 km. The species also occurs at a few sites between these two localities.

The margins of the Oorlogskloof Canyon are capped with 30 m cliffs of Peninsula Formation Sandstone. This has eroded to form coarse sandstone talus screes below the cliffs that are partly covered in a light woodland of relictual Afromontane evergreen forest elements, principally *Olea europaea* subsp. africana, *Maytenus acuminata*, *M. oleoides*, *Cassine schinoides*, *Halleria lucida* and *Podocarpus elongatus* with additional shade provided by outsize, (4 m tall) specimens of *Phylica oleaefolia*. Small groups of *C. mirabilis* grow rooted in humus between cracks in the sandstone talus of the rock scree, either as solitary individuals or in small groups. Occasionally some clumps occur in full sun but these tend to have shorter leaves and often show signs of water stress (dried leaf tips). However, the remaining leaves show no signs of sunburn, despite the intense insolation experienced for several months each year. The main population extends over several hectares and probably consists of well over 1 000 individuals. Due to the position of these two sites under the eastern cliffs of Oorlogskloof Canyon, most plants experience shade until about mid-morning after which they are in direct sun.

The area is characterized by a semi-arid Mediterranean climate with a strictly

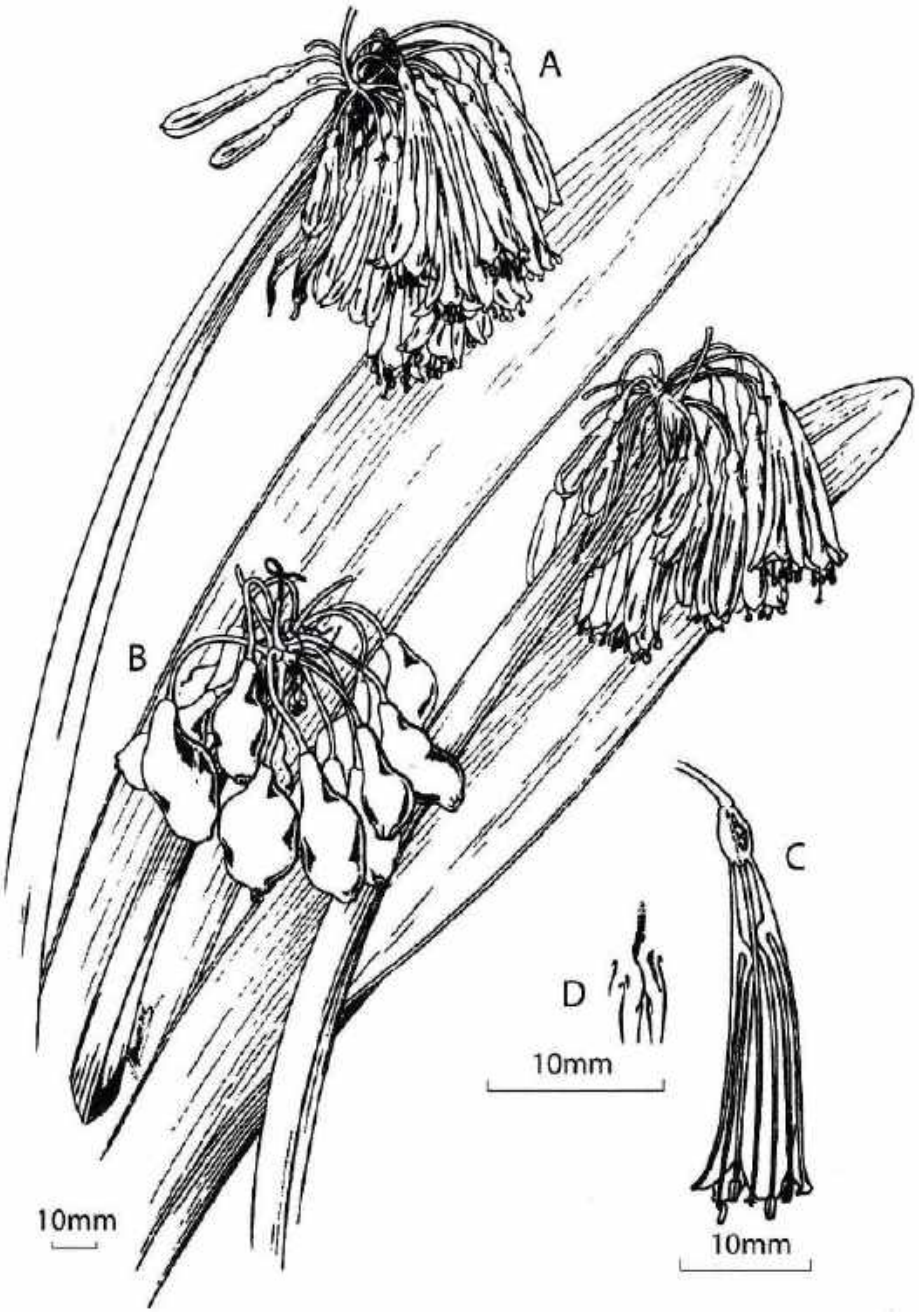


FIGURE I. *Clivia mirabilis*: A, mature inflorescence; B, fruiting head with irregularly shaped berries; C, longitudinal section through flower; note filament bases adpressed to style forming nectar reservoir; D, detail of filament bases. Scale bars: 10 mm. Artist: John Manning.

winter rainfall regime— exactly the opposite climatic conditions experienced by the other four species in this genus. The mean annual rainfall for Oorlogskloof is 414 mm, falling mainly between May and September. Vegetative growth is thus restricted to a brief winter growing period. Situated at 850–900 m, some 100 km inland from the coast, these populations are subject to brief but light frost in winter.

Morphology and biology

Root system

On excavating several plants in the habitat for cultivation at Kirstenbosch, the enormous root system characteristic of this species was revealed. Large adult plants have a mass of fleshy, succulent roots radiating between ½–¾ m from the base of the rhizome, each root ± 20 mm in diameter. This disproportionally large volume of subterranean biomass gives mature plants an extensive water storage capacity, allowing them to survive the prolonged rainless summers of the Oorlogskloof environment.

Flower colour, development and pollination

The general impression of a fully open scape is of bicoloured, perianths, orange-red at the base, yellow towards the mouth and with orange-red pedicels. During the development of the flower, both perianth and ovary progress through a series of well-marked colour changes. The unopened bud is yellowish, but prominently green-tipped, and the ovary is also pale green. At anthe-

More examples of the variety of colours and forms found over three *C. mirabilis* sites.

sis the green coloration slowly disappears from the tips of the tepals which take on the same yellow tones as the basal half of the perianth. The pedicels and upper half of the perianth are deep orange-red at this stage. After pollination the yellow coloration disappears and the whole perianth and ovary take on a uniform orange/red colour. As the perianth begins to wither, the ovary swells and undergoes an abrupt colour change from orange to bright green, as do the pedicels. No other Clivia has pedicels the same colour as the perianth when the flower is fully open. The pedicels abruptly change to green as the perianth abscisses and the ovary swells in the post-pollination phase.

The purpose of these colour changes is not yet understood, but is probably related to pollinator cues. Pollination appears to be by sunbirds. A single sighting of a malachite sunbird probing the perianths was made at Oorlogskloof in October 2001 suggesting that sunbirds could be involved in pollen transfer. However, like the other three tubular-flowered species, C mirabilis may also be a selfer as between 80 and 90% of the flowers in each umbel are pollinated and produce viable berries. Flowering time: ± six weeks, from October to mid-November.

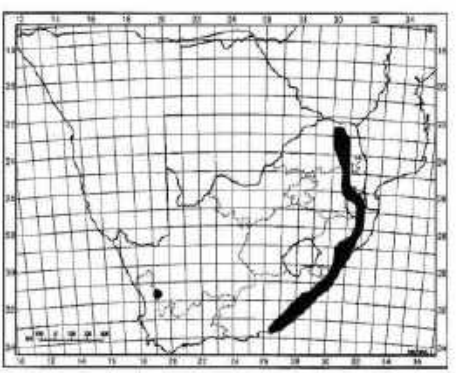


FIGURE 2. Distribution of *C. mirabilis*, •, in relation to the distribution of the remainder of the genus *Clivia* (black shaded area).

Fruiting

The berries mature more rapidly than in the other *Clivia* species. By the end of February, four months after flowering, the fully developed berries turn from yellow and orange to pinkish and later red by the end of March and are shed shortly thereafter prior to the onset of the first winter rains in April/May. This rapid autumn maturation of berries is in sharp contrast to the summer rainfall area clivias which mature slowly, usually 12 months for *C. miniata* and *C. gardenii*, about nine months for *C. caulescens* and *C. nobilis* (Duncan 1999) to coincide with the commencement of October/November summer rains.

Seed dispersal and germination

Berries commence falling from late February to early April. Germination appears to be rapid in response to the onset of autumn/early winter rains. At Kirstenbosch seeds sowed on 18 March 2001 had already developed a 10 mm radicle by 10 April 2001.

On germinating, the primary root develops into a swollen, white, succulent cylinder up to 50 × 5–6 mm. During the moist winter months (May–September), it swells, accumulating water in its succulent tissue. By October, two short (5–10 mm long) leaves have been produced, whereafter further vegetative growth of the seedling slows or largely ceases with the onset of summer dormancy (November–April). During the rainless phase of ± six months the seedling survives on water reserves stored in the greatly enlarged primary root. Vegetative growth commences again in autumn. Thus the biology of a *C. mirabilis* seedling in its first year is much akin to a winter rainfall area geophyte with the swollen primary root being functionally equivalent to a corm or bulb.

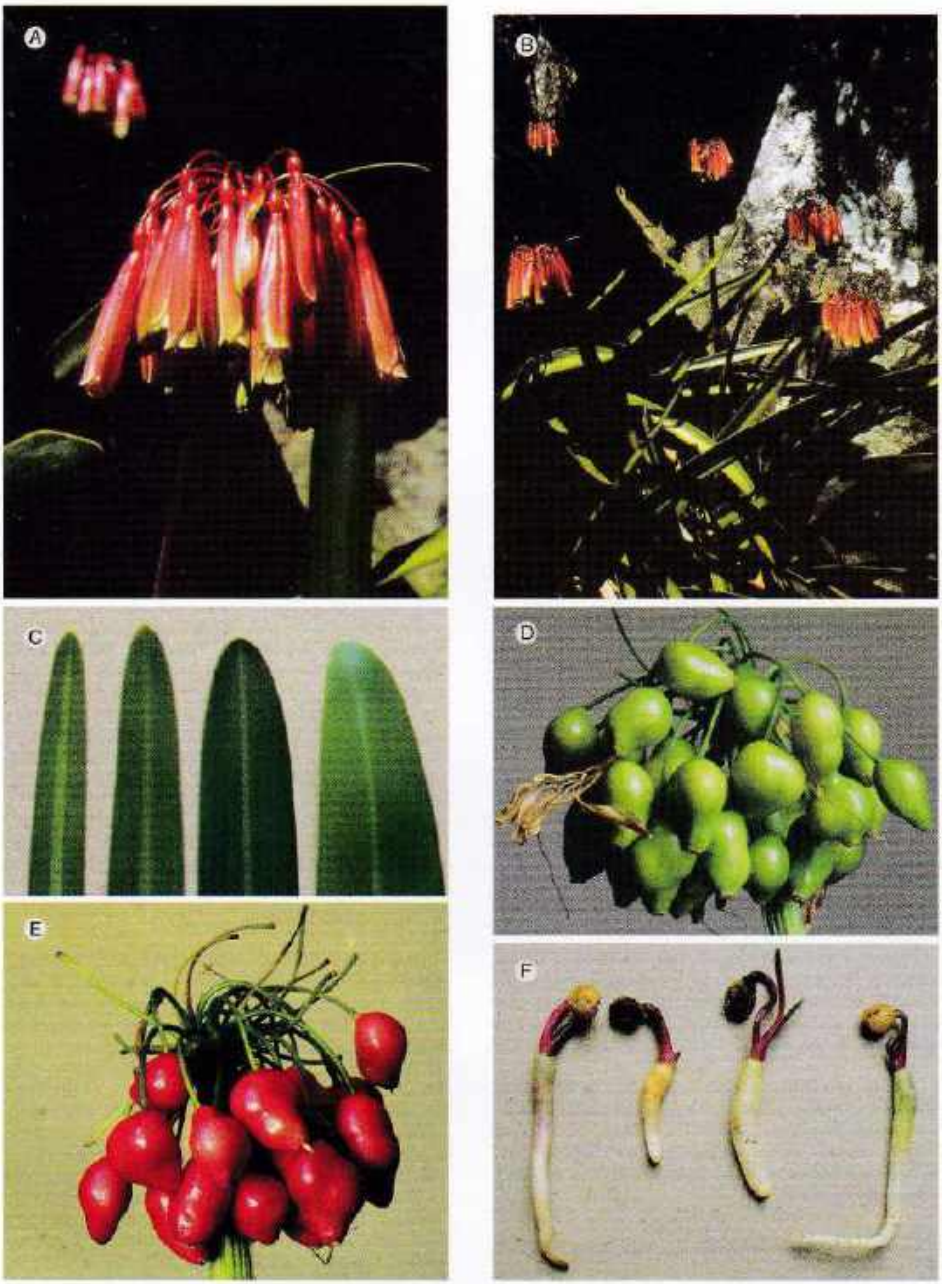
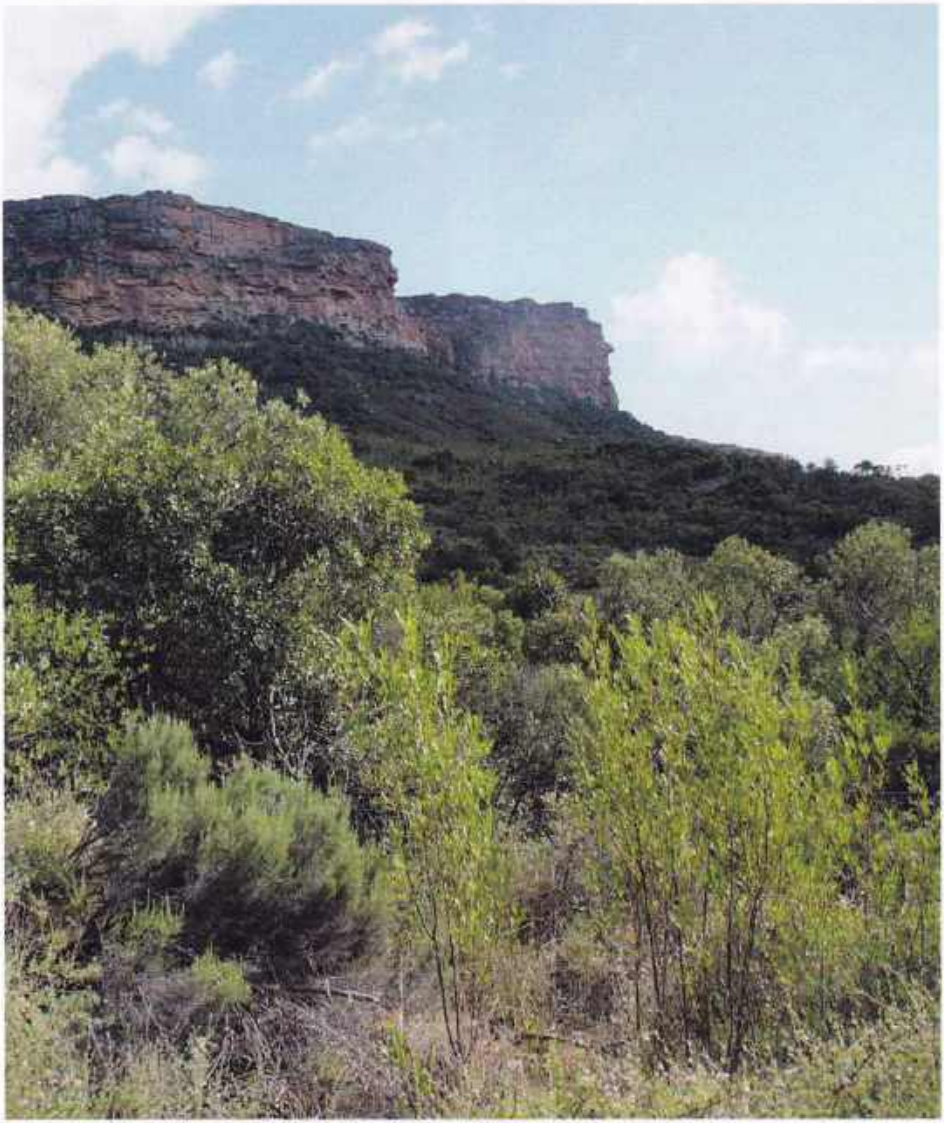


Plate 1. *Clivia mirabilis*, A, inflorescence in habitat showing orange/red pedicels; B, plants in habitat between Peninsula Formation Sandstone boulders; C, leaves showing prominent median white stripe on upper surface and variation in dimensions. D, E, fruiting head; D, immature berries; E, mature berries; F, seedlings five months after germination, note large radicle and prominent carmine pigmentation on cotyledon and at base of first pair of leaves. Photo: C. Paterson-Jones.

The phenology of the germinating seed described above is clearly an adaptation to a semi-arid Mediterranean climatic regime—exactly the reverse of the summer rainfall region *Clivia* species.

Within a few months of germinating, the plumular bud (cotyledon plus first true leaf) (Boyd 1932), becomes densely pigmented with anthocyanins (Plate IF). This prominent development of anthocyanins at the base of the leaves is later evident in the leaf sheaths of adult plants which are heavily suffused with purple-carmine pigments. Why the seedlings of *C.*



C. mirabilis country. In all cases they grow on the areas immediately below the escarpment.

mirabilis are so densely pigmented with anthocyanins is not clear, but it may be a response to the intense levels of sunlight experienced in the natural habitat, thereby providing effective screening during the seedlings' critical establishment phase.

Relationships

The distribution ranges of all four previously known *Clivia* species are contiguous or overlap, while at many localities different pairs of species occur sympatrically, *C. nobilis* with *C. miniata*, *C. gardenii* with *C. miniata*, and *C. caulescens* with *C. miniata*. Geographically, populations of *C. nobilis* in Eastern Cape, though more than 800 km distant, are the closest spatially to *C. mirabilis*. *C nobilis* also appears to be the closest relative to *C. mirabilis* on morphological grounds: tough stiffly erect coriaceous leaves with a median pale striation on the upper surface (some populations of *C. nobilis* occasionally have a faint median striation), and the small seeds.

Phytogeographic implications

Palynological evidence indicates that in Western Cape and southern Namaqualand, subtropical forests were present during Miocene and Pliocene times (± 5.3 million years BP) (Scott *et al.* 1997). Since then, apart from more recent cyclical changes in the Quaternary, there has been a progressive eastward retreat of these forest elements. Assuming that the genus *Clivia* has not changed its dependence on a forest environment significantly since pre-Quaternary times, it can be argued that the Nieuwoudtville species is relictual and that its survival in the Oorlogskloof Canyon is partly fortuitous and partly due to its adaptation to a different climate. The berry maturation period, seedling and germination biology are so perfectly in harmony with an arid Mediterranean climatic regime that *Clivia mirabilis* is able to survive environmental conditions inimical to all other *Clivia* species.

It is currently believed that the late Miocene also saw the development of a Mediterranean climate in the western part of the Cape (Axelrod & Raven 1978). This would have interrupted the further spread of an essentially summer rainfall genus like Clivia into the forests of the southern and western part of the Cape. It would also have left the precursors of *Clivia mirabilis* to adapt to increasing aridification and the onset of a pronounced Mediterranean type climate. Thus if *C. mirabilis* evolved from forms with an essentially summer rainfall phenology, the adaptation to an arid Mediterranean type climate is a derived condition dating from late Miocene times.

Long distance dispersal should also be considered as a possible explanation for this bizarre distribution pattern, but this

Typical habitat showing some offsets but mostly seedlings where they have been caught by the existing clump as they roll downhill.

Plate 2. *Clivia mirabilis*, × 0.75, showing flowering and fruiting scapes against a background depicting Oorlogskloof Canyon. A fully open inflorescence on left shows the red/yellow colour pattern. A younger inflorescence with green tipped perianths is on its right. From the type collection, *Rourke* 2220. Artist: Auriol Batten.

seems highly unlikely as no living vectors for the long-distance dispersal of *Clivia* seed have yet been identified nor has biotic dispersal been recorded for any other species of Amaryllidaceae (Meerow & Snijman 1998). Birds are probably the main seed dispersal vectors. *Clivia miniata, C. gardenii* and *C. caulescens* have all been observed by the author growing epiphytically in forest trees, five or more metres above ground level. It is probable that frugivorous birds deposited seeds in these positions, leading one to postulate that forest dwelling birds are responsible for the dispersal of large scarlet *Clivia* berries. While the dispersal of *Clivia* seed by birds between closely adjacent forest patches is a strong possibility, dispersal over distances of 800 km of arid country seems highly unlikely.

Conservation status

No populations are known outside the Oorlogskloof Nature Reserve where the species currently enjoys maximum protection. Yet there is no reason why *C. mirabilis* should not occur further down the Oorlogskloof Canyon, outside the reserve, as numerous suitable habitats occur there. If this proves to be the case, special efforts will have to be made to protect these populations as the species' horticultural potential will render it vulnerable to exploitation.

Other material examined

NORTHERN CAPE.—3119 (Calvinia): Oorlogskloof Nature Reserve, (-AC), 10-11-2000, *W. Pretorius 651* (NBG).

Acknowledgements

I am most grateful to the Northern Cape Department of Nature and Environmental Conservation for granting permission to collect the type material of this species; also to Wessel Pretorius, officer in charge of the Oorlogskloof Nature Reserve for his generous assistance in the field. Colin Paterson Jones patiently photographed various stages in the life history of C. mirabilis and John Manning skilfully prepared the line drawings reproduced here. Dee Snijman and John Manning provided critical comments on early drafts of the manuscript. I thank all of them for their invaluable assistance.

Auriol Batten's fine painting of *C. mirabilis* was prepared from the type material. I am especially grateful to her for loaning this plate to the National Botanical Institute for reproduction in this paper.

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Clivia nobilis —Cinderella of the Clivia World

Charl Malan, South Africa

The distribution and ecology of *Clivia nobilis* is well documented and a number of articles on the subject have appeared in previous Society publications. I am going to look at this species, which I regard as the Cinderella of the genus, from a different perspective.

C. nobilis is normally poorly represented at Clivia Shows as well as in the collections of Society members. The reasons for this may be ascribed to the following factors:-

- As it grows very slowly from seed, most collectors probably do not have the patience or time to see through a propagation programme.
- *C. nobilis* is not a particularly attractive plant from a horticultural perspective. Plants removed from the natural habitat have the tendency to die back and may take years to recover, particularly if injured in the process of removal.
- *C. nobilis* is not readily available in the market, even in the Eastern Cape, where it originates.

Photo: Courtesy Mike Christie

A red form of *C. nobilis*

How then do we solve the dilemma of popularising this Cinderella of the *Clivia* world. There may be several ways, one of which is to involve *C. nobilis* in hybridisation programmes. *C. nobilis* has unique features which makes it an ideal candidate for such programmes, particularly with *C. miniata* as a participant. These features are:-

- The number of flowers in the inflorescence. I have recorded 51 flowers in a specimen from a population at Riet River near Port Alfred!
- The leaf structure – A tough, rigid and leathery leaf which is well adapted to variable climates.
- A range of flower colours – from dark red to very light pastel.

From my own experience, crossing *C. nobilis* (pod parent) with *C. miniata* (pollen parent) produces the typical *Clivia cyrtanthiflora* hybrids which most knowledgeable members can recognize at a glance. See Photos 53 and 54 in CLIVIA 2. Conversely, however, hybrids comprising *C. miniata* (pod parent) and *C. nobilis* (pollen parent) result in much more varied forms, colours and shapes.

Although my own breeding programme is in its infancy and is awaiting flowering of an F_2 generation, I have no doubt that there are exciting times ahead and the advantages to be derived will be many. These include:-

- Flowering outside the normal spring season which could open up a totally new flowering window.
- A wonderful colour range.
- Large inflorescences with many flowers of all shapes and sizes.
- Attractive variegated leaves with a different

form to the usual *C. miniata* and Daruma types.

- Hybrid vigour which is often the result of interpecific hybridisation.

The first two characteristics mentioned above were first observed by Miss Gladys Blackbeard during her early hybridisation attempts at Scott's Farm in Grahamstown (see CLIVIA 2: 42).

While the purists amongst us may not like all this talk about hybridisation, such work opens up new horizons, and if in the process it can turn a Cinderella into a pretty and desirable Princess, let us enjoy it.

Photos: Charl Malan

C. miniata 'Vico Yellow' x *C. nobilis*

Two examples of *C. miniata* 'Shima Fu' x *C. nobilis*

Photo: John van der Linde

F_2 *C. miniata* x *C. nobilis* cross. Breeder: Jim Holmes; Owner: John van der Linde.

Clivia nobilis – out of obscurity

Wayne Haselau – South Africa

Clivia nobilis is a profoundly interesting species as not only was it the first species described in the genus but it has proven to be an extremely good candidate for creating hybrids, especially when crossed with *C. miniata*.

Clivia nobilis is the most southerly occurring *Clivia* species and like it's recently described cousin, *C. mirabilis*, it is drought tolerant and can stand very high light intensities. Up until fairly recently colour forms i.e. yellows, blushes and other pastel forms of the species have been extremely rare. All this changed a few years ago when East London plantsman and 'tswele' (herbalist), Mike Onions, located a superb colony of *C. nobilis* near the coast south of East London. Mike heard rumours about unusually coloured *C. nobilis* from local sangomas. I was asked to accompany him on the inaugural trip in September 2005.

The bush in this area is extremely thick and thorny, more suited to buffalo and rhino, which used to frequent this habitat. Nowadays referred to as sub-tropical transitional thicket, this is a low growing xeric (dry) thicket. *Clivia nobilis* loves this habitat and typically grow along the stream banks ensuring that they get great drainage and higher humidity. On this first exploratory trip it was decidedly hot in the valley, once out of the wind on the hilltops. We struggled to find our first plants. However, once we found them, they

C. nobilis in sub-tropical transitional thicket habitat.

seemed to be everywhere – what a joy to see so many lovely plants in full flower. Initially we found no unusual colour forms and after many hours of sweat and blood (thorns) we managed to turn up two potential yellow plants.

The rest is history. However, as is so often the case the whereabouts of this colony became known to others and most of its unique clones have subsequently been plundered.

Since *C. nobilis* was first discovered and described in the 1800's it has been cultivated

Pink *C. nobilis* ex habitat.

C. nobilis ex habitat.

Yellow *C. nobilis* ex habitat.

Pearl *C. nobilis* ex habitat.

in Europe for almost two centuries. *Clivia nobilis* was the first pendulous *Clivia* to be crossed with its showier sister species, *C. miniata*. The results of these early crossings were not only successful but often spectacular and one has to admit that a really good *Cyrthanthiflora* is a superb plant. A number of authors have written most eloquently on the early history of *Clivia*, most notably Harold Koopowitz in his treatise *Clivia* and John van der Linde and Charl Malan in the Clivia Society yearbooks. *Clivia nobilis* occurs in large numbers in certain localities throughout its distribution range and certain localities contain thousands of individual mature plants. Places where the distribution of *C. miniata* and *C. nobilis* overlap are extremely rare and form what are known as mutating colonies (often with unusual plant and or flower forms), where plants have had the opportunity to interbreed over a long period of time.

Almost all known forms of *C. nobilis* are orange or red and mostly of inferior horticultural form. These plants have been utilized in breeding past hybrids. Despite the recent discovery of a fabulous yellow-blush colony, good quality *C. nobilis* forms are still rare. As a result serious hybrid breeding programmes using the best forms of this species have only recently begun or have yet to be undertaken. I have embraced this and made it my mission. In addition to this, *C. nobilis* is also underutilized in breeding programmes, largely as a result of ignorance, as there is a general persistent belief amongst the *Clivia* fraternity that *C. nobilis* just takes too long to flower from seed (see new growing techniques). All this despite a number of good articles by certain authors to the contrary in a valiant attempt to dispel this deeply entrenched myth, as such I believe *C. nobilis* gets a bad

Red form of *C. nobilis*

rap. Charl Malan of Grahamstown is a prominent Eastern Cape breeder, who has led the charge in attempting to promote *Clivia nobilis* in popular articles and by using his *C. nobilis* in extensive breeding programmes, with spectacular results. Charl was one of the first South Africans to make the pilgrimage to Japan to investigate new trends in *Clivia* breeding and visited the now famous Clivia Breeding Plantation of Yoshi Nakamura. Mr Nakamura is the first modern *Clivia* breeder to use *C. nobilis* extensively in his hybrid breeding programmes. Charl was impressed by Nakamura's success and came back to South Africa intent on using *C. nobilis* more seriously in his own breeding programmes. The Lotter family in Gauteng have also been actively breeding interspecific clivias for many years and have produced some fabulous crosses to date.

In addition to the many magnificent new flower colour forms, a large number of new leaf forms have been discovered, such as short-broad, robust, semibroad, miniature and variegated, which are also bound to have a positive effect when utilized correctly in any breeding programme.

Distribution

The historical distribution of *C. nobilis* is fascinating and many questions are still a mystery. Why does the distribution stop abruptly just north of Port Elizabeth? Why does it fade into obscurity in the central Transkei near Coffee Bay? It is highly likely that *C. nobilis* was more populous during the last ice age when the coastal plain was far more expansive (extending to the currently submerged continental shelf) due to a significant drop in sea level along the eastern coast of South Africa.

Red form of *C. nobilis*.

Presently *C. nobilis* still has one of the most extensive distribution ranges, extending almost 500 km along the eastern coast of South Africa from the Alexandria district just north east of the port city of Port Elizabeth to Coffee Bay in the Central Transkei. This area of distribution falls within the mainly warm/temperate transition zone lying between the temperate Fynbos biome in the south, the xeric Karoo biome in the West and the Subtropical biome in the North East. There are three or more significant spikes inland where this species can be found up to 70 or more kilometres from the sea. These occur in the Grahamstown District in the south of its range and the King Williams Town and Butterworth Districts in the centre of the distribution area.

Throughout its range *C. nobilis* occurs in a wide variety of habitat types and can be found in dry coastal dune scrub, in warm inland valley thickets and in deep forest. This makes it the most habitat tolerant species and lends credence to the fact that it is perhaps one of the most ancient forms of *Clivia* i.e. one of the oldest and most successful. *Clivia* colonies are often found near water and are normally also associated with rocks and this holds true for this species as well. The ongoing genetic study at the University of the Free State will hopefully throw some light on phylogeny of this species and place it once and for all in its correct place on the *Clivia* family tree (I believe it is a ancient form).

C. x cyrtanthiflora hybridised out of *C. nobilis*.

C. nobilis on the sparsely vegetated floor of the forest thicket.

Habitat

Clivia nobilis occurs in a wide range of habitats often close to water which ensures a fairly constant range in both temperature and humidity.

An interesting phenomenon occurs annually in *Clivia* habitat. Due to the deciduous nature of many tree species in the forests of southern Africa, trees lose some or all their leaves during the dry winter months. This increases light intensity to the understory plants and associated with this comes a reduction of photoperiod and colder temperatures. The fallen leaves accumulate on the forest floor forming a mulch which helps insulate the roots, keeping them warm and moist. At the onset of the first summer rains in spring these leaves begin to decay and provide a sudden release of nutrients

C. nobilis in full fruit.

which fertilizes the plants, initiating and assisting with the flowering.

Recently during a drought, I was surprised to note that many *C. nobilis* plants in habitat were not flowering as normal and many had, or where in the process, of dropping (aborting) their flowers. This is an obvious strategy for conserving vital stored reserves and moisture as due to the lack of rain the flowering process had been terminated half way. This proves the importance of the spring rains in the *Clivia* life-cycle.

In some years there is a definite winter (July) early flowering spike in this species that is, I believe, brought upon by radically fluctuating temperatures and moisture levels. This happens occasionally in the Eastern Cape when in some years a winter rainfall pattern predominates. Cold fronts pushing up from the Cape are preceded by hot dry berg winds blowing towards the coast from the interior of the country are then replaced shortly thereafter by the rapidly dropping temperatures and moisture (rain) associated with these fronts.

Growing requirements

As many of us who spend time in *Clivia* habitat have realized, the current methods of growing *Clivia* are somewhat archaic and based on the established horticultural techniques developed for other myriad species in horticulture. This is a gross simplification, as clivias are unique and should be grown accordingly. The fact that almost all *Clivia* species can be found growing as epiphytes under the right conditions proves my point. Many innovative growers are experimenting with new mediums and fertilization regimes.

Most pots currently in use for clivias are too deep and have insufficient drainage for the aerobic roots of *Clivia* plants. *Clivia* species with xerophytic tendencies such as *C. nobilis* and *C. mirabilis* benefit from the use of

Ripening *C. nobilis* fruit.

Germinating *C. nobilis* seed.

porous pots such as clay which breathe and dry out more quickly. Shallow clay pots, albeit expensive, are ideal for specimen plants of these species and it is possible to cut extra breathing slots up the side of the pots using an angle grinder.

All *Clivia* require a myccorhizal root fungus in order to absorb inorganic nutrients effectively. In a healthy plant this myccorhiza and associated aerobic bacteria assist the plant at a cellular level by providing a degree of protection against pathogens as well (somewhat like an immune system). *Clivia nobilis* and *C. mirabilis* (and indeed all *Clivia* species) are extremely dependent on healthy myccorhiza, if they are to achieve optimum growth as they both have very large individual root systems (storage mechanism in the absence of a bulb) under natural conditions. *Clivia nobilis* differs markedly from *C. mirabilis* in the type of root system in that that the roots of *C. nobilis* forms a large adventitious mat around the plant. In *C. mirabilis* there is distinct tendency for the roots to penetrate downwards, only moving sideways when blocked by rocks.

I believe this to be an extremely important and often overlooked aspect of part of their successful cultivation; this is especially true for their germination and growth of seedlings. As I grow large numbers of *C. nobilis* from seed, I make a point of inoculating each new seed tray and seedling container with soil from the pots of mature *C. nobilis* plants. I find that this makes a huge difference as is the importance of not spraying fungicides regularly on these plants. I only treat pathogens when absolutely necessary and then with minimum doses initially.

Clivia nobilis seedlings germinate rapidly, however they then endure a seemingly agonizing two year growth stage that seems to the grower to be ridiculously slow. What they are in fact attempting to do is build up root mass as this is their only protection during drought years. Both *C. mirabilis* and *C. nobilis* are guilty of this, although in my experience this takes longer in *C. mirabilis*. I grow large numbers of select *C. nobilis* seed annually and have strived to achieve faster growth rates in cultivation (myccorhiza). I find that higher light intensity and warmth in combination are critical to ensure faster growth. As *C. nobilis* is a shallow rooting species, growing seedlings in shallow trays is also a very good idea. Using finely chopped composted leaf litter as mulch also benefits growth enormously, as does fertilizing regularly with organic fertilizer such as well rotted cattle or horse manure.

Decaying mulch releases nutrients to forming *Clivia nobilis* seedling roots.

C. nobilis germinated seedlings. Note some variegated.

I am experimenting with a number of alternative types of containers for *C. nobilis* plants and have so far had the best results with plastic wash basins. By cutting slots up the sides and drilling holes in the bottom it is possible to make a really functional relatively cheap container for specimen plants. Fired clay bonsai pots also make superb, albeit expensive, containers for specimen plants. The large basins have the added advantage of helping to keep plants well spaced.

Mixes are important when growing xerophytic Clivias, as they need to be free draining, assuring that the roots get plenty of air and also that they provide a degree of nutrition. Jaco Truter and I recently discussed this very point at length. To facilitate lightness in his mixes and to prevent binding, he adds polystyrene granules (balls). I think this might just be the way forward for creating a superior *C. nobilis* potting mix. Polystyrene is inert (cannot break down) so maintains critical aerobic processes. Binding, i.e. the rapid decomposition of a mix, often exacerbated by earth worms, can be fatal to plants as this prevents oxygen from reaching the roots freely, causing anaerobic (rotting) bacteria to increase dramatically.

Using crusher dust, finely crushed dolomite (blue shale), seems to benefit the plants enormously (some growers use dolomitic lime), providing plenty of essential inorganic trace elements to the plants. I now incorporate this into all my mixes; however, it is advisable to use this material in small quantities as it can make the mix heavy. Coarse quartz sand is another good material to add for drainage but again I feel one should only use small quantities.

Natural history

In the wild *C. nobilis* may flower at any time, although 90% of flowering occurs in the Southern Hemisphere spring (Sept/Oct). I have noticed a distinct early flowering spike in mid-winter (June/July) both in habitat and in collections and I believe this coincides with the first cold winter weather and associated rain. In the warm/temperate zone the severity of the cold and whether it rains or not varies from year to year so that in some years little or no flowering occurs at this time.

All pendulous *Clivia* are primarily pollinated by sunbirds. I can tell you this with certainty as I have problem sunbirds in my garden that insist on pollinating my pendulous Clivias. I have to go to great lengths to prevent them from doing so. The culprits are easy to spot as they often

have pollen covered yellowy ceres. In my experience the number one *C. nobilis* pollinator is the Greater Double Collared Sunbird, closely followed by the larger and more secretive Olive Sunbird. In the southern part of the range of *C. nobilis*, Grey Sunbirds are common and they undoubtedly also play their part. In a recent article I wrote about small bees in the family Anthophoridae, which are also important pollinators of *Clivia* in the wild in my area. I believe they are invaluable in that they move pollen between species (interspecific) which results in mutating colonies, i.e. *C. miniata* to *C. nobilis* and vice versa.

Clivia seed dispersal is a fascinating subject and one that I often ruminate about. Ever notice how *Clivia* seeds bounce when they are dropped inadvertently, like when you are trying to clean them in the kitchen? I believe *Clivia* seeds have evolved to bounce. Take a few cleaned *Clivia* seeds and drop them on to rocks, you'll be amazed to see how far they travel, especially if they are on a slope and have gravity as assistance.

They bounce high (proportional to the height from which they are dropped) and in a great many different directions. In nature this assures that most of the seed falls down slope. So how do plants move upslope and long distance? They use seed dispersers of course and in the case of *Clivia* these are most often fruit eating birds, although monkeys and in some areas certain rodent species also avidly, albeit unwittingly play a part. The berries of *Clivia* are most often bright orange or red, occasionally yellow, and cover the seeds with a highly visible nutritious wrapper that shouts food to all frugivores (fruit eaters) even in the deep shade of the forest. I believe birds such as bulbuls, loeries (Turacous) have the ability to move *Clivia* seeds long distances in the wild, as they may pick a fruit and then fly a considerable distance before finding a suitable perch on which to clean it.

Monkeys undoubtedly also move seed around especially during the dry winter months when there is little food. They may pick a *Clivia* fruit out of curiosity, especially the young ones and carry it for some distance before dropping it. *Clivia nobilis*, like all *Clivia*, grow extremely well as epiphytes especially in Forest or Dune Forest and can only find their way into the trees buy using birds and monkeys to get there. Fruit eating bats, such as the common Wahlberg Fruit Bat may also play a part in *Clivia* seed dispersal. Although this would be extremely hard to prove, it is likely as similar genera like *Haemanthus* and *Scadoxus* also have highly visible seed, which in the case of *Haemanthus membranaceous* gives off a strong odour when ripe.

Clivia nobilis releases its seed reluctantly as seed is often trapped in the leaf axils of the mother plant. These seeds often find their way onto the ground close to the mother plant, where they germinate readily, assisted by the mother plants mychorriza. Like all clivias, rain falling on the leaves is funnelled down to the base of the plant where it is absorbed by the roots. Any small seedlings growing here would then obviously benefit from this rainfall funnelling effect.

New forms / varieties

I believe *C. nobilis* is hugely underestimated currently as a parent in hybrid breeding programmes largely due to ignorance. Very few people are aware of how many wonderful new forms and varieties are now available. This should not be the case when one looks at its marvellous track record both internationally – Nakamura's breeding programme and locally with people such as Charl Malan who has bred some fabulous interspecifics

using *C. nobilis* as a reciprocal parent. Charl was undoubtedly heavily influenced by Yoshi Nakamura after he visited Japan some years ago. Recent research has shown the hidden potential for colour breeding as certain chemicals found in some pendulous species have the ability to block the standard anthocyanin pathways, potentially leading to the development of new colour varieties.

Clivia nobilis is now known to have a much broader colour range. I recently viewed a DVD compilation of photographs taken over two flowering seasons by the wife of a friend when visiting a local *C. nobilis* population. It was profound – the amount of flower variation displayed by individuals within this one population is remarkable. Only by viewing these pictures at home is the true degree of variation apparent.

Over the years I have made a concerted effort to seek out new and rare forms that are horticulturally significant and can honestly say that variegates, true pinks, yellows, blushes, party colours, deep reds, plum and bronze *C. nobilis* are now being utilized in my breeding programme. I recently acquired a plant that can only be described as an apple-blush. Some plants also have a very high flower count. I have one with 96 flowers recorded. I am aware of another that has 92.

Conservation

So much is said about clivias and their obvious decline. A lot has been said about the importance for conservation of all species and populations. Most is just lip service, as to date very little or nothing has been done to protect clivias in the wild. I propose that the Clivia Society gets more involved with the protection of clivias both in habitat and in heritage collections (which form an extremely important *ex situ* conservation role) and I propose that a *Clivia* conservation portfolio be established as soon as possible by the Clivia Society to promote these goals for future generations.

Clivia numbers are declining throughout their range as more and more suitable *Clivia* habitats are impacted upon by humankind in one way or another. There is in fact very little pristine *Clivia* habitat left, so if we do not act now there will be little or nothing left for future generations to enjoy. *Clivia nobilis* is a good benchmark species as it inhabits the narrow coastal plain of the Eastern Cape. This area is facing large scale development as it is in a zone easily accessible to people and much sought after for industrial and housing development, i.e. the huge Coega Industrial Development on the Albany Flats outside Port Elizabeth and surrounding areas and ongoing coastal holiday developments along East Cape estuaries, which is often in prime *C. nobilis* habitat.

I believe that one way forward is to actively promote the cultivation of *Clivia* from seed, especially naturally rare and or slow growing species, much like what John Winter achieved when growing *C. mirabilis* from seed for Kirstenbosch. *Clivia nobilis* is a naturally slower maturing species than say *C. gardenii*, and it is therefore understandable that growers are reluctant to wait a long time for plants to mature. It is far quicker and easier to either collect mature plants or buy them from other growers or nurseries. The sad part about this is that these mature plants have often been removed directly from the wild. Unfortunately, there are plenty of unscrupulous collectors and growers out there eager to make a quick buck and who will stop at nothing to get large quantities of desirable plants. The illegal cycad trade is a good example of this.

Growing large numbers of good quality *C. nobilis* plants from seed will, I believe, ultimately take a lot of pressure off the wild stocks if they are made available to growers in reasonable quantities and at fair prices, i.e. flooding the market lessens the demand and forces the price down (this is basic economics). This is all of our responsibility so when next you see good first class *C. nobilis* seed advertised you will hopefully purchase a few to try.

Pests

Clivias generally suffer the unwanted attentions of a vast array of pests. *Clivia nobilis is* largely immune to the ravages of the destructive lily borer caterpillar, although I did notice an affected plant in a local collection recently. I believe this is largely due to the inherently tough nature of the *C. nobilis* leaf. The greatest threat to *C. nobilis* plants is over-watering and binding of the potting mix soil leading to anaerobic conditions and associated rotting.

Many *C. nobilis* plants have what looks like a mosaic virus and this is especially obvious on young leaves. Most growers, myself included treat their plants for nutrient deficiency when plants start showing these signs however if symptoms persist I move the plant to secluded sickbay area. I believe this is wise as some forms of virus are definitely transferable from one plant to another. Occasionally, scale insects and mealy bug affect *C. nobilis* plants and to prevent their spread one should treat affected plants with a strong systemic insecticide. Ants are a nuisance, as they are the main vectors (movers) of these pests so I spray for them too.

Recently, I have noticed a marked increase in a form of pustular rust which forms unsightly wart-like lesions on the underside of *Clivia* leaves. This rust occurs naturally in the habitat and in many collections as well. To treat it, I break off the effected leaves and treat the damaged area with flowers of sulphur. Virikop and other copper based fungicides seem to work well in preventing this scourge.

There is a small white beetle larva that bores into the rhizome of *Clivia* plants that is becoming more common in collections and I strongly advise people to take it seriously. This is also a pest that occurs in the habitat and seldom affects adult plants fatally; however it is pernicious and can attack seedlings fatally. It can be treated by soaking affected plants in a strong systemic insecticide overnight. I then place a teaspoon of Karbaryl granules, which dissipate slowly, at the base of the plant and they seem to do the trick.

Recently, while walking in the dune forest near my home, I came upon a large striped African land snail devouring a mature *C. nobilis* plant. At first I was surprised that the snail would actively seek out and eat the tough foliage of *C. nobilis*, but once I started looking it became evident that this is a regular feature in this area.

Future

The future for *C. nobilis* horticulturally, looks bright, as more and more growers become interested in the pendulous species and their breeding potential. *Clivia nobilis* holds wonderful promise for *Clivia* breeding especially the breeding for colour as it is a vigorous parent and genetically it undoubtedly holds some of the greatest possibilities for colour breeding.

It is essential that we also grow more *Clivia* species, especially pendulous plants and promote the slower growing forms amongst younger growers, who will ulti-

mately really derive the most benefit from growing these plants. *Clivia* numbers are rapidly declining in the wild due mainly to habitat loss and the increased demand for wild *Clivia* plant matter in the muti (traditional medicine) trade. The wholesale destruction of *Clivia* colonies by unscrupulous collectors, out to make a quick buck, is also a very real threat and it's high time that such individuals be taken to task for such practices.

The heritage potential of this species is unsurpassed. Let's help this often maligned species to take its rightful place once and for all – meanwhile nurture what you have and pass some on.

1828

Clivia nobilis

Lindley, J., (1828). Clivia nobilis. Edwards's Botanical Register 14: t. 1182.

Clivia nobilis*

Scarlet Clivia

HEXANDRIA MONOGYNIA

Nat. ord. Amaryllideæ

CLIVIA. – ***Perianthium*** tubulosum, sexpartitum, deciduum, laciniis imbricantibus: exterioribus paulò brevioribus. ***Stamina*** sex, æqualia, perianthio basin versùs inserta; ***filamenta*** subulata, subinclusa; antheræ versatiles. ***Ovarium*** 3-loculare polyspermum. ***Fructus*** baccatus, indehiscens, monospermus. ***Semen*** carnosum; subrotundum. – Herba (*Capensis*) radicibus *fasciculatis*, foliis *distichis*, floribus *umbellatis pendulis*. Scapo *plano-convexo*!

C. nobilis, a good full head of flowers, from near the Kei River.

C. nobilis.

Radices *carnosi, fasciculati.* ***Folia*** *disticha, coriacea, atroviridia, ligulata, basi vaginantia, apice retusa oblique, margine scabra.* ***Scapus*** *erectus, plano-convexus, marginatus, versùs fastigium sulcatus.* ***Flores*** *circiter 48 v. 50, longè pedunculati, umbellate, penduli.* ***Perianthium*** *tubulosum, clavatum, deciduum, laciniis luteo-coccincis, apice virescentibus, obtusis, duplici ordine imbricates, versùs basin connatis, exterioribus paulò brevioribus, Lachenaliæ modo.* ***Stamina*** *6, fauce tubi inserta, æqualia; filamenta glabra; antheræ parvæ, ovales, viridi-luteæ, versatiles.* ***Ovarium*** *inferum, luteo-viride, 3- loculare, polyspermum, sphæricum, ventricosum;* ***ovula*** *plurima versùs basin axeos inserta;* ***stylus*** *filiformis;* ***stigma*** *subtrilobum.* ***Fructus*** *baccatus, indehiscens, ruber, sæpiùs, loculis 2, ovulisque plurimis abortientibus, monospermus; apice perianthio deciduo cicatrizatus.* ***Semen*** *unicum, ascendens, (maturum non vidi), glaberrimum, hyalinum, ovale;* ***hilo*** *parvo suprabasilari;* ***foramine*** *basilari;* ***raphe*** *brevi, elevatá.* ***Testa*** *junior minutissimè areolata;* ***albumen*** *copiosum.* ***Embryo***.....

Left: *Clivia nobilis* by Barbara Jeppe

*We have named this genus in compliment to her Grace the Duchess of Northumberland, to whom we are greatly indebted for an opportunity of publishing it. Such a compliment has long been due to the noble family of Clive; and we are proud in having the honour of being the first to pay it.

Clivia nobilis type illustration from Edwards's Botanical Register, t.1182. Based on a plant that flowered at Syon House in 1827.

"The fruit of this plant is a round berry, about the size of a boy's marble, or ⅝ths of an inch diameter, slightly coloured with red. The three cells which contain the seeds consist of a red and very juicy pulp, which (like the internal segments of an orange) are separable from the rind and from each other; and they might easily be mistaken for seeds. Within each cell are from two to four, but generally three, pearl-coloured seeds, which are apt to germinate while still contained in the berry, and even long before it is perfectly ripe. In a cool and airy greenhouse the fruit is from twelve to fourteen months coming to maturity. The progress of the young plants, also, is slow." — *W. H.*

Hooker, W.J. (1832). Note upon *Clivia nobilis*, fol. 1182. Edwards's Botanical Register, 18: sub.t.1546

Clivia nobilis in habitat at Kei River.

This noble plant is supposed to have been one of the discoveries of Mr. Bowie at the Cape of Good Hope, from some of the inner districts of which colony it was probably procured. The plant from which our drawing was made flowered for the second time in July last, in the princely Garden of his Grace the Duke of Northumberland, at Syon House, and was communicated to us by Mr. Forrest, to whom we are indebted for several observations upon its habit and characters.

At first sight it has so much the appearance of a Cyrtanthus that it may easily be mistaken for one, especially if the detached flowers only are seen. But upon a more minute examination, it will be found that it is not only not referable to that genus, but that it is actually doubtful whether it does not belong to a distinct natural order. In the first place, it does not form a bulb, an almost indispensable character of Amaryllideae, from which there is but one other variation hitherto

Clivia nobilis in habitat at Qwaninga River showing flowers and last year's ripe berries.

One of many *C. nobilis* plants at Qwaninga River growing off the ground.

Clivia nobilis on the left bank of a dry river bed, with inset showing its inflorescence.

known, namely in Doryanthes. In the second place, the fruit is not a dehiscent dry capsule, but fleshy and indehiscent; and, thirdly, the seeds are not numerous, compressed, and membranous, but solitary, round, and fleshy. It is, therefore, obviously distinct from Cyrtanthus; and there is no other Amaryllideous genus to compare with it, except Eustephia, the fruit of which is still unknown, but which is peculiarly characterised by its 3-toothed filaments, and which is probably not far removed from Phycella.

Perhaps the real affinity of this plant cannot at present be determined: to us it appears most closely allied to Hæmanthus, the bulbs of which are very imperfect.

A greenhouse plant, not appearing to require particular care in its cultivation, and propagating either by seeds or suckers.

Roots fleshy, fascicled. ***Leaves*** distichous, coriaceous, dark green, strap-shaped, sheathing at the base, retuse and oblique at the apex, rough at the margin. ***Scape*** erect, plano-convex, bordered, furrowed towards the summit. ***Flowers*** from 48 to 50, on long stalks, pendulous, arranged in an umbel. ***Perianth*** tubular, clavate, deciduous; the segments yellowish scarlet, greenish at the apex, obtuse, imbricated in a double row, cohering towards the base, the outer rather shorter than the inner, like those of a Lachenalia. ***Stamens*** 6, inserted in the orifice of the tube, equal; ***filaments*** smooth; ***anthers*** small, oval, greenish yellow, versatile. ***Ovarium*** inferior, greenish yellow, 3-celled, many seeded, round, ventricose. ***Ovula*** numerous, inserted towards the base of the axis; ***style*** filiform; ***stigma*** somewhat 3-lobed. ***Fruit*** berried, indehiscent, red, generally, in consequence of the abortion of two cells and most of the ovula, one-seeded, marked at the top by the scar of the fallen perianth. ***Seed*** single, ascending, (only seen unripe), very smooth, transparent, oval; ***hilum*** small, above the base; ***foramen*** in the base; ***raphe*** short, raised. ***Testa***, when young, marked with very minute areolations; ***albumen*** abundant. ***Embryo***.....

A variety of phenotypes at a single location, showing the diversity of colour and shape observed in *Clivia nobilis*. Note the high flower count (78!) on the overhead shot.

Hooker, W.J., (1828). Imatophyllum Aitoni. Handsome-flowered Imatophyllum. Curtis's Botanical Magazine series II 55: t2856.

Imatophyllum Aitoni.

Handsome-flowered Imatophyllum

Class and Order.

HEXANDRIA MONOGYNIA.

(Nat.Ord. – AMARYLLIDEÆ.)

Generic Character.

Flores umbellati, spathacei, nutantes. ***Perianthium*** superum, subcurvatum, sexpartitum, tubulosum, laciniis subæqualibus. ***Stamina*** basi submonadelpha, tubo inserta, perianthio longiora. ***Germen*** globosum, hexagonum: ***Stylus*** filiformis, exsertus: ***Stigma*** trifidum. ***Bacca*** globosa, trilocularis, loculis trispermis.

Habitus *Cyrtanthi; sed* radix *fibrosa:* folia *numerosa, loricata, disticha, marginata:* umbella *multiflora, floribus vix curvatis, limbo perianthii profunde sexpartito:* stamina *exserta.*

Specific Name.

IMATOPHYLLUM* *Aitoni.*

DESCR. ***Root*** perennial, consisting of numerous large and thick, fleshy, simply or branched fibres. ***Leaves*** radical, long, spreading out in a distichous manner, strap-shaped, flat, striated, green, with a diaphanous, jagged margin, the apex blunt, almost retuse, the bases sheathing each other, and purplish. On breaking a leaf, a greenish, gelatinous fluid extrudes in considerable quantity, which has the flavor and smell of a fully ripe apple. From the centre of these leaves arise one or more erect, rounded ***scapes***, with a large umbel at the extremity, of handsome, numerous, drooping flowers, accompanied by a many-leaved spatha, which soon withers. ***Peduncles*** filiform, glabrous. ***Perianth*** superior; of six somewhat incurved and slightly unequal, lanceolate, acute, orange-green segments, united at the base into a tube. ***Stamens*** six, inserted at the top of this tube, and, at the very base of the filaments, monadelphous: longer than the perianth. ***Anthers*** oblong, yellow, fixed near the centre of the back; the cells opening at the sides. ***Germen*** globose, with six angles and three cells, each with three ovules: ***Style*** longer than the stamens, filiform: ***Stigma*** trifid. ***Fruit***, a large, three-celled, red ***Berry***, containing about six, somewhat triangular, whitish seeds, clothed in a double integument; the outer loose and pulpy. Albumen between waxy and horny. ***Embryo*** cylindrical.

*From Ιμας, αντος a thong, or strap, and φυλλον a leaf, from the shape of the foliage.

Mr. BOWIE, who so successfully explored the Botany of Southern Africa, and enriched the Royal Gardens at Kew with many of its choicest productions, in the summer of last year, immediately previous to his return to the Cape, mentioned to me a Cyrtanthus-like plant, which he had there found and imported, and which, if it blossomed in this country, he desired might bear the Specific Name of his patron, Mr. AITON. At the same time, the letter enclosed one or two of the wild specimens of the flowers, and a small piece of the leaf; from which it was evident that, however closely allied the plant might be to CYRTANTHUS, it could not rank in the same Genus.

A specimen having flowered in October of last year, in the noble gardens at Sion House, Mr. FORREST, under whose skilful charge is placed the whole of those truly princely collections, kindly requested His Grace the DUKE of NORTHUMBERLAND'S permission for a drawing to be made of the plant, from which, the accompanying figure is copied. Mr. AITON has likewise been so obliging as to send me a drawing and specimens of the fruit, with the particulars of its habitat, extracted from Mr. BOWIE'S notes: "on shaded spots, near Quagga flats, and more common in the Albany tracts, near the great Fish River."

Fig. 1. Lower part of a Plant, to shew the Root. 2,3. Flowering Scape and portion of a leaf, *natural size*. 4. Flower, from which the segments of the Perianth are removed. 6. Anther. 7. Pistil. 8. Section of the Germen. 9. Berry, *natural size*. 10. Seed, *natural size*. 11. Section of ditto. – Figures 4-8 *magnified*.

Was the plant named *Clivia nobilis* in 1828 surreptitiously obtained from Kew?

John van der Linde

[First published in Clivia 5, pp. 92-95]

The late Amelia Obermeyer (Mrs. Mauve), who was a botanist at the National Botanical Institute in Pretoria, wrote the following in the August 1972 issue of *Flowering Plants of Africa*-. *"By a curious coincidence two English botanists, Lindley and Hooker, separately published on the same day in October, 1828, a new genus based on the same plant. Lindley named this new genus Clivia and Hooker called it Imantophyllum. In 1830 Roemer and Schultes (Syst. Meg. 7:892) chose the name Clivia and reduced Imantophyllum to synonymy. The plant in question was an introduction from the eastern Cape by Bowie and it grew in the hot houses at Kew and at Syon House, the residence of the Duchess of Northumberland. Lindley named the plant Clivia nobilis saying that such a compliment had long been overdue to the noble family of Clive.*

A high flower count at Kei River. The colour of this flower is very similar to the original one collected and still grown at Kew Gardens.

It is said that the plant described by Lindley 'had been surreptitiously obtained from Kew'."

The final sentence, with its strong hint of *Clivia* theft and the receiving of stolen property back in the early 1800s, intrigued me. I set out to examine the evidence. I began by reading what the two botanists *closest to the action* had said. Were there any clues there? I then spread the net wider to other writers, looking for evidence of any crime. Finally, I set out to track the allegation to its source.

Lindley, in naming the plant *Clivia nobilis*, said *"This noble plant is supposed to have been one of the discoveries of Mr Bowie at the Cape of Good Hope, from some of the inner districts of which colony it was probably procured. The plant from which our drawing was made, flowered for the second time in July last, in the princely Garden of his Grace the Duke of Northumberland, at Syon House, and was communicated to us by Mr. Forrest, to whom we are indebted for several observations upon its habit and characters."* Lindley also says *"We have named this genus in compliment to her Grace the Duchess of Northumberland, to whom we are greatly indebted for our opportunity of publishing it."*

The plant flowered for the second time in July, more or less the time one would expect a *C. nobilis* to flower in the Northern summer. This suggests that the plant was well-acclimatized to the Northern Hemisphere, and was probably imported before 1827.

The noble couple would almost certainly not have been directly involved in buying the plant; the Head Gardener would normally have dealt with suppliers. The said Mr. Forrest became Gardener to the Duke at Syon House in 1826. If the plant had been bought by his predecessor, Forrest may not have known its source. Lindley refers to Bowie as having discovered the plant, but the words he uses do not actually say that the plant at Syon came from those introduced by Bowie to Kew. Bowie is certainly credited in the records of Kew as having introduced *Clivia nobilis* to Kew. He must have done this when or before he was recalled to England in 1823, after 'his contract to collect plants in South Africa for Kew had been terminated. All *C. nobilis* plants he may have collected then would all have belonged to Kew. There was of course nothing to stop Bowie legitimately importing plants to England on his own account, but only after his recall in 1823, as speculated below.

In naming the plant *Imantophyllum aitonii* (after William Townsend Aiton) in the October 1828 issue of *Curtis's Botanical Magazine* Hooker gives considerably more detail than did Lindley: *"Mr. Bowie .... in the summer of last year, immediately previous to his return to the Cape, mentioned to me a Cyrtanthus-like? plant, which he had there found and imported, and which if it blossomed in this country, he desired might bear the specific name of his patron, Mr. Aiton. At the same time the letter enclosed one or two of the wild specimens of the flowers, and a small piece of the leaf ...".* Does the use of the word 'imported' imply that Bowie was already in England, i.e., between 1823 and 1827, the year he returned to South Africa?

Hooker, then goes on to say that a specimen of the plant had flowered in October 1827 *"in the noble gardens of Syon House"*, and that *"Mr. Forrest ... kindly requested His Grace the Duke of Northumberland's permission for a drawing to be made of the plant..."* Clearly a plant had also flowered at Kew, because W.T. Aiton, Director-General of all the Royal Gardens, including Kew

"has likewise been so obliging to send me a drawing and specimens of the fruit...". Aiton also consulted Bowie's notes, stored at Kew, to tell Hooker that the plant(s) at Kew had been found *"on shaded spots, near Quagga flats, and more common in the Albany tracts, near the great Fish River"*.

Forrest would hardly be likely to have knowingly drawn attention to a plant that had been 'nicked' from Kew; similarly if Aiton had known that a plant 'surreptitiously acquired from Kew' had flowered anywhere else he is hardly likely to have co-operated in supplying further information on the plant, especially if it were to be named for him! This would have made him an accomplice to theft.

There had in fact been thefts from Kew; plants that were exclusively Kew's were appearing for sale in nurseries, probably smuggled out with the assistance of garden staff, bribed by middle-men who could make a profit on-selling to eager customers. In 1824 it was found that the keys to the Royal Gardens at Kew had been counterfeited and all the locks had to be changed.

Robert Sweet, the manager of Colvill's nursery (which incidentally had a large collection of Cape bulbs) in Kings Road, Chelsea, was accused of receiving some choice Australian plants stolen from Kew. Aiton was determined to make an example of him and the case was heard at the Old Bailey in February 1824. *"Sweet's unblemished reputation, vouched for by other nurserymen, secured his acquittal on technical grounds"*.

So, going on what I had discovered to date there did not seem to be any evidence that the plant at Syon House had been 'surreptitiously obtained from Kew', even though other thefts from Kew had indeed taken place. So where did the plant come from? From Hookers' account which ties in with Lindley's in this regard, one could perhaps, at a stretch, conclude that it came from an importation by Bowie some time after 1823, when he was no longer under contract to Kew. Important to the story is the wording of Bowie's contract to collect for Kew. Exclusive supply to Kew was demanded: *"Should a plant sent by you to Kew appear in any other garden, an enquiry will immediately be set...."*

Then along comes the very well-connected Rev. William Herbert, the multi-talented bulb expert and younger son of the Earl of Carnarvon, with a more conclusive explanation. I repeat in full his account, given in his classic monograph *Amaryllidaceae* published in 1837:

"This beautiful plant was first discovered by Dr. Burchell, in whose herbarium, soon after his return from Africa, I saw a fine specimen, which not having been

A closer picture of typical habitat conditions shown on the next page.

C. nobilis growing in brackish sand adjacent to the Indian Ocean beach just showing at the foot of the picture. The large-leaved plants are strelitzias, which typically occur in *Clivia* habitats.

carefully examined, had been mistaken for an Agapanthus, *to which its root and leaves have a striking affinity. I soon after became possessed of a plant of this species, brought over by an officer who had been employed on the Caffre frontier, and I recognized it to be the plant I had seen in Dr. Burchell herbarium, but concluded it to be an Agapanthus. Not long after, I obtained for Mr. Tate, from the kindness of Dr. Burchell, a precise account of the spot where he had seen this plant; the result of which was a large importation of the roots—but after they had vegetated, Mr. Tate mistook them for the common* Agapanthus, *and was about to dispose of them as such, when I saw them accidentally, and immediately recognized them. One of the plants flowered for the first time in this country in the collection of the Duchess of Northumberland, after whom it was named. By a singular accident it appeared on the same day in the Bot. Reg. and Mag., being named in the latter work Imatophyllum aytonii, but the name* Clivia nobilis *has been generally preferred. Sir W. Hooker was mistaken in supposing Mr. Bowie to have been the first discoverer of this plant. Indeed, roots of it were in my hands before he had seen it in Africa. It is a plant of perfectly easy culture, requiring no particular care but to shelter it from frost, and it flowers freely in the greenhouse if placed near a front light, and ripens its seeds; but the seedlings are of very slow growth. The reason of its not having flowered in my collection earlier was that from the slowness of its growth I had been induced to put it in the stove, hoping that it might grow there more freely; but the heat increased its sulkiness."*

Left: Herbarium specimen of *Clivia nobilis*, housed at Kew, and collected by WJ Burchell between Rietfontein and the source of the Kasuga River, Bathurst Division, Oct 25, 1813.

'Stove' was the word used in those days for a hothouse with artificial heat. Herbert says he saw the plant (a dried specimen?) soon after Burchell returned to England, which was in 1815. He says that there was a *"large importation of roots"* which subsequently *"vegetated"*. This would have taken several years – Herbert refers to very slow growth – and then one or more plants were sold, prior to flowering.

Tate imported the plants directly, maybe even before Bowie returned to England in 1823. James Charles Tate had a nursery in Sloane Street, Chelsea, close to Burchell, who had collected in South Africa from 1810 to 1815, and who was then living in Fulham. Four other horticultural Tates are listed as having been born in Alnwick, Northumberland. What is significant about that is that Alnwick was the 'home territory' of the Duke of Northumberland, owner of Syon House. If James Tate had a family connection with Alnwick then this may have given him an entree to supply plants to the garden at Syon.

Herbert says that his own plant was acquired from an army officer before 1823, the year Bowie returned to England. Tate may have used a similar contact in South Africa – Bowie complains about having to compete with officers who sent their troops out on plant-hunting expeditions!

So neither Hooker nor Lindley appear to have known of Burchell's dried specimen, or of Tate's importation. Were they both in so much of a hurry to publish that they missed this information? Hooker does not even seem to have seen the plant at Syon. (This did not stop him from ingeniously putting together the picture which accompanies this article -his *Imantophyllum aitonii*, from *Curtis's Botanical Magazine*, Vol. 55 of 1828. It is a collage based on a drawing of the plant at Syon House, on a *'drawing and specimens of the fruit'* of a plant at Kew, supplied by Aiton, and possibly also on a *'small piece of the leaf'* given to Hooker by Bowie!)

With this additional evidence all three accounts seem to hang together, without significant contradictions, so where on earth did the *"surreptitiously obtained from Kew"* allegations originate? Robert Archer at the National Botanic Institute in Pretoria put me on a track which led back over the years from one source to another, each saying more or less the same thing, in more or less the same words; back to Saturday 29th October 1881.

This was the date on which the weekly newspaper for the serious gardener, *The Gardeners Chronicle of London*, published the latest in a series of articles on earlier plant collectors. This issue was about James Bowie. No author is named and no references were given. The relevant section of the article, dealing with events nearly 60 years before, reads: *"In the country of the Orange River State he discovered the beautiful Amaryllidaceous plant which was received at Kew in 1823 and having flowered, was in 1826 figured and named in the Botanical magazine by Dr. Hooker (afterwards Sir William) under the name* Imantophyllum aitonii; *at the same time a plant which had been surreptitiously obtained from Kew flowered in the Duke of Northumberland's garden at Syon House, was figured and described by Dr. Lindley under the name* Clivia nobilis, *both names appearing in their respective journals of the same date. Dr Lindley was requested to forego the name Clivia, but refused to do so, and ultimately it became the popular name"*.

And there the trail goes cold. Who wrote that article and who were his informants? Perhaps we will never know. But what I can say is that he did not read Hooker (writing

in 1828, not 1826), who set out exactly where Bowie found the plants growing – certainly nowhere near the Orange River State! Also, I find it hard to believe that any specialist writer at that time would not have known of Herbert's classic book and his version of events. Was that anonymous author simply doing what others did after him i.e. repeating without checking what had been written even earlier by someone else?

I did not let the matter rest there. To make sure this was indeed the end of the trail, I looked at other sources including the 465-page long very detailed *Kew – The History of the Royal Botanic Gardens* by Ray Desmond, former Chief Librarian and Archivist at Kew. Nowhere could I find any reference to the theft from Kew of a plant, subsequently to flower *"in the princely garden"* of the Duke of Northumberland, and to be published on the same day in October 1828 by two of the most prominent botanists in two leading botanical magazines in England. This must have been a high-profile event in horticultural circles. Surely there would have been some comment, if the plant had in fact been *"surreptitiously obtained from Kew"*?

My account contains speculations, but they – I submit – are logical, though they may not be conclusive. I would welcome any reader of this article to throw further light on this interesting episode in *Clivia* history. Until then, case dismissed or should it only be adjourned?

I would like to thank Victoria Herriott of Syon House, and Topher Martyn, currently the Head Gardener there, for examining Forrest's 'Alphabetical Catalogue of Plants of Syon garden", which he put together in 1831. I thought that might tell us where the plant came from. Yes, one *Clivia nobilis* appears on the list, but unfortunately there are no details of where it was obtained.

At an early stage in my research John Rourke drew my attention to Herbert's book and to his explanation for how the plant came to be at Syon House. When Harold Koopowitz's book Clivia was published I was interested to see his interpretation of this episode.

Michael Jeans and Drs. Robert Archer, Keith Hammett, Harold Koopowitz and John Rourke helped me, also Prof. Donal McCracken, who is researching the life of James Bowie. I thank them all.

Finally, you may have seen the Duke of Northumberland's two ancestral homes without knowing it; they have recently featured in three movies:
Syon House, Middlesex, in *Gosford Park*,
Alnwick Castle, Northumberland, in two *Harry Potter* films.

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In addition to the sources specifically mentioned above, I also referred to:

Edwards' Botanical Register, Oct. 1828 (1182)

Gardeners Chronicle, 29 Oct. 1881 (568), which I traced back through

Kew Bulletin, 1891 (309)

Journal of Botany, 1889

Transactions of the Philosophical Society of South Africa, vol. 4, xlii, 1887, the 1886 Presidential Address of P. MacOwan, Director of the Cape Town Botanical Garden, entitled Personalia of Botanical Collectors at the Cape.

I also looked, without success, for some mention of this episode in a number of books on Hooker and Lindley.

The British National Dictionary of Biography, and two further books by Ray Desmond, his *British and Irish Botanists and Horticulturalists*, and *A celebration of flowers: 200 years of Curtis's Botanical Magazine* helped me get a feel for the times.

I also referred back to my earlier articles 'James Bowie' and *The noble family of Clive*, William Aiton, William Hooker and John Lindley', in Newsletters of the Clivia Society (Vol. 11, nos. 3 and 4 of 2002)

Some biographical notes on James Bowie

Extracted and edited from Smith, Gideon F &van Wyk, AE. 1989. Biographical Notes on James Bowie and the Discovery of Aloe bowiea *Schult. & JH Schult. (Alooideae: Asphodelaceae). In* Taxon, *Vol 38, No 4 (Nov), pp. 557-568*

Background

James Bowie spent a total of almost 49 years in South Africa and during his initial stay (1816-1823) undertook four journeys into the interior. Although very little is known about his activities after his emigration to the Cape Colony (1827) he no doubt travelled widely and was a member of many more botanical expeditions (Bowie, 1842). Apart from not having published much about his collecting trips and field experience in southern Africa, Bowie was notorious for providing insufficient and misleading details of the material which he collected, apparently for business reasons. An example is *Clivia nobilis* Lindl. (=*Imatophyllum aitoni* Hook.) which Bowie introduced into England at a time that Cape plants were in high fashion in Europe. He mentioned this species as having been collected from the Orange River, although its natural habitat is known to be in the vicinity of Grahamstown (Obermeyer, 1972; Duncan, 1985). This habit of Bowie has greatly detracted from the scientific value of his collections.

Clivia nobilis in habitat showing notched leaf tip.

James Bowie (*ca.* 1789–2 July 1869)

It was as the successor to Masson that James Bowie was sent to the Cape of Good Hope, almost 22 years after this great botanical collector had finally left the shores of southern Africa. Bowie was the son of a London seedsman who did business at the west end of what used to be Oxford Street in the early 1880's (MacOwan, 1887; Watson, 1897). In 1810, when nearly 21, Bowie also obtained employment at Kew and spent the next four years working there as a gardener. In 1814 Bowie and a colleague, Allan Cunningham, were sent on what was to be his first collecting trip abroad. They embarked for Rio de Janeiro and collected material in Brazil until 1816 (MacOwan, 1887; Hutchinson, 1946; Gunn and Codd, 1981). This visit lasted until 28 September 1816 (Hutchinson, 1946) [and not 1817 as stated by Smith (1881), MacOwan (1887), and Watson (1897)]. Bowie was then ordered

to the Cape of Good Hope as botanical collector and Cunningham, in a similar capacity, to New South Wales, Australia. ... . On 28 September 1816 Bowie boarded the 'Mulgrave Castle' and arrived at Table Bay on 1 November 1816. During the first eighteen months of his initial stay at the Cape, Bowie concentrated his collecting activities to the vicinity of Cape Town. At this time he seems to have been engaged in the normal duties expected of a collector, cultivating and exporting to Kew plants of mainly horticultural interest (MacOwan, 1887; Rowley, 1960). Bowie apparently held his own collecting capabilities in high esteem since he stated in a letter dated November 1826 (quoted by MacOwan, 1887) that he collected and forwarded to Kew almost every plant from the Cape of Good Hope figured in Great Britain after 1817. In identifying the Bowie localities, the presentations of Hutchinson (1946) and Gunn and Codd (1981) have been followed. Hutchinson (1946) based his account of Bowie's travels on information obtained from GH Fourcade, a plant collector and Forest Officer at Knysna, stationed with the Superintendent of Woods and Forests for the Cape of Good Hope from 1882 to 1913. With regard to specific localities little can, however, be gleaned from the above sources. In many cases the only information available is a general locality or district. Bowie began his first collecting trip into the interior of southern Africa on 23 March 1818. On this trip he explored from Cape Town and Caledon in the west to Knysna and Plettenberg Bay in the east, returning to Cape Town almost ten months later along the coastal route. Bowie arrived at Cape Town on 14 January 1819 and probably spent the next three months dispatching to Kew the material that he collected on this journey. During this and subsequent journeys Bowie made Plettenberg Bay his headquarters (Fourcade, 1944). On 9 April 1819 Bowie departed from Cape Town on his second collecting trip. This trip again lasted almost ten months and took Bowie as far east as Knysna where Bowie stayed with George Rex (19 July or 29 August 1765-3 April 1839), a notary and pioneer of this town. The legend that Rex was the legitimate son of Prince George (later King George III) seems to be unfounded (Gunn and Codd, 1981). King George III did, however, act as patron of the overseas collecting trips of, amongst others, James Bowie. Rex was a hospitable man and he received many naturalists of that time at Knysna, Bowie in particular paying him frequent visits (Fourcade, 1944). He is commemorated in *Streptocarpus rexii* (Hook.) Lindl. which was collected by Bowie at Melkhoutkraal, one of Rex's farms at Knysna (Gunn and Codd, 1981). *Streptocarpus rexii* was the first species of this interesting genus to be discovered and was introduced into cultivation from the material sent to Kew by Bowie (Hilliard and Burtt, 1971). After having completed his second journey, Bowie arrived back at Cape Town on 22 January 1820 in the company of George Rex (Fourcade, 1944). Although the exact date on which Bowie departed on his third journey which took him as far east as Bushmans River, Kowie and Graham-

stown is not known, it must have been shortly after 22 January 1820. On 9 March 1820 he was already residing at Knysna, whilst it took him between three and seven months, respectively, to reach Rex on his first two journeys. One would thus have to assume that Bowie was now more familiar with the route from Cape Town to Knysna and that he did not stop to collect along the way. On this third journey George Rex accompanied Bowie from Cape Town to Knysna. This collecting trip, which lasted approximately one year, took Bowie further east than either of his first two journeys. After completing this journey he sailed from Algoa Bay on 15 January 1821, arriving on 29 January 1821 in Tabel Bay where he remained until 23 May 1821. On his fourth journey Bowie seems to have been eager to explore from Algoa Bay eastward since he again sailed from Cape Town (24 May 1821) and arrived at Algoa Bay two weeks later on 5 June 1821. During this last collecting trip that Bowie undertook into the interior of southern Africa during his initial stay at the Cape, he explored the lesser-known eastern and south-eastern parts of the Colony more thoroughly and also proceeded to the north-eastern Cape where he collected plants in the vicinity of Colesberg. He again resided with George Rex at Knysna from 1 June 1822 to 22 September 1822 and eventually returned to Cape Town overland. On his return journey Bowie met Dr George Thom (18 June 1789-11 May 1842), a missionary and minister of the Dutch Reformed Church at Caledon. Thom took a great interest in botany and sent specimens from South Africa to Prof WJ Hooker at the Glasgow University (Stirton, 1986). Sir Joseph Banks, who initially convinced King George III to make funds available for the employment of collectors of foreign botanical material, died on 19 June 1820. Two years later a vote reducing by one half the sum available for such collectors was passed in the House of Commons (Smith, 1881). This meant that either Cunningham, an earlier exploring companion of Bowie in Brazil, had to be recalled from New South Wales, or that Bowie had to be recalled from the Cape. Apparently because of his intemperate habits and lack of perseverance in his collecting duties, it was decided that Bowie should be recalled. On 23 May 1823, six months after completing his fourth journey into the southern African interior, he sailed from Cape Town for England in the 'Earl of Egremont'. After briefly collecting at St Helena, he arrived at London on 15 August 1823 (Hutchinson, 1946). Bowie was now no longer employed by Kew and spent his days working on herbarium specimens collected during his visits abroad. At night he passed his time in public houses and there boasted of his adventures and encounters with wild animals at the Cape and in Brazil (Verduyn den Boer, 1929). These drinking bouts eventually resulted in Bowie becoming an alcoholic. He decided to settle in South Africa and to become a collector of objects of natural history. After four aimless years in England, Bowie finally sailed for the Cape in the "Jessie" in April 1827 (Ffolliot, 1981). For the next 42 years Bowie,

who never married, lead an unproductive life at the Cape. His attempts to take over the business of Villet and Son, who dealt in the export of natural history specimens, failed and his hope of becoming the curator of a botanic garden at the Cape was never realized (MacOwan, 1887; Gunn and Codd, 1981). Later he made an unsuccessful attempt to make a living from selling Cape bulbs and also failed to obtain land for establishing an experimental English nursery (Anon., 1970; Ffolliot, 1981). By 1836, some nine years after having settled in Cape Town, he seems to have been employed as gardener and collector to Baron Carl von Ludwig of Ludwigs Garden in Kloof Street (Marloth, 1915; Stafleu and Cowan, 1983). This engagement lasted less than five years and, by 1841, he was again working independently and making a meagre living from horticultural tuition and inspection and from selling plants collected on field trips (Bowie, 1842). During the latter part of his life he was in poor health and, as an act of charity, was employed as a gardener by Ralph H Arderne at his magnificent garden in Claremont, Cape Town (Gunn and Codd, 1981). James Bowie died on 2 July 1869 (not in 1853 as stated by Smith, 1881) and was buried in Cape Town. Specimens that Bowie collected at the Cape of Good Hope are kept at the British Museum (Natural History) and at Kew. Drawings of plants sent to England by Bowie are in the Kew collection (Hutchinson, 1946; Reynolds, 1982).

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THE IDEAL pH AND NUTRITION FOR CLIVIA

Pierre de Coster, Belgium

The pH scale shows the acidity or alkalinity of the growing medium. The scale ranges from 0 to 14 with the neutral point at 7. The lower the number is below 7, the higher the acidity; conversely the higher the number is above 7, the higher the alkalinity.

Experience has taught us that Clivia can tolerate a wide scale of pH -let us say from 3.5 to 6.5.

Above 6 their growth becomes stunted and there is yellowing of their leaves.

I experienced that myself last year, and a fellow grower experienced major problems in the same year at 6.2.

It is important that the potting mix has the correct pH right from the inception of the plant's growth. Management of the pH is a problem because it is not easy to fix it for every individual pot.

We should aim for a pH of 4.3 to 5.5.

I estimate that for the average potting mix of pure peat and peat with pine needle compost 3.0 to 3.5 kg calcium carbonate is required per cubic metre of mix.

I no longer use pine needle compost but rather a mixture of coconut fibre and peat and compressed peat pieces.

Our calcium fertilizers in Belgium have varying compositions. They are all based on calcium carbonate but some contain in addition 3% to 30% of magnesium carbonate. These are to be preferred because not only do they provide essential magnesium, but magnesium carbonate is 5 to 6 times more soluble than calcium carbonate. Thus 1 kilogram of magnesium carbonate will neutralize more acid than 1 kilogram of calcium carbonate and is therefore more effective in raising the pH.

Nutrition

I referred the editors to the article written by Marc Vissers on the roles played by the various elements of nutrition in the life, growth and health of a plant, which was made available to them with his consent.

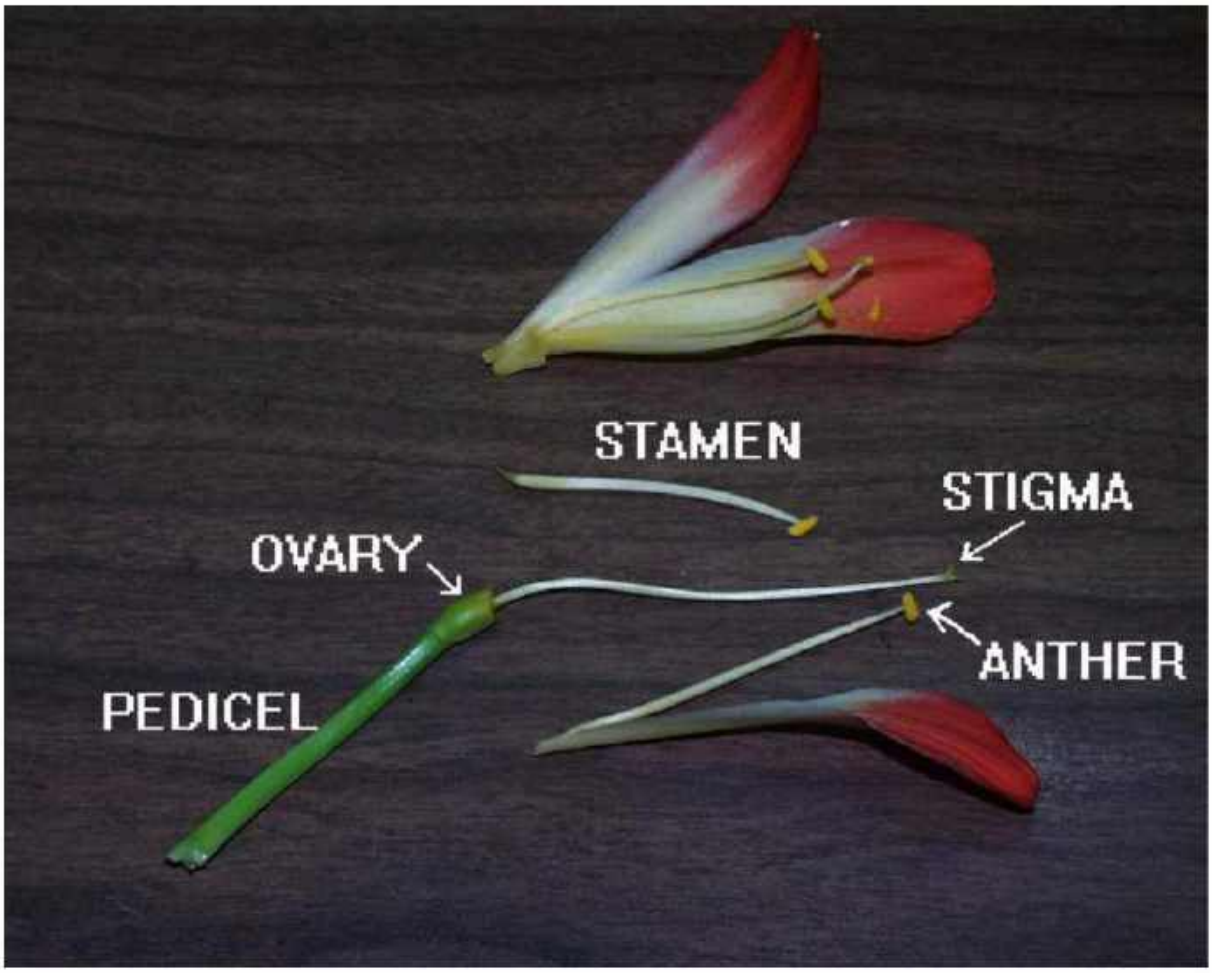
However, it has always been difficult to establish the ideal feeding program for *Clivia* because they respond slowly and not always clearly. My target figures are:

pH of H_2O 4.50 to 6.0
Conductivity 200 to 400

milligrams per litre potting mix	
N	30.00 to 140.00
P	min. 30.00
K	150.00 to 250.00
Ca	400.00 to 1200.00
Mg	150.00 to 250.00
Fe	min. 1.00

*C. miniata 'Sh*aja Moja'. Winner - pot plant section NC 2001 Grower: Dawie van Heerden

Clivia Pollen Storage



Pollen of Clivia as well as that of most other plants in the Amaryllis Family, the Amaryllidaceae, can be stored for extended periods of time and still retain useful viability. The length of time that a sample of pollen can be stored will depend on several factors:

The genus and species of the plant.
Clivia pollen is said to retain viability for many years
Nerine pollen appears to retain viability for several years
Hippeastrum ("amaryllis") pollen keeps for a maximum of 12 months
Hymenocallis pollen retains viability for only a few months
Daylily (Hemerocallis, not an amaryllids) pollen stays viable for many years

The extent to which the pollen was dried before storage.
Clivia pollen is quite dry at the time of ripening
Most pollens require drying in air or over a drying agent for 12 to 48 hours before storage.

Blue Silica Gel crystals are a good drying agent, but Drierite® is better.

The temperature at which it is stored.
For immediate use, a few hours later, room temperature storage is quite satisfactory
Short term storage (days or weeks) in a refrigerator at ca. 39°F (4°C) is satisfactory
Long term storage (months or years) must be done at subfreezing temperatures; the colder, the better.

Storage should be done in a tightly closed container. I prefer using 1.5 mL microcentrifuge tubes of polyethylene or polypropylene (Eppendorf tubes). Two or three anthers of Clivia are removed from their "stems" (*filaments*) (see Anatomy of a Flower). Place the anthers in a microcentrifuge tube, and leave open at the top.

Dry the anthers. In very dry climates, such as deserts and semi-deserts, drying in air will probably suffice. In humid climates, such as the North-eastern U.S.A., it is better to place the microcentrifuge tube with its anthers in a larger container with some drying agent such as Blue Silica Gel Crystals, for 12 to 24 hours. When dry, cap the microcentrifuge tube tightly. Label the tube with the botanical name and the date. Store the tube in a home freezer.

Best of luck with your pollen!

Jim Shields USA – Shields Gardens

BEGINNERS LUCK – Bill Morris

Beginners are often bemused by pollination and consider it a magical task that only a few initiated can perform. It is of course, quite simple and easy to do once you know what to do. It has also been found that pollination is far more successful when carried out under certain conditions.

If we look into our miniata flower, we can quite easily see six stamens with the anthers on top supported by the slender filament which is affixed to the base of the petals. The seventh little stem in the flower divides into three at the top, and this is the style which grows out of the ovary and on the triple tip it carries the stigma. This stem projects a little further out of the flower than the others. In our case the stigma is on the ends of the three divisions. When the flower first opens the three divisions of the stigma are not fully opened, but in a day or two they extend out, and you can see sticky exudate on them. At the same time the anthers open up and the pollen is clearly visible.

All one needs to do is to transfer pollen from the ripe anther to the ready stigma and fertilisation can take place. Of course, if you do it on the same plant, then you would have self-pollinated or "selfed" the plant. Broadly speaking, there are two types of breeding that you can go in for. Inbreeding, and outbreeding. In inbreeding you use self-pollination, or closely related pollen. For example, you may have three or four plants from the same stock. If you cross-pollinated with these plants this would be inbreeding. If you got pollen from an outside source and applied it to your plants, this would be outbreeding.

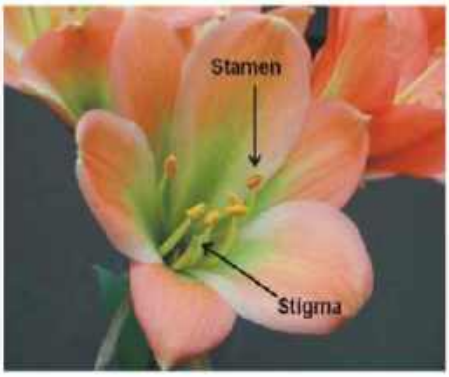
Pollen is destroyed by warm temperatures and loses its viability in warm weather. Thus, it is recommended that pollination should take place when it is cool, as in the early morning. One could snap the filament of a stamen off and carry it between two fingers and apply it to the mother plant. You could take a small paint brush and scoop up some pollen with this and apply it to the plant you wish to fertilise. Of course, you would avoid contaminants such as water, chemicals and foreign bodies.

You may need to transport the pollen, and it could be knocked off the anthers into a vial or capsule which you can get at the chemist. You can store the pollen for over a year in the refrigerator or the freezer. However, it must be kept dry. It is also best removed from the anthers, as these can rot, and the pollen will suffer.

So, you have become a plant breeder, and will need to keep records to have accurate accounts of your breeding achievements. It is best to keep a record in a book. One could have a column for the date, one for the mother plants number, one for the pollen-parent's number and a

column that records the amount of seed produced. If this line was numbered A1 because it was the first line in the first book, these seeds could be identified in further breeding records as being A1 seeds or plants. It would then be possible to trace back in a simple manner some twenty years and twenty books later, how you arrived at some of your show winners.

POLLINATING CLIVIAS



In an early newsletter our editor described how to pollinate clivias using a small brush. As I have a large number of plants and do quite a lot of pollinating, I have found the brush method slow. It also suffers from the difficulty of having to clean the brush of pollen if one wants to make a different cross. This also takes time.

So, for many years I have simply used my fingers. Lightly pinching an anther, the portion of the sexual apparatus of the flower which carries the pollen, will transfer quite a lot of pollen to the surface of the index finger and thumb. Brushing this surface across the end of the stigma of the flower transfers the pollen to this female receptive part of the flower. It is best not to do this as soon as the flower opens as the stigma may not be fully developed at that stage. I like to repeat my pollinations a number of times with intervals of a complete day between pollinations to ensure that some are done when the stigma is most receptive.

In pollinating my yellows, where I use pollen from my best couple of plants on most of the other yellows, I have now found it easier and quicker to simply pinch the stigma very gently with both of my pollen covered fingers and slightly roll the stigma between them. Once you get used to it, it is very easy to do. Again, I repeat the pollination a number of times over the period the flowers are out. It is important not to pinch tight enough to damage the stigma. I have found this method very successful, and it is about as fast as anyone can manage.

It is much easier to clean one's fingers than a brush. I simply wipe them hard on my own garden clothing a number of times. Occasional pollen grains may remain trapped in the skin ridges and valleys, but very few, and they are overwhelmed by the millions of pollen grains from the next anther that supplies the pollen to be used next.

Bill Morris, Australia

2004

Clivia robusta

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A new species of *Clivia* (Amaryllidaceae)

endemic to the Pondoland Centre of Endemism, South Africa

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Clivia robusta **B.G. Murray, Ran, de Lange, Hammett, Truter et Swanevelder sp. nov.** (Amaryllidaceae) is a tabular, pendulous-flowered *Clivia* species, restricted to the Pondoland Centre of Endemism, South Africa. The unique morphology, distribution, karyotype and molecular fingerprint distinguish it from all other pendulous-flowered species in the genus. © 2004 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2004, 146, 369–374.

ADDITIONAL KEYWORDS: *Clivia gardenii* – Haemantheae – taxonomy.

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Left: *Clivia robusta* painted by Claire Smith. This painting originally appeared as *Clivia nobilis* in Flowering Plants of Africa, Vol 53, Page 74, Plate 2094.

Introduction

Clivia Lindl. (Amaryllidaceae), with five described species, falls within the African tribe Haemantheae (Meerow *et al.*, 1999; Rourke, 2002a). It is indigenous to South Africa and Swaziland and forms part of the southern Africa centre of diversity for the family Amaryllidaceae (Meerow & Snijman, 1998; Snijman, 2000).

This perennial genus is well known for growing in diverse habitats ranging from coastal forest and secondary coastal dunes, to swamps, riverbanks and rock screes; specimens are even reported to grow as epiphytes in some localities. The genus generally favours cool, shaded, well-drained habitats with the exception of *C. mirabilis* Rourke, which is found in a semi-arid area with a Mediterranean climate. The genus is linked directly to the inland and coastal Afromontane forests of southern Africa, with *C. mirabilis* found in relictual evergreen Afromontane forest elements in the south-western corner of the Northern Cape province, South Africa (Duncan,

1999; Winter, 2000; Rourke, 2002a, b).

In July 1960, W. L. Chiazzari deposited specimens of an unidentified *Clivia* species at the National Botanical Institute (Pretoria) (FSB 37066 and PRE 37058). These specimens were later identified as *C. gardenii* Hook., with the differences in morphology attributed to natural variation. Subsequently, chromosome and DNA sequence analysis by Ran and coworkers (Ran, Murray & Hammett, 1999, 2001; Ran, Hammett & Murray, 2001a, b), carried out to establish relationships between and within species, further showed that plants identical to Chiazzari's specimens and known in horticulture as the 'robust form' of *C gardenii*, 'Swamp Forest *Clivia*' or 'Robust *gardenii*' (Hammett, 2002) had a distinct karyotype and unique DNA marker pattern. The chromosome studies used Giemsa C-banding, fluorochrome banding with DAPI (4'-6-diamidino-2-phenylindole) and CMA (chromomycin A3), which preferentially bind to AT- or GC-rich regions of the genome, respectively, and the location by fluorescent *in situ* hybridization (FISH) of the 45S and 5S rRNA genes to identify the chromosomes of the complements.

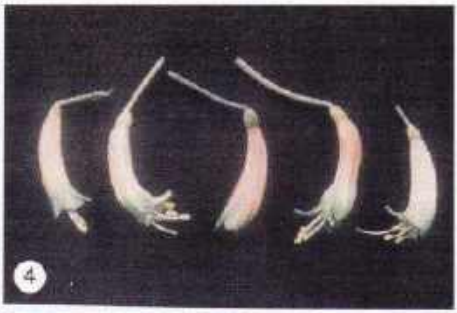
Little intraspecific karyotype variation was observed and all the described species plus 'Robust *gardenii*' could be identified on the basis of their karyotypes (Ran *et al.*, 1999, 2001b). Two different approaches were used to investigate the phylogeny of the group. DNA sequences from the nontranscribed spacer between the nuclear 5S rRNA genes and the internal transcribed spacer of the 45S rRNA genes and the RAPD (random amplified polymorphic DNA) profiles were used to construct phylogenetic trees. In all cases 'Robust *gardenii*' was sister to *C. gardenii* and *C. miniata* Regel (Ran *et al.*, 2001; Ran *et al.* 2001b). Further investigation indicated that these plants have a distinct morphology, but appear to be closely related to *C. gardenii*. In tandem with the unique karyotype and DNA profiles, the morphological characters amply distinguish these plants from *C. gardenii* and all other known *Clivia* species. We therefore recognize these plants herein as a distinct taxon at the rank of species.

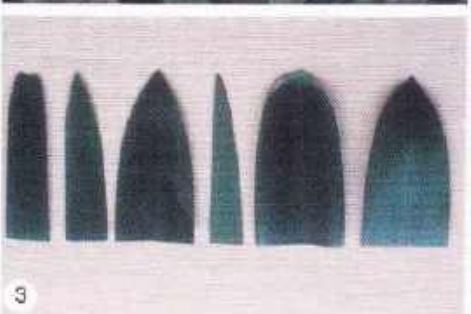
Material and methods

Plants of 'Robust *gardenii*' were grown outdoors in Auckland, New Zealand from seed collected from seven localities in the Pondoland Centre of Endemism, Transkei, South Africa. The localities were: (1) Nkambati Nature Reserve, subsequently cultivated at Kirstenbosch Botanic Garden, Professor Kobus Eloff (133/86); (2) near Lusikisiki at the Fraser Falls, S. Venter (885); (3) swamp at Mkambati, M. Dower (8988); (4) Lambasi Village, KRW Hammett, J. Winter & J.P. Rourke (81141); (5) Dimfi, between Ndindindi and Mkambati River mouth, KRW Hammett, J. Winter & J.P. Rourke (8144); (6) Umtamvuna Nature Reserve, KRW Hammett, J. Winter & J.P. Rourke (81147); (7) cultivated material ex. A. McLeman.

Right: Figures 1–6. Fig. 1. *Clivia robusta* sp. nov. growing at Kirstenbosch Botanic Garden, South Africa to show plant size. Fig. 2. Inflorescence of *C. robusta*. Fig. 3. Leaf apices of (left to right) *C. nobilis*, *C. miniata* (narrow leaved variant), *C. miniata* (broad leaved variant), *C. gardenii*, *C. robusta* and *C. coulescens*. Fig. 4. Single flower of *C. robusta* (centre) with flowers from four different accessions of *C. gardenii*, two on each side, showing the clear difference in stamen exsertion between the two species. Fig. 5. *C. robusta* growing at Umtamvuna showing stilt roots. Fig. 6. *C. robusta* growing in water at Lambasi.

[Anne-Lise Fourie of SANBI is thanked for her assistance in obtaining these illustrations – Eds.]





Material from natural populations was collected in accordance with the rules and regulations of the particular provinces and with permits from Ezemvelo KwaZulu-Natal Wildlife, South Africa (permits, 27110/2001, 30443/2002 and 966/2003) and Department of Economic Affairs, Environment and Tourism, Province of the Eastern Cape, South Africa (General Permit 01/07/2001). Seeds and plants in South Africa were grown outdoors and under shade netting.

In addition to field observations, we supplemented our knowledge about the environment, habitat and natural populations of 'Robust *gardenii*' through correspondence with *Clivia* enthusiasts familiar with the species. Data supplied by these individuals were verified by comparison with available herbarium records.

Measurements of morphological features were made from random samples selected in the different populations and compared with observations made by the enthusiasts. These are given as ranges with outlier values given in brackets. Observations and measurements from live plants were made from cultivated material grown from seed collected from throughout the distribution range of the species.

Description of new species

CLIVIA ROBUSTA B. G. MURRAY, RAN, DE LANGE, HAMMETT, TRUTER & SWANEVELDER SP. NOV.

Diagnosis: *Clivia gardenii* Hook, affinis sed qua habitu robustiore majoribus, apicibus foliorum apiculatis, staminibus et pistillis inclusis, habitatione silva palustri anteferenti, et ab omnibus aliis speciebus generis Clivia karyotypo chromosomatum et ordinationibus DNA indicibus differt.

Holotype: [South Africa]: Eastern Cape, Transkei, Port St. Johns, Mt. Sullivan (Topo. Ref. 3128 UMTATA 1:250 000): southern flanks of mountain, growing in wet seepage on ledge against cliff face, roots in humus and leaf mould, 100–200 m, 1.i.2001, J.T. Truter 4072 (PRU).

Description: Perennial plant, stout, rhizomatous, solitary or clumping, evergreen, 0.5–1.6 m tall; stem reduced to a vertical rhizome < 400 mm long, terminating in a tuft of leaves. ***Root system*** massive, horizontally spreading. ***Roots*** perennial covered in a corky, velamen-like layer. 'Stilt/buttress' roots produced along the stem in swampy conditions. Root diameter 5–15 mm. ***Leaf sheath*** green to light red. ***Leaves*** long-lived, arching-erect, distichous, strap-shaped, 0.3–0.8(–1.5) m × 40–70(–90) mm, glabrous, alternate, 6–10 leaves per rhizome, broadly linear to linear-oblanceolate, coriaceous, weakly canaliculate, base markedly plano-convex, broadening and becoming planar from midsection to obtuse apiculate apex. Lamina of adaxial surface dark green, pale whitish grey striatum in the mid-rib area may be present, becoming less distinct in older leaves; abaxial surface markedly paler green, lamina margin entire with extreme distal portion slightly scabrid, teeth antrorse. ***Scape*** hermaphrodite, up to 0.8–1 m long, subterete, somewhat laterally compressed, ellipsoid, grooved with weakly developed median ridge, green, flushed pinkish red, flecked pale yellow or cream. ***Inflorescence*** an umbel, form variable, usually loose and tending to globose, with 15–40(–45) flowers subtended by two chartaceous, deciduous, lanceolate bracts 30 × 40 mm. ***Pedicels*** stiff, erect/suberect, slender 15–60 × 1.2 mm, green but variable. ***Perianth*** tubular, somewhat

Over six foot of Wayne Haselau dwarfed by *C. robusta*.

A typical *C. robusta* umbel.

One of a number of large yellow-flowering *C. robusta* plants.

A clump of orange *C. robusta*. Buttress roots can be seen close to the ground where they support large plants in the soft water-logged soil.

Typical *C. robusta* habitat, wet and swampy with many plants with their feet in the water.

falcate with an increasingly flaring apex, 30–55 × 5 mm, widening to 6–13(–20) mm diameter at mouth. ***Colour*** variable from dark orange-red, with red tips, through pale orange to pink orange; rarely yellow in some plants with light to dark green apices. ***Perianth*** segments (tepals) 6, united only at the base, otherwise overlapping, decurved, slightly asymmetrical, oblanceolate, infundibuliform, slender, involute, dilated at apex to form a somewhat thickened lip; apiculate at apex, the apiculum finely covered in white hairs. ***Stamens*** 6, adnate to perianth, one per segment, usually included within perianth tube, very occasionally extending to, and exceeding the perianth mouth. ***Filaments*** 30–35 mm long, white, terete, glabrous. ***Anthers*** 6, versatile, 3–4x1–1.5 mm oblong dorsifixed, 2-locular; pollen yellow. ***Style***: 28–35(–50) mm, terete, glabrous, included within perianth tube. ***Stigma*** tri-lobed, 5 mm terete, approx. glabrous, usually with sparse, fine, white cobwebbed hairs scattered along inner surfaces, distial portion pale green to pinkish-green, finely papillate near apex. Stigma occasionally protrudes from tip of perianth tube prominently. ***Ovary*** subglobose, dark-greenish in bud, remaining that colour at anthesis, changing to green-orange colour after pollination; 3-locular. Fruiting heads with (1–)10–2(K–35) pendant berries. ***Berries*** irregularly ovoid, 15–40 × 10–20 mm, globulose, containing 1 or 2(–4) large seed (largest in genus), prominently projecting through thin pericarp. ***Pericarp*** glossy, pale green, maturing through orange to bright red. Yellow-flowered clones produce yellow or mustard-coloured berries. SEED large, somewhat globose, 10–18(–20) mm diameter, white in colour. ***Emerging seedlings*** the most robust in the genus exhibiting rapid growth. ***Flowering time*** extended over 5–6-month period from late March to early August, i.e. early autumn to late winter (Southern Hemisphere); 9–12 months for seed to ripen and berries to fall off. ***Chromosome number*** 2n = 22.

Habitat: Afromontane Forest in the Pondoland Centre of Endemism, 0–500 m.

Material examined: SOUTH AFRICA: *Lusikisiki District, Lombazi River, North of Port St. Johns*: Chiazzari 3129BD (PRE); *Transkei, Ntsubane, Mkoziriver valley*, Venter 76/885 (PRE). CULTIVATED ex South Africa: *Transkei, Nkombati Nature Reserve*: Hammett 133/86 (AK) (specimen over four sheets).

Table 1. Summary of the key differences between Clivia gardenii and C. robusta sp. nov.

Morphology	C. gardenii	C. robusta
Habit	Gracile plant, strongly clump-forming, <1 m in height	Massive plant with stout rhizome, often with prop roots, ^ 2 m in height
Leaves	Linear-accuminate, strongly sulcate in cross-section	Broad, strap-shaped with with obcuse-apiculate apex, planar in cross section
Flowers	Stigma and stamens strongly exserted	Stigma barely protrudes and stamens usually retained within corolla tube
Karyology	45S rDNA site + C-band on chromosome 2 No 45S rDNA site or associated C-band chromosome 8	45S rDNA site but no C-band on chromosome 2 45S rDNA site + C-band on chromosome 8
Distribution	Widespread in KwaZulu-Natal	Confined to Pondoland Centre of Endemism

Etymology: The species epithet 'robusta' refers to the massive nature of the plant compared to other species in the genus.

Distribution: *C. robusta* is endemic to the east coast of South Africa, with its distribution as isolated populations from Port St. Johns in the south (Eastern Cape Province) to Mzimkulu River in the north (KwaZulu-Natal) (Swanevelder, 2003), with a few northern outliers at Oribi Gorge, Paddock, Umtentweni, Southport and one southern outlier just south of Port St. Johns. This region is known as the Pondoland Centre of Endemism (Van Wyk, 1994; Van Wyk & Smith, 2001).

Karyotype studies: The unique karyotype initially observed in material collected from Nkambati Nature Reserve, subsequently cultivated at Kirstenbosch Botanic Garden and illustrated in Ran *et al.* (2001b) was also observed in the additional material from the locations listed above in Material and Methods. There are two key features of the *C. robusta* karyotype that differentiate it from that of *C. gardenii*. In *C. robusta* there are two 45S rDNA sites compared to one in *C. gardenii*. One of these sites shares a common location in the two species (on chromosome 2) but in *C. gardenii* it is associated with a Giemsa C-band that is absent in *C. robusta*. The second site in *C. robusta* is on chromosome 8 and is also associated with a C-band.

Recognition and relationships: The key characters that distinguish *C. robusta* from *C. gardenii* are summarized in Table 1 and elaborated upon here. Morphologically, *C. robusta* is distinguished by being extremely robust; specimens approach 1.5–2 m in height (Fig. 1). The very long, broad leaves, abruptly rounded leaf apex with fine serrations (Fig. 3), pale whitish-grey striation occasionally present in the upper leaf midrib, stigma and anthers largely included within the perianth (Figs 2, 4), as well as prominent 'buttress/stilt' roots (Fig. 5) in swamp populations, amply distinguish this from all other known Olivia species. This is the only species in the genus that seems to prefer perennially wet, swampy habitats (Fig. 6) or damp seepages on rock ledges. However, the allied *C. gardenii* does occasionally grow along stream edges or in wetter than usual habitats. Botanically, *C. robusta* was regarded as part of *C. gardenii* although it has commonly been confused with other species also. For example, Vorster (1994) used *C. robusta* to illustrate C. nobilis Lindl.

Using a variety of chromosome techniques, DNA fingerprinting and sequencing, Ran and coworkers (Ran *et al.*, 1999, 2001; Ran *et al.*, 2001b) showed that 'Robust *gardenii*' was sufficiently distinct from the other species to justify naming it as a new species. 'Robust *gardenii*' was sister to *C. gardenii* and *C. miniata* (Lindl.) Regel in their phylogenetic trees based on the two regions that were sequenced and on the RAPD profiles.

Clivia robusta is also distinct from *C. gardenii* with regard to its distribution. Swanevelder (2003) showed that the plant named here as *C. robusta* formed one of three geographically distinct groupings apparent from an examination of herbarium specimens collectively treated as *C. gardenii*. *Clivia robusta* is one of these groups and its distribution is distinct from that of *C. gardenii* s.s., which is only recorded from the Durban area northwards; no records connect the different distribution regions.

Ecology: The vegetation of the Pondoland Centre of Endemism consists mainly of grassland plateau, with a few isolated for-

est patches in the protected riverine gorges that occasionally spill over onto south- and south-west-facing slopes. Forest is more extensive and exposed in the south of the region. Of all the forest types in this region, Swamp Forests are the most rare, usually comprising small patches associated with marshy areas in grassland. *Clivia robusta* is found in these Swamp Forest patches, either sparsely (c. 5–6 plants 10 m^{-2}) or in extremely dense stands (c. 20 plants 10 m^{-2}) in wetter areas.

Buttress roots, along intervals on the vertical rhizome, act as support for the larger individuals growing in this marshy environment. The swamps are never stagnant: water

A clump of yellow flowering *C. robusta* with orange flowering plants in the background

moves through these specialized systems, albeit very slowly. The wet soil has a high content of rotting humus and leaf debris. The new species is also found along stream banks where the soil is often moist or wet, but not swampy. Field-work has confirmed that the species also grows in seepage on cliff faces and also relatively dry rocky areas adjacent to the wet swamps. In these situations, plants are noticeably 'stockier'. In all localities, the plants are found under a high understorey of closed canopy trees in light to semi-shade.

The Pondoland Centre is highly diverse, with approximately 1800 specific/intraspecific taxa residing within its boundaries, of which 120 are endemics or near-endemics (Van Wyk & Smith, 2001). This 1880 km² large outcrop of Msikaba Formation sandstone is characterized topographically by rugged plateaus (100–500 m a.s.l.) that are deeply dissected by narrow river gorges in which isolated forest patches, with mixed tropical and Afromontane elements, are confined. Annual rainfall varies from 1000 to 1200 mm and occurs mainly in the summer months, with a mean annual temperature of 20 °C along the coast. Soils in this centre are usually sandy, acidic, highly leached and often shallow (Van Wyk, 1994; Van Wyk & Smith, 2001).

The conservation status of *Clivia robusta*: Human exploitation in the form of habitat destruction and illegal removal of specimens is the main threat to *Clivia* in the wild. Habitat destruction occurs as forests are removed for fuel, agricultural purposes and/or urbanization (Chubb, 1996; Duncan, 1999). Plant collection for medicinal purposes is probably the most serious threat (Chubb, 1996; Duncan, 1999; Lötter & Krynauw, 2002). The high demand by traditional healers for *Clivia* plants was clearly evident when Mander (1998) identified *C. miniata* as the tenth most sought after medicinal plant traded in Durban, KwaZulu-Natal. Williams, Balkwill & Witkowski (2001) found Clivia species in 70% of the Witwatersrand *muti* shops they surveyed. A. Hardinge (pers. comm.) confirmed that the same factors are also threatening the survival of *C. robusta* populations, with only remnants of some remaining.

At present, most *Clivia* species are classified as Lower Risk-Least Concerned, Lower Risk-Near Threatened and Vulnerable (Golding, 2002; Lötter & Krynauw, 2002). This seems insufficient when one considers the restricted ecological niche, geographical distribution and current exploitation. Swanevelder (2003) proposed that plants treated here as *C. robusta* should be categorized as Endangered (EN) B1a +2a (according to 2001IUCN Red List Categories, Version 3.1, as in (Golding, 2002)).

The survival of *C. robusta* is constrained by its limited geographical distribution and human exploitation. Limited to the Pondoland Centre of Endemism, this species is further restricted to microhabitats usually associated with patchy Afromontane forest elements (Swanevelder, 2003). Afromontane Forests occupy c.6000 km² of South Africa and Swaziland of which only 17.64% are conserved (Lubke & Mckenzie, 1996). Even though *C. robusta* distribution may be termed 'locally abundant', communities are restricted to specific ecological niches (Swanevelder, 2003).

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ment and Tourism, Province of the Eastern Cape, South Africa for their assistance in obtaining the necessary documentation. We extend special thanks to Mr Andy Hardinge for the discussions we had regarding populations, habitat, conservation, etc., Mr Fanie Venter for discussions on the distribution of populations, and Professor A. E. van Wyk for reading the manuscript. We also thank Kirstenbosch Botanic Gardens for supplying plant material.

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Clivia robusta — the "Swamp Clivia"

Keith Hammett, New Zealand

Every person on earth has an individual view or paradigm of the world. Such paradigms are influenced by the culture in which we are raised, our education and by individual experiences as we pass through life. Problems often arise when discussing a topic if we do not check out the other person's understanding, or we do not clearly explain our own.

It is clear to me that there are several quite different concepts of what constitutes a species. This was brought home to me when I posed the question "what is a species" to a meeting of a Rhododendron Society. The consensus answer was "a weedy version of the nice hybrids we grow".

As a botanist / plant breeder, this was an eye-opener for me as I realised that had I not asked the question I would have talked right past my audience. Similarly, if we are to discuss *Clivia* species, we must first establish some common ground.

Clivia is a small genus confined to Southern Africa. I feel that there is sufficient evidence to believe that the species that constitute the genus have evolved over time from ancestral types, rather than having been created at a single point in time by a supernatural force.

This distinction is critically important. If someone happens to believe in Creation, it is likely that they will see species as entities waiting around for us to discover and to give them a name. This is rather like a sculptor who sees his role as liberating a form that already exists within a block of stone or wood. Such a view is essentially static and species are likely to be seen as being well defined and capable of being fitted into neat pigeonholes. In contrast, the evolutionary view is fluid and in consequence defining the limits of a species is seen to be more a matter of opinion based on an accumulated body of information.

If we take *Clivia miniata* as an example, the work of John Winter and others, who have spent much time looking at populations in the wild, has shown us that there is a lot of naturally occurring variation within this species. I chose *C. miniata* deliberately because, as it has the single trait of having upright flowers, there is seldom much dispute about its identity, despite exhibiting considerable variability in floral and leaf characteristics.

Variability is extremely important as it encompasses many physiological traits in addition to morphological and pigment variation. Without adequate inherent variation, plants and animals are unable to survive and adapt as the climate changes. This same variability is equally important to the plant breeder.

Often the term **gene pool**[1] is used to describe the range of variability that we have gathered together in our collections. In using this term it will be seen that there has been a shift in focus from whole plants to the genes or chemical entities that code for the characters we see. A breeder's gene pool is akin to a painter's box of paints.

An extension of this train of thought is the paradigm encapsulated by the term **germ plasm**. Here the genetic material is seen as a river flowing through time and all the plants and animals that exist at any point in time are simply manifestations of this. The idea was first put forward by the German, August Weismann, towards the end of the Nineteenth Century.

[1] I note a tendency in commercial circles for people to talk about a breeder's **genetics** rather than gene pool. This is a misuse of the term.

Conceptually this idea is very helpful to plant breeders and evolutionary botanists alike. I like to think of a genus as a bank of cumulus clouds moving across the sky. **The act of a cloud breaking into two separate clouds is analogous to speciation in nature. Similarly, when clouds aggregate together this is analogous to species being crossed in cultivation to form hybrids.** With this model, you will realise that the clouds making up the genus have many characters in common, and whether clouds are seen to still be connected or are separate will depend to a large extent on viewpoint.

Hopefully having established some common ground, it is now appropriate to discuss the recent establishment of the taxon *Clivia robusta* (Murray *et al.*, 2004). Most of the background to this was discussed in CLIVIA 3. Little has changed since that time except that a few additional accessions have been positively identified as being *C. robusta*, while South African botanists Truter and Swanevelder have added to our understanding of the natural distribution of this taxon.

Over time different pieces of information in addition to plant shape have been taken into consideration when delineating a species. For instance, chromosome numbers and biochemical data have been used for various genera. Increasingly DNA data are being used.

Between 1996 and 2000 Dr Yidong Ran completed a cytogenetic analysis of the genus *Clivia* as a PhD study here in Auckland jointly supervised by Professor Brian Murray and myself. This was made possible as I had brought together an extensive collection of both *Clivia* species and hybrids from around the world.

In this collection were some plants originally given to me as seed by Graham Duncan at Kirstenbosch following the inaugural Clivia Conference held in 1994. These plants were referred to as a robust form of *C. gardenii*. Initially the seedlings looked pretty much like those of any other *Clivia* except *C. nobilis*, but as they became older the plants stood out from anything else. They were very vigorous and with a tall stiff habit and rounded leaf tips quite distinct from the very pointed lax leaves of *C. gardenii*, although they did have the pale green almost white lower leaf surface that one associates with *C. gardenii*.

As shown in our scientific paper which was reprinted in CLIVIA 2, it is possible to identify the different named species of *Clivia* on the basis of banding patterns that develop when the chromosomes are stained in various ways.

When Yidong looked at the chromosomes of the "Robust *gardenii*" he found that while the banding pattern was closer to *C. miniata* and *C. gardenii* than to *C. nobilis* or *C. caulescens*, it was distinguishable from both.

We hear much about DNA analyses and fingerprinting in connection with forensic work and criminal trials. Similar techniques are available to plant scientists and Yidong used two distinct methods, random amplified polymorphic DNA analysis (RAPD) and DNA sequencing. Two regions were sequenced, the internal transcribed spacers (ITS1 & ITS2) of nuclear ribosomal 45S DNA and the non-transcribed spacers between the 5S RNA genes. When these methods are combined with appropriate statistical models it is possible to estimate how closely related different species and varieties may be. Our DNA analyses showed that "Robust *gardenii*" was distinct from the four species already named but was most closely related to *C. gardenii* and *C. miniata*.

Correspondence with John Winter at Kirstenbosch established that the original accession of "Robust *gardenii*" had been collected by Kobus Eloff from the Wild Coast. Dr John Rourke of the Compton Herbarium at Kirstenbosch, in a letter dated 13 March 2000,

Photo: Courtesy Sean Chubb

C. robusta

Photo: Keith Hammett

Single flower of *C. robusta* (centre) with flowers from four different accessions of *C. gardenii*, two on each side, showing the clear difference in stamen exsertion between the two species

Courtesy SANBI collection

Plate 2094 from Flowering Plants of Africa, 53 (1994) incorrectly identified as *Clivia nobilis*. Artist Claire Smith.

indicated that he had recognised it as a distinct entity based both on its morphology and habitat and referred to it as the "Swamp Forest *Clivia*". He provided details of herbarium specimens held at the National Herbarium in Pretoria and at Kirstenbosch and he indicated that geographically its distribution fitted in between *C. nobilis* from the southern Kwazulu-Natal and the Eastern Cape and *C. gardenii* in Natal. He went on to say, "Most of the populations I am aware of are situated between Port St Johns and Umtamvuna at Port Edward. Ecologically it is very distinct and is mainly found in swamp forest - those patches of *Syzigium* forest, like islands in the grassland which are situated in depressions and fill with water during summer. Thus the Swamp Forest *Clivia* is semi-aquatic standing in 6-9 inches of water for several months. It also occurs along river banks in the area. Flowering takes place in June and July. This is the same species we collected at Mkambati in a swamp forest west of the Mtentu River (my no. 2145).

The leaves tend to be pale green, rather fleshy and flaccid and the flowers tubular orange-red. There are notes on the National Herbarium specimens written by Prof. Olive Hilliard indicating that it does not fit the *nobilis* or *gardenii* concepts, but she abandoned the problem at that point. Unfortunately, it was illustrated in colour in Flowering Plants of Africa plate 2094 in 1994 under the incorrect name *Clivia nobilis*. The plate is a very poor one confusing the matter even more".

This communication from John Rourke was especially valuable as it confirmed that a plant that Yidong had been able to identify at the genomic level had been recognised as being distinct in the field. It also explained why the description of *C. nobilis* published in 1994 differed so markedly from what most of us in the Clivia Society understand to be *C. nobilis*.

A coincidence with regard to the receipt of John's letter was that one of the herbarium specimens of the "Swamp *Clivia*" to which John referred was collected by Fanie Venter in 1976. Fanie now lives in New Zealand and happened to visit me on the very day that I received distinct material of a caulescent form of *C. gardenii* from South Africa and Fanie was able to examine it and discuss his knowledge of the "Swamp *Clivia*".

John Rourke pointed out that while he felt sure the plant was a distinct taxon, before formally naming it more needed to be known about its distribution and ecology. I was fortunate in June 2000 to be able to travel with John Rourke, John Winter and Brian Tarr to look at the "Swamp *Clivia*" in habitat and to collect seed from separate populations in KwaZulu-Natal.

After returning to New Zealand I was able to raise seedling populations of these collections and Yidong was able to confirm that three of them have the same chromosome staining pattern as the original Eloff "Robust *gardenii*".

Possibly the first record of the plant was that made by W.L. Chiazzari in 1943 who made notes on a plant which could not be fitted into one of the named species of *Clivia*. While visiting South Africa for the Second International Clivia Conference in 1998 Nick Primich showed me a plant owned by Pat Gore. This was a very large plant which could not be assigned to any of the then recognised species, but was informally being called "robust *nobilis*". After sterling efforts by James Abel and many subsequent trials and tribulations, I was able to get an offset of Pat's plant as far as quarantine confinement here in New Zealand. Yidong was able to determine the chromosome staining pattern of the plant which enabled us to identify it as what we now call *C. robusta*.

It has been demonstrated that all the named species except *C. mirabilis* (because that was not available to us) can be recognized both by gross morphology of the whole plant and by chromosome and DNA characters. In the case of *C. robusta*, the most obvious feature is the sheer size of the mature plants and their ability to grow in both running and stagnant water as well as in better-drained situations. When grown in damp conditions prominent prop or stilt roots are developed. Leaves are broad with rounded tips and contrast markedly with the narrow tapering leaves of *C. gardenii*. Like the other pendulous species except *C. gardenii* the stigma and stamens are essentially retained within the flower tube. Accessions of *C. gardenii* are notable for the protrusion of these organs.

The distribution of *C. robusta* has been shown to be endemic to Pondoland and to be separate from that of *C. gardenii*, which is recorded only from the Durban area northwards.

I have been asked why we did not try to locate the type herbarium specimen of *C. gardenii* as described by Hooker in 1856 and compare the DNA of this with living material of *C. robusta*. All our work was done with living plants. An adequate number of distinct living accessions for each species was used and these were identifiable both by concurrence with accepted morphological descriptions for each species and their karyotypes.

In the course of the work, the "Swamp *Clivia*" was seen to be distinct, both morphologically and by karyotype from the other taxa. I went to considerable personal expense to ensure that an adequate number of different accessions was obtained and tested. Four different DNA/phylogenetic tests confirmed that the "Swamp

Clivia" was distinct from the then known species. *C. mirabilis*, which was described subsequently, is based only on morphological and geographic criteria.

C. gardenii was described 149 years ago. Presumably a herbarium specimen was prepared somewhat earlier than this. As the plant was first grown at Kew, this presumably would be the place to look. Whether it would be possible to get permission to borrow and to make DNA samples from a type specimen is a moot point. It is also a moot point whether after 150 years the DNA had degraded or not and whether a comparison between fresh and long dried material would be valid.

Hooker's original description and illustration closely match the accessions that we have determined to be *C. gardenii* and are quite distinct from *C. robusta*.

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Table 1. Summary of the key differences between *Clivia gardenii* and *C. robusta*

Morphology	*Clivia gardenii*	*Clivia robusta*
Habit	Gracile plant, strongly clump-forming, ±1 m in height	Massive plant with stout rhizome, often with prop roots, ± 2 m in height
Leaves	Linear-acuminate, strongly sulcate in cross-section	Broad, strap-shaped with with obtuse-apiculate apex, planar in cross section
Flowers	Stigma and stamens strongly exserted	Stigma barely protrudes and stamens usually retained within corolla tube
Karyology	45S rDNA site + C-band on chromosome 2 45S rDNA site but no C-band on chromosome 2 No 45S rDNA site or associated C-band chromosome 8	45S rDNA site or associated C-band chromosome 2 45S rDNA site + C-band on chromosome 8
Distribution	Widespread in KwaZulu-Natal	Confined to Pondoland Centre of Endemism

Notes on the sketch of *C. robusta* by W.L. Chiazzari .

We are indebted to Mr W. L Chiazzari for permission to reproduce his sketch, shown here. An extract from a letter that he wrote from Pietermaritzburg on 14 July 1965 to the National Herbarium, Pretoria, is set out below:

"The Clivia was taken from a small patch of isolated swamp forest growing in dense masses beneath the trees. I first located this same group of Clivia in 1943 when I was serving with the S.A.A.F. during the last war and had been sent with No. 29 Squadron to a landing strip named Lombazi approximately 1 mile from this patch of forest. A coloured sketch was prepared from a flowering head at the time, and is still in my possession. However about four years ago, I again visited the areas and brought back a number of plants, one of which I took to the Herbarium, Botanic Gardens, Durban, from where it was consigned to your Department in Pretoria for identification by a Miss Johnson. To this date I have not heard as to the identity of this species.

The main characteristic of this species is the procumbent or semi-procumbent stem more than 18" long and with leaves strap shaped, forming a plant on an average of well grown plants 4'0" - 5'0" height. The heads contained between 22-35 flowers each. From available literature, it does not appear to be C. gardenii which has from 10-14 flowers in an umbel nor is procumbent, as far as I am aware. This also applies to C. nobilis which is also diminutive by comparison. The description of C. caulescens nearest meets the description except for its locality and fewer flowers.

I have successfully grown and flowered plants in my plant houses at Richmond. I should be pleased to forward another plant to your Department should the original be mislaid or the species be of interest?" Eds.

Courtesy W.L. Chiazzari

C. robusta by W.L. Chiazzari, 1943.

C. robusta seed.

Photos: Courtesy Sean Chubb

A Red form of *C. robusta*

Photo: Keith Hammett

A *C. robusta* inflorescence.

Clivia Species and Hybrids Identification

Multipetal

Spider

Recurve

Bi Colour

Ghost

Bi Colour

Pink Picotte

Green Throat

Clivia Species and Hybrids Identification

Florid White Lips


C. robusta


C. nobilis

C. mirabilis

C. miniata

C. gardenii

C. caulescens

Photographs are courtesy of Clivia Society – www.cliviasociety.org

Clivia Wonders – www.cliviawonders.com and

Cosmic Clivias – https://www.kiwiclivia.com.

Clivia x nimbicola
a Stunning Beauty from the Bearded Man

J.T. Truter, Z.H. Swanevelder & T.N. Pearton, South Africa

The Amaryllid genus *Clivia,* an endemic to Southern Africa, consists of six described species. Many of the species and cultivars are extensively grown worldwide, making this group of considerable horticultural importance.

Man-made hybrids between the different *Clivia* species are currently enjoying great popularity in breeding programs, mainly because of the beautiful progeny they produce—though the first hybrids were made as early as 1856 (C. *nobilis* and C. *miniata).* Various references to putative natural hybrids between C. *miniata* and C. *nobilis;* C. *miniata* and C. *gardenii* and C. *miniata* and C. *caulescens,* have been recorded in literature in recent years. Rourke (2003) reported on a natural hybrid between C. *miniata* and C. *caulescens* from the Bearded Man Mountain (on the border between Mpumalanga, South Africa and Swaziland) and its subsequent collection and cultivation at Kirstenbosch Botanical Gardens, South Africa. Though these reports exist in literature, no scientific documentation, *i.e.* formal description of a nothotaxon existed till recently. A nothotax6n is a botanical term used to describe a naturally occurring hybrid.

The recognition of naturally occurring hybrids is often regarded as speculative and the existence of such taxa is usually based on circumstantial evidence. Therefore, scientific reports of putative nothotaxa are rare. The following are some criteria that have been suggested as standards to help facilitate the identification (Stewart and Manning, 1982):

1. The possession of intermediate morphological features
2. Proximity to the putative parents
3. Hybrid fertility, with segregation recognisable in the F2 progeny
4. Preferably supplemented by the artificial hybridisation of the putative parents

The first, formal description of such a natural hybrid, with the hybrid identity supported by the four criteria stipulated above, has recently been published in *Bothalia. Clivia* x *nimbicola* Swanevelder, Truter and van Wyk, is intermediate between C. *caulescens* and C. *miniata* with regards to rhizome, leaves, umbel and flower morphology (See Table 1, for an abridged comparative listing). Flower colour exhibits a range of tonalities, from pastel pinks through to pastel oranges and deep reds, some specimens showing pronounced green tepal apices. Flowering is somewhat erratic, and can occur at various times throughout the year, but mainly from July to December. Some clones even flower twice yearly, the second flush occurring from February to May. The extended flowering period of C. x *nimbicola* is regarded as further evidence in support of the taxon's hybrid origin; bearing in mind that *C. caulescens* flowers October—December and C. *miniata* October—November in this specific locality (Bearded Man Mountain). Furthermore, the hybrid plants carry fertile berries and produce seedlings that grow close to the parent plants, thus inferring the maintenance of the populations by subsequent breeding.

Field observations suggest some introgression *(i.e.* back-crossing) between C. x *nimbicola* and its putative parents. Where populations of C. x *nimbicola* occur close

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to or amongst C. *caulescens*, backcrossing of the hybrid with C. *caulescens* produces umbels with fewer flowers that are tubular, yet more open than typical C. *caulescens*. Conversely, where the hybrid occurs close to or amongst C. *miniata*, the umbels are less floriferous and the flowers are more funnel-shaped; yet not as open as typical C. *miniata*. It is suggested that from the inferred initial hybrid cross, subsequent generations have resulted from various backcrosses, resulting in a hybrid swarm. Records proving that artificial hybridisation between C. *miniata* and C. *caulescens* can successfully be done, date back to 1945 (*e.g.* 1945/66, R. Marais PRE 37106). Morphologically, the resultant hybrids closely match C. x *nimbicola* in the wild.

Forest-covered Bearded Man Mountain in the distance, the locality of Clivia x nimbicola

The holotype of C. x *nimbicola* was collected on the Bearded Man Mountain, near Barberton, South Africa. Located at an altitude of between 1100m and 1300m above sea level, Bearded Man Mountain receives approximately 1200mm of rain per year. In this locality, the new taxon is fairly common (an estimated 50 or more individual plants), occurring in sympatric stands (*i.e.* the populations are intermingled) of C. *miniata* and C. *caulescens*. At least three separate, well-established populations of C. x *nimbicola* have been recorded for this locality, with stands extending into both South Africa and Swaziland. Judging by plant size and the height of aerial stems, original hybrids can be as old as their putative parents. Toppled plants with long aerial stems freely produce suckers when in contact with the soil. The natural distribution range of *C.* x *nimbicola* is confined to the Barberton Centre of Endemism (van Wyk & Smith, 2001), the only known region in which the distribution ranges of C. *caulescens* and C. *miniata* overlap (Swanevelder, 2003).

Clivia caulescens of the area

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In this locality, C. *caulescens* prefer steep cliff faces or steep rocky embankments, while C. *miniata* generally prefer gentler scree embankments or flatter forest habitats. The C x *nimbicola* plants are distributed between and amongst both parents, occupying both specific habitats found in the Afromontane Forest. The epithet `nimbicola' means 'dweller in the mist/cloud' and refers to the mist belt habitat in which this hybrid and its putative parents are found. The new nothospecies is intended to cover all hybrids between C. *miniata* (including all varieties) and C. *caulescens*.

A. ***Clivia* x *nimbicola*** **`Int1B. This clone is shown next to a metrestick (10cm divisions) - note the firm leaves with rounded tips and lack of tip die-back, commonly found in both parent species.**

B. ***Clivia* x *nimbicola*** **'Int1C. This clone bears a symmetrical, flat-topped umbel - note green tips to tepals. A self-sterile, vigorous grower that sets seed poorly but flowers twice yearly.**

C. ***Clivia* x *nimbicola*** **'Int5a'. This done is an example from the Swaziland side - note the full rounded umbel with green tepal tips that fade fairly quickly. It is a larger specimen which flowers in April and sets copious seed.**

Cultivation of *Clivia* x *nimbicola*

Clivia x *nimbicola* is typically a vigorous grower, enjoying the strong points of both the C. *miniata* and *C. caulescens* parents. It benefits also in that unlike C. *miniata* from the area, the leaves are very healthy and strong and do not have the characteristic tip die-back of C. *miniata*. The plants sucker readily if exposed to bright light - a sucker can flower in its second year after emerging. Seeds collected from the habitat and those grown in cultivation are not all vigorous, with an equal split between vigorous, average and weak seedlings. The full strength of the best seedlings only becomes evident at the end of the second year of growth. Seedlings do not appear to be as susceptible to fungal attack as either of the parent plants. C. *miniata* accepts C. x *nimbicola* pollen readily but the berries often contain only one or two seeds. Seedlings grown are not on average as strong

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as C. x *nimbicola* and have shown considerable variety in leaf form. The characteristics of C. x *nimbicola* are clearly evident in all cases.

Examples of the natural variation of *Clivia Miniata* found on the Bearded Man Mountain. Colour and flower forms vary significantly

Photographs courtesy of the authors

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ABBREVIATED COMPARISON OF *Clivia* x *nimbicola* WITH ITS PUTATIVE PARENTS, AT THE BEARDED MAN MOUNTAIN, MPUMALANGA

Character	*Clivia caulescens*	*Clivia x nimbicola*	*Clivia miniata*
Aerial stem	Present in mature plants, length age dependent	Present in mature plants, length age dependent but shorter than in C. caulescens	Present in these populations when plants are mature, length age-dependent, usually shorter than in hybrid
Leaf length x width (in mm)	100-600 x 35-45	250-350 x 55-70	450-600 x 35-70
Leaf apex / margin	Obtuse-acute apex with rarely serrated margins	Acute apex that is usually entire, but with occasional serration	Acute apex with margins usually entire
Umbel	Usually compact but, flattened on one side	Loose/open form with ± flat-top	Loose form but almost globose
Flowers	14-40 in number, up to 50, Drooping in orientation, 30-45 mm long with a tubular and curved shape; inner segments slightly spreading	Usually 10-20, but up to 30, orientation ranging from semi-erect to drooping with flowers between 30 and 60 mm long; flowers are trumpet-shaped and curved, with segments open; funnel-shaped and mostly spreading	Only 7 - 10 in number with a maximum of 15 flowers in an erect orientation. The flowers are 60 to 80 mm long with open, funnel-shaped, ± straight, spreading perianth segments.
Seed	1-4 seeds that are ± 8-10 mm in diameter taking approximately 9 months to mature	1-4 seeds with a diameter of ± 10-15 mm, maturing in 9 months	1-4 seeds with a ± 12-15 mm diameter, taking up to 12 months to mature
Flowering time	October - December	Erratic, mainly July - December and/ or February - May	October - November

Courtesy of Clivia Society South Africa Yearbook 8

Clivia x *nimbicola* – A walk on the Wild Side

By Wayne Haselau

Much has been written about *C.* x *nimbicola*. A great deal of discussion has taken place regarding this unusual *Clivia* and a few lucky individuals have been fortunate enough to visit their restricted habitat at the Bearded Man Mountain in the Sondeza mountain range on the South Africa - Swaziland border.

The first time I read about the *C.* x *nimbicola* plants was in John Rouke's article in the Clivia newsletter, which described the story of the discovery of an unusual plant in the Nelspruit Botanical Garden and the subsequent investigative trip by Willem Froneman. Willem, the garden's horticulturist, together with Kirstenbosch botanists John Rourke and John Winter, visited the Bearded Man habitat site. The picture in the Clivia Yearbook shows a very pink interspecific type plant. Most *C.* x *nimbicola* flowers are in fact light orange or red and very few are actually true pinks. Varying colour forms of *C. caulescens* occur in the same area and there are also some large flowered and unusual *C. miniata* that occur there as well.

My first trip to The Bearded Man was a birding trip with a conservation colleague, while still employed by Nature Conservation, in the late 1990s. We slept on the mountain that night and it was eerie, as a big storm developed and the wind howled all night. We had a dog with us and it barked loudly and intermittently all night. The next day found the mountain completely blanketed by a thick swirling mist and everything was wet, with water dripping off the foliage. I have always been interested in

A close-up of the fabulous mother plant Site B.

Another close-up shot of the red.

Attie and Stephen looking towards the Sheba Mine and Barberton in the distance.

Clivia caulescens berries near Site B.

Close-up of red bud in Area C.

plants and I remember well seeing *C. miniata* and *C. caulescens* growing at altitude in the shaded kloofs of the southern and eastern slopes. Many plant species grow here, as it is a region of very high plant biodiversity, falling within the Barberton Centre of Endemism. It does not take a lot to realise that this place is extremely special floristically as the grasslands here harbour many rare geophytes and the forests and thickets are full of forest species such as Orchid, ferns, Streptocarpus, Impatiens and Begonia.

Looking into the top of the inflorescence note the yellow ovaries.

My second trip to The Bearded Man almost 15 years later was with two of the mountain's most knowledgeable guides. Stephen van der Linde, the local forester and Attie Le Roux, have spent many hours on the mountain surveying the unique *Clivia*. Stephen van der Linde is a quiet, unassuming man, with a Father Christmas-like persona. He was the officer in charge of the commercial forests on the mountain for some 20 years and was a passionate conservationist and *Clivia* lover. He was effectively the best friend of the local *Clivia*. All trips to the mountain have to be arranged through Stephen van der Linde.

Attie Le Roux is a long-time friend of Stephen and a passionate Cliviaphile who loves pendulous and rare *Clivia* (also known as Mr. Nimbicola). He has done long-term monitoring of *C. x nimbicola* in the habitat and together with Stephen they have identified four separate sub-colonies of *C. x nimbicola*.

C. x nimbicola bud Site B.

Each locality is separate and distinct as are the plants in each of these localities with regards to flower shape and colour. For instance, Area B is relatively close to Area C but plants of both these sub-populations are generally very different in colour. In Area B flowers are mostly light orange and pink and there are also some apricot and peach colours, some with white undertones. Area C's plants are only a short distance away and are strikingly different in colour, varying from orange to dark orange and almost red, with varying degrees of green. When one enters the forest near the

C. x *nimbicola* habitat Site C note open canopy and increased degree of light.

summit of Bearded Man on the South African side it is only a short distance before one encounters *Clivia*. It is in this area that the first *C.* x *nimbicola* was found. Attie and Stephen took me to see these *C.* x *nimbicola* plants in so-called Area A, but unfortunately very few remain today, owing to their accessibility and that fact that in the past many of the mother plant clumps have been completely removed.

C. x *nimbicola* tend to form large clumps in the habitat and offsets readily. It is therefore totally unnecessary to remove mother plants from the habitat. The seeds also breed true to type, which is a very unique trait in a so-called interspecific i.e. they self, close to 100% true to the motherplant! In Area A there are still some really lovely forms of *Clivia miniata* flowers, with some forms displaying recurved tepals and other tepals being spidery. The month of July is the peak flowering time of the *C.* x *nimbicola*. Many *C.* x *nimbicola* plants flower more than once a year and may in fact flower at any time throughout the year.

After leaving Area A we began our descent down the mountain and the going became really tough and quite precipitous. After walking for what seemed a long while through lush forest, we climbed down a narrow kloof, laden with tree ferns and many other fern species as well as a thick cover of streptocarpus, begonias and impatiens. We crossed another ridge which had a lovely stand of *C. miniata* on the top and we made our way cautiously down a narrow buck path which weaved in and out of the clumps of *C. miniata* plants. Further down we started to see *C. caulescens* and some of the adult plants were typical of the species, with long aerial stems drooping over rocks and tree stumps in spectacular disarray. I was busy photographing the clumps of *C. caulescens* when Stephen and Attie passed me and a short while later I heard the first call to come and look. As I moved through the forest, the canopy dissipated and the canopy

Red C. x *nimbicola* close up in habitat

height dropped considerably as well. It was here in this lighter area that I witnessed one of the *Clivia* habitat highlights of my life, with a superb pinky pastel interspecific-type mother plant standing before us in full bloom. I looked up at Stephen and Attie and we all smiled and nodded our heads in reverence, and the word "Wow" come to mind immediately. I was, however, frankly overwhelmed by the sheer beauty and size of the plant before us. Although Attie and Stephen moved on, I could not drag myself away from this spectacular plant and I was determined to get as many photos of it *in situ* as possible. A short while later more "oops" and "ahhhs" and "wows" were heard as the lads discovered more of Area B's plants flowering randomly down the slope.

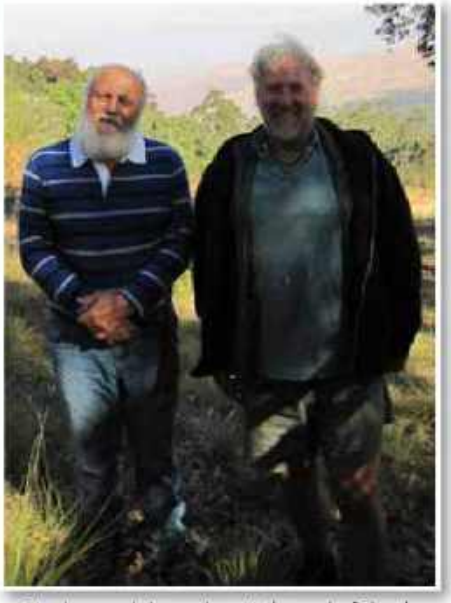
Attie called me down to show me where a large landslide had occurred a few years previously. Unfortunately this resulted in damage through the heart of Area B, effectively destroying at least 50% of the colony. I was amazed to see the extent of the naturally occurring damage to the area and its plants. Despite the best efforts of my companions, many precious plants were lost due to this natural event. This is not the first time that I had encountered extreme natural changes to a *Clivia* colony in the habitat, however this was without a doubt the most destructive event I am aware of to date, especially considering the rarity of the plants involved. Despite this, we found 19 different *C. x nimbicola* clones in bud or in flower here, which was a truly wonderful experience.

I was attempting to capture as much of this amazing habitat on camera and I missed out on the initial transition to Area C which begins across a nearby valley. A short distance away as the crow flies, lies a spectacular group of plants, the so-called "Red *C. x nimbicola*".

Red C. x *nimbicola* mother plant clump.

Sondeza Range with Bearded Man peak left of the picture from Barberton.

Stephen van der Linde *in situ*.



Stephen and the author at the end of the day looking towards Swaziland.

Once again I was the last to arrive at the scene and again the air was filled with all kinds of adulation. The plants here have very different flowers and seem larger, more floriforous and robust than the ones we had just seen. Dark orange and red forms occur here in greater numbers and the visual effect is staggering. We spent a couple of hours here communing with these plants and it was again a very special experience. I took as many photos as possible but my camera could not possibly do this scene justice as the plants were growing in very deep shade (and I wished I had my very talented *Clivia* photographer friend, Ian Coates, along with his crazy photographic skills).

Area D was close by, however, this population occurs in Swaziland and there is much unsavoury hostile border crossing-type stuff going on in the area, which makes it a fairly hazardous and unsafe place to visit. To venture down the mountain in this area would be unwise to say the least and I get this same uncomfortable, "out on a limb" feeling often when visiting remote areas such as in the rural Transkei. Consequently very few plants from this area have been photographed and material from this area remains extremely rare. So we looked down from the South African border into Swaziland, shook our heads and started the long climb back up the mountain to our vehicle. The feeling of isolation and remoteness is like being in another world, as it was extremely quiet and windless at altitude on the shaded side of the mountain. We picked our way back slowly and I used the opportunity to take a few more pictures of the best flowers en route. We finally emerged from the forest into the light and the grassland of the south-east side of the mountain. The views from here are spectacular as one looks towards Barberton and the famous Sheba gold mine. Swaziland is far off to the east.

Stephen and Attie have collaborated over the years to conserve the unique *Clivia* on the Bearded Man Mountain and they have been instrumental in preventing the wholesale plundering of its unique *Clivia*. In my mind they are the unsung heroes of the Mountain's *Clivia* and deserve a lot of credit for their efforts.

The boys resting amongst the *C. nimbicola* in Site C.

I would recommend that anyone wishing to visit the area consult with either one of these gentlemen first or better still to ask them to accompany you as a guide.

I believe that it is simplistic to consider the *C.* x *nimbicola* as a naturally occurring interspecific. If my theory is true, then it implies that this is possibly a new species of *Clivia*. Current consideration is that perhaps it is in fact an ancient form and may have been the transition species from which the area's *C. caulescens* and *C. miniata* evolved. *C.* x *nimbicola* may therefore be a species, albeit a very old one, that is now relictual, restricted to a few pockets in the remaining suitable habitat! There are no other known *Clivia* habitats in which interspecific individuals are found in any number despite the fact that some mutating colonies and hybrid swarms are known. In these colonies it is possible to see more than one species of *Clivia* growing together or in close proximity to one another, such as with the *Clivia miniata* and *C. nobilis* colonies in Southern Transkei. However one does not typically find plants of an intermediate nature growing in these colonies. The pollination of intermediate *Clivia* forms obviously presents a problem to the would-be pollinators and could be a possible reason why such plants are so rare in the wild. The nearby Songimvelo colonies visited and photographed by Roger Dixon have large numbers of healthy *C. miniata* and *C. caulescens* growing in close proximity to one another but to date, as far as I am aware, NO interspecifics have been found there, which is typical of wild mutating colonies.

Naturally occurring interspecifics with F1 traits are extremely rare in the wild. It is believed that *C.* x *nimbicola* breeds 100% true to type when selfed. If this is true, then I believe it is not an interspecific, as an interspecific, when self pollinated, would produce plants with a large degree of floral variation.

View of the summit from the south eastern side of the mountain.

Attie le Roux pointed out another extremely constant diagnostic characteristic of these wild plants and that is that in almost every instance the ovaries are yellow. The plants are found growing together in small sub-populations, with few if any *C. miniata* or *C. caulescens*, the supposed parents, in the immediate vicinity. The fact that it is restricted to a very small altitudinal range and quite possibly a specific geological niche as well, further points to its rarity and uniqueness. I have discussed this matter with a number of *Clivia* collectors, breeders and scholars, and the current consideration is that these may possibly be the mother stock from which the north-eastern *Clivia* plants evolved i.e. the transition species. Is it possible that *C. miniata*, *C. caulescens* in the Barberton centre and the ngome form of *Clivia gardenii* in the adjacent Ngome diversity hotspot to the south-east may all have evolved from this ancient *Clivia* form.

Obviously more work needs to done in this regard and I suggest that a project focusing on these plants be considered for a research topic, sponsored by the Society and/or the SANBI.

John Winter used *C. x nimbicola* in his breeding programmes with fascinating results and he said that he believed in its vigour and uniqueness. It may be some time before we can be sure of the status of these plants, however in the meantime we need to make sure that these plants are better protected in the habitat.

Further to this, I do not believe that man-made hybrids using *C. caulescens* and *C. miniata* and reciprocal crosses in cultivation can be called *C. x nimbicola*. I have a few of the man-made crosses in my collection and they are obviously not the same as the naturally occurring *C. x nimbicola*. Furthermore, all the ovaries in the man-made crosses are not yellow, but are green!