CLIVIA

FIVE

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Front cover: C. *miniata* 'Bronze Greenboy' Best on Show and Winner C. *miniata* with green throat Section KZNCC 2002 Show. Grower: Louis Swanepoel.

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Clivia miniata **'What a Peach'.** Breeder and grower: Brian Tarr.

EDITORS
Mick Dower   Claude Felbert
John van der Linde   John Winter

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* Papers read at the International Clivia Conference

EDITORIAL

Two events stand out in the period covered by this Yearbook. One is the third International Clivia Conference held at Pietermaritzburg; the other, the publication of Harold Koopowitz's outstanding and authoritative book, CLIVIAS. Both set standards that can only auger well for the future of the *genus*.

The first Yearbook was the product of a challenge to come up with something more than Newsletters to showcase the Clivia Club. The book was based on the proceedings at the second International Clivia Conference held at Kirstenbosch in 1998. At that time we had to rely on photographs of plants bred outside South Africa, mostly in Japan and Australia. Subsequent Yearbooks have increasingly brought forward photographs of outstanding plants bred in South Africa and at last we can see, in this Yearbook, what has been bred from the very small gene pool in the U.S.A.

This, the fifth Yearbook, covers primarily the proceedings at the Pietermaritzburg Conference, particularly for the benefit of the many who were unable to attend it. We have not published Dr John Rourke's keynote address on the discovery of *Clivia mirabilis* as it covered the same ground as his leading article in CLIVIA FOUR.

One of the highlights of that Conference was the 3-D slide show of spectacular Clivias presented by James Comstock, whose photographs illustrate Harold's book. Unfortunately, space allows us to include only a small selection of those slides.

Clivia miniata in full bloom provided a spectacular backdrop to this Conference. The Host Club, Kwa-Zulu Natal, excelled in their organisation and administration and provided wonderful opportunities to visit populations of *Clivia* in their natural habitat in relatively close proximity to the conference venue.

A notable feature was the honouring of Fred Gibello, Wessel Lötter and Bill Morris for their outstanding contributions to the spread of *Clivia* knowledge by awarding them Honorary Life Membership of the Clivia Society.

Another highlight of the Conference was the Auction, where rare and exceptionally magnificent *Clivia* realised excellent prices in Rand terms. But no amount of money could buy the single plant of *Clivia mirabilis* which was displayed by the National Botanical Institute. Identifiable in part by its characteristic white streak down the centre of its leaves, C. *mirabilis* attracted great interest. The discovery of this new species, growing in an isolated habitat in the North West Cape and in a harsh environment very different from that which other *Clivia* species thrive in, raises many questions and only time may produce some of the answers!

In this Yearbook Dr Dee Snijman, a senior researcher at the Compton Herbarium at Kirstenbosch, tells us why she believes C. *mirabilis* occurs where it does and why it is so isolated. Dr John Rourke also tells us about finding C. *mirabilis* with pedicels which had developed into secondary umbels, resulting in many more florets, and speculates on the breeding potential of this characteristic.

Clivia mirabilis seed is now being grown on at Kirstenbosch on behalf of the Northern Cape Nature Conservation Department and seedlings will be made available to the public towards the end of 2004.

With the proliferation of named *Clivia* it is of importance that growers read Ken Smith's article where, as the *Clivia* names Registrar, he advises on the naming procedure for *Clivia* hybrids that are constantly being introduced.

Once again the Yearbook has a number of articles on growing *Clivia* and covering the fascinating subject of genetics to promote a better understanding of breeding and to demonstrate the rich potential of this relatively small genus.

The Yearbook has become the showpiece of the Clivia Society which was formed in 1992 by Nick Primich as the Clivia Club. It held the first International Conference in Pretoria in 1994. The Clivia Society is now the umbrella body which brings together and facilitates the common interests of regional Clivia Clubs as well as individual enthusiasts throughout the world. Within this overall 'Clivia fellowship' there are many people with multiple skills, knowledge and expertise and the Yearbook seeks to pass on such information to *Clivia* enthusiasts worldwide, stimulating interest and contributing to the conservation and development of the genus.

All enthusiasts are encouraged to share their knowledge and ideas by submitting articles and photographs to the Editorial Committee and the Editor of the Newsletter.

This Editorial Team has now produced five Yearbooks and the time has come for new blood and new ideas. Another Team will produce Yearbook Six. They will need your full support! We wish them every success and trust that they will gain as much pleasure, satisfaction and sense of achievement as we have, in rising to the challenge.

The Editors
CAPE TOWN. April, 2003

The following abbreviations have been used, particularly in the captions to the photographs:
CC Cape Clivia Club EC- Eastern Cape Clivia Club KZN - KwaZulu-Natal Clivia Club
Metro - Metro Interest Group NC- Northern Clivia Club

The International Clivia Show

COLLECTING CLIVIA IN THEIR NATURAL HABITAT

John Winter

As a horticulturist, I have always had a passion for plants. My interest has focused on a number of groups, such as *Erica, Disa* and *Drosera* which I have collected extensively through the years to build up the living plant collections at Kirstenbosch Botanic Garden where I was employed for 34 years.

My interest in *Clivia* grew after attending the First International *Clivia* Conference that Nick Primich organized in Pretoria in 1994. I investigated the herbarium records of the National Herbarium in Pretoria, the Natal Herbarium in Durban and the Selmar Schonland Herbarium at the University of Grahamstown. Rather surprisingly I discovered that *Clivia* were poorly represented in all three herbaria. It was obvious to me that no extensive study had ever been done on the genus.

The living collections of *Clivia* in all of the eight gardens of the National Botanical Institute, of which Kirstenbosch is one, were also a poor reflection of the genus. My natural reaction was to plan a collection programme to improve the living collections of *Clivia* in the National Botanical Institute (NBI) gardens, contribute towards improving the herbarium records and make selections of *Clivia* to be used in a breeding programme. What pleased me particularly was that there were only four species in the genus!

Although the NBI is charged by government decree to study, research, promote and conserve South Africa’s indigenous flora, this does not give the staff the authority to collect plant material without obtaining permission from the local authority, i.e. the relevant Department of Nature Conservation as well as the owners of properties to be visited. All plant collecting undertaken by NBI staff has to be covered by a permit which stipulates certain conditions, such as the exact plants that may be taken out as well as the quantity. A permit is issued for a certain area and for a limited time period. After the collecting trip has taken place, a report has to be submitted detailing what plants have been collected and the permit has to be returned.

I have spent many hours in the field observing what pressures have been brought to bear on *Clivia* communities, many of which have long since disappeared. The reasons are many. The local indigenous people living in close proximity to Clivia populations, who use the plant for medicinal purposes, seek after *Clivia*. The horticultural industry and *Clivia* enthusiasts collect selected forms and many *Clivia* populations have been destroyed through the harvesting of timber for building, firewood and to establish arable land. This destroys the shade canopy and ultimately results in the death of the *Clivia* population which grew in the shade of these trees. And of course urban development has also played a part in the destruction of plant communities particularly along our East coast where *Clivia nobilis* used to be very common. In Kwazulu-Natal sugar cane farming has also contributed significantly to the destruction of our natural vegetation.

Fortunately *Clivia* are easy to grow and for this reason will certainly not be a candidate for the Rare and Endangered Species list. However the recently described *Clivia mirabilis* is certainly not as common as the other four species and its well-being is a source of concern. I appeal to *Clivia* enthusiasts to be patient and not put pressure on the known population but to wait for this new species to be made available.

In the last five years numerous collections of *Clivia* have been made of all of the species - C. *mirabilis* had not yet been discovered. These collections have been grown on at Kirstenbosch and selections have been made of certain plants with particular characteristics, which will be used in a breeding programme. As *Clivia* are long lived and multiply vegetatively, they have grown in numbers and most of the plants in the collections have now been passed on to six of the botanic gardens within the National Botanical Institute for purposes of education, display and, most important of all, to retain and preserve this genetic material. Seed and seedlings have been made available to the general public through the Cape *Clivia* Club and vegetative material will also be made available of the selections as they multiply.

In 1996, as part of my five year collecting programme, I started collecting in the Eastern Cape and moved east into the Transkei visiting known populations of *Clivia*. Herbarium records were useful in locating populations. However what was even more useful, in fact essential, was the support and knowledge of local people. Without that help, it is like looking for a needle in a haystack!

As we all know *Clivia* are shade loving and grow in forests. *Clivia* are scattered throughout the forests in the Eastern Cape, Transkei, Kwazulu-Natal and Mpumalanga, occurring in deep valleys and along river banks which run down to the sea. The Transkei has many rivers and travelling from east to west complicates progress because one has to travel inland along the river to an appropriate crossing, and then return to the coast to continue the set course. Therefore, it can take the best part of a day just to reach one destination.

A typical Transkei River with C. *miniata* growing in forest on the eastern bank.

All Clivia grow in isolated populations. Not all forests have *Clivia* growing in them. Hence the need to have inside information if one is to be successful in locating a particular population. New populations of *Clivia* will continue to be discovered for many years hence, as vast areas of South Africa are botanically unknown.

Ecology

The ecology of *Clivia* includes a number of factors which are common to all of the five species:

- Shade loving
- Water wise, i.e. they survive on minimum water supply
- Growing medium - they prefer a well drained and aerated growing medium
- Roots - their roots are epiphytic.

Umtamvuna Gorge

Clivia nobilis This species occurs in a range of environments along the east coast growing on the coastal sand dunes where the roots run just below the surface of the sand. Shade is provided by the long living Milkwood tree (*Sideroxylon inerme*). In these areas which are exposed to the prevailing winds and where the canopy provides little shade at times, the leaves of C. *nobilis* are short and rigid. Inland populations occur in isolated forests which are sheltered. These heavily shaded areas produce plants with leaves of at least a metre in length. The soils in these areas are a heavy loam with abundant organic material on the surface.

In all conditions the roots of this species spread just below the surface with a great deal of organic material aerating the root area and creating drainage which can be described as sharp. Temperatures range on average from 6°C to 28°C on the coast and 3°C to 35°C in the inland areas.

C. ***miniata*** occurs in a wider range of environmental conditions than all of the other species. On occasion they are found growing as epiphytes in the forks of trees, or on decaying logs or even on rocks. However, generally C. *miniata* grows on rocky screes amongst abundant leaf litter or on steep or gradual slopes but their roots are always very shallow and spread amongst the organic matter which is deposited on the forest floor.

C. *miniata* growing in the Transkei

The *Clivia* populations that occur on the coast in the Transkei are virtually at sea level in places. Growing in forests and subject to the cool sea breeze their growing conditions are cool with not a very wide fluctuation in maximum and minimum temperatures. In Kwazulu-Natal and Eastern Cape, on the other hand, the populations of *Clivia* are situated inland and are subject to greater maximum and minimum temperatures. At the northern end of the distribution range of C. *miniata* altitude plays a role. At an altitude of over 1300 metres the mists and cloud which cover these mountains create conditions with a chill factor very close to freezing and at the same time the forest canopy collects much moisture from the clouds and mist which benefits the vegetation on the forest floor.

C. *miniata* from Entumeni Forest

Light has a strong influence on the flowering of all *Clivia* species. In forests where the shade is heavy only a small percentage of the *Clivia* will flower. On the forest verges or where there are breaks in the forest canopy which allow light to penetrate to the forest floor, one tends to find more flowering plants.

C. *gardenii* The environment in which C. *gardenii* is found growing differs from that of all of the other *Clivia* species. All of the populations that I have visited in the field have been growing in swamps or very wet conditions with the exception of one population. They occur in heavy to light shade but in the Transkei most of the populations were found growing under the canopy of the tree *Syzygium cordatum*, commonly known as the Waterbessie. These trees are always found growing in very wet areas - hence their common name. The canopy they provide is light shade. These swamps are not stagnant as the water drains away continually.

C. *caulescens* grow in a very similar environment to that of C. *miniata* in shade on the forest floor with plenty of leaf litter, and are often found growing on tree stumps or in the fork of a tree.

Swamp Forest in Grassland

The populations I have visited grow at an altitude of over 1300 metres and on occasions experience falls of snow in winter. The minimum ground temperatures are probably in the region of 5°C.

C. *mirabilis* I shall not dwell on these details as John Rourke has discussed in detail the ecology and climate in which this species has survived for centuries (See Clivia 4).

Variation

Variation exists within the various species of

Clivia in characteristics such as leaf width, length, height of plants, flower colour, size and shape and peduncle length and width.

My observations in the field indicate that the greatest variation exists particularly in C. *miniata* and C. *gardenii*. The following characteristics have been observed to vary from population to population but occasionally also just within a single population which makes that population unique. In most cases however populations are fairly uniform.

Flowers : Colour, size, petal width, pedicel length, number of flowers per inflorescence

Peduncle : Length, width

Leaf: Length, width, arrangement of leaf, spiral-wound round/coiled, distichous (arranged in two rows).

C. *miniata* is the most variable of all the species. Flower colour varies considerably; however this characteristic is not stable as it is influenced by other factors such as light. Size of flower, width of petal, pedicel length and the number of flowers per inflorescence can vary within a single population. The length and width of the peduncle was another noticeable characteristic but apart from the flowers the other most important characteristic is the foliage.

Generally the leaves of *Clivia* are long and strap-like which, to my mind, is unfortunate. Fortunately, however, there is variation in the natural populations which the European, Japanese and Chinese growers have focused on to develop the products that they grow today.

The characteristics of short, broad and a distichous arrangement of leaves is evident in some populations of C. *miniata.* Consequently the plants are a great deal shorter than the usual *Clivia* with it's strap-like leaf and coiled arrangement of the leaves.

C. *gardenii* is not as popular as a garden subject as C. *miniata* probably because it is not as freely available and not as well known. The following variations in characteristics have been observed :

Flower ; Colour, size, fully and partly pendulous

Peduncle: Length, width

Leaf: Length, width

The flowers of C. *gardenii* are predominantly orange with green tips and yellow with green tips. The numbers of flowers per inflorescence range between 20 and 30 and the size of flower can also vary from population to population.

The length of peduncle and height of the plant varies depending on the locality. They range from 500mm in height to one metre. Generally the leaves are narrow (30mm wide) with one or two exceptions where the leaves are as broad as 60mm.

C. *nobilis* is the slowest growing of all the Clivia species. The variation observed in the characteristics of this species is as follows:

Flowers : Colour

Peduncle : Length

Leaf: Length

C. *nobilis* produces pendulous flowers with shades of red and green. The length of the peduncle and leaves are short in the coastal areas where the shade is light. Heavy shade produces plants with leaves of a metre in length and the flowers can also appear to be yellow due to the lack of light. The photograph of a yellow C. *nobilis* published in Yearbook 1998 (Photograph No. 6) is unfortunately not a true yellow as that particular plant was grown in reduced light with the result that the flowers were very pale and in the photograph appear to be yellow. Many populations have a distinct pale green stripe running down the centre of the leaf which is similar to the markings on the leaves of C. *mirabilis*. The leaves are usually notched at the tip.

I have not made many collections of **C. *caulescens*** and have not observed a great deal of variation in the characteristics of this species. I have, however, seen photographs illustrating colour forms and received reports of a yellow form of this species.

Distribution

As many of us know the most westerly population of *Clivia* is C. *mirabilis* which has turned up in the winter rainfall region of the Northern Cape. About 800km east of the Oorlogskloof Nature Reserve Clivia *nobilis* occurs just north west of the Addo Game Reserve. The most easterly record of C. *nobilis* is in the region of the Dwesa Nature Reserve occurring in coastal forest. *Clivia miniata* is the most widespread of all of the *Clivia* species stretching from just west of the Kei River to the northern boundary of Swaziland. C. *miniata* does occur in Swaziland and reportedly also in Mozambique. I have a plant of C. *miniata* which was reportedly collected in Kenya but I have not been able to trace any herbarium records or publications on the flora of Kenya which list *Clivia miniata* as a species which occurs there naturally.

The distribution of C. *gardenii* stretches from Port St Johns eastwards as far as Vryheid in Kwazulu-Natal. The most northerly species is *Clivia caulescens* occurring in the mountains in the east and Gods Window in the west.

We have five species of *Clivia,* one of which occurs not far from our West coast. All of the other four species occur up the eastern side of Southern Africa and there is a certain amount of overlap. I have observed C. *nobilis* growing in populations of C. *miniata* in the Transkei but have not come across any natural hybrids of these two species. In Kwazulu-Natal I have seen C, *gardenii* and C, *miniata* grow together in a number of localities but here again I have not come across any natural hybrids. The fact that C. *gardenii* flowers in June and C. *miniata* in August and September very likely is the reason why natural hybrids do not occur. Finally in Mpumalanga at the most northern extent of C. *miniata* populations C. *caulescens* also grows. In the early 1970's Clivia *miniata* plants were collected from this population to plant in the Lowveld botanic garden. When they flowered hybrids were discovered which indicated that natural hybrids do exist of these two species.

For me collecting *Clivia* in their natural habitat has been a wonderful experience, observing the conditions under which they grow, their environment, the soils they grow in, their distribution and the range of variation which occurs within some of the species. Endless possibilities exist for the plant breeder and endless challenges. It is no wonder that there is so much enthusiasm for this diverse and remarkable genus.

See also Distribution Map on pp. 96-7. Eds.

C. *miniata* growing in the Umtamvuna Gorge.

CLIVIA IN AUSTRALIA

Kenneth R Smith

Thanks to Nick Primich starting the Clivia Club, now renamed the Clivia Society, *Clivia* have come a long way in Australia during the past ten years.

Early records show that *Clivia* were listed in nursery catalogues in 1866. The species listed was *Clivea* (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*, are widespread right up the eastern seaboard of Australia, in South Australia, and also in the SW corner of Western Australia. At this stage I am unsure about the status in the Northern Territory.

A Cowlishaw C. *miniata* hybrid

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. One nursery in Queensland offered *Clivia nobilis* 'Rubra'. I purchased a plant and when it flowered it was the same as the legion of plants growing in the parks and gardens of Sydney. 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. I remember when Mr Yoshikazu Nakamura stayed with me and spent the day in Sydney Gardens. His comment after inspecting every flower was *'all same'*. I know his keen eye when it comes to *Clivia* would have picked up any variation. 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 K 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.

There are two gentlemen known to us that have done a lot to popularise *Clivia.* Mr Kevin Walters has produced an array of beautiful forms, many of them named, from his breeding work covering the past thirty 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. Kevin is still developing and selecting choice plants today and 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 *Clivia* in Toowoomba, along with the support of other Clivia Society members. There are more great *Clivia* to appear yet from Kevin Walters.

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, too, has taken over thirty years of growing, selecting and learning about the plants to achieve the quality he has today. The many yellow seedlings on the 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 line that Bill refers to as sunset shades. Then there are the Daruma forms. Did I mention the *nobilis, gardenii* and *caulescens* hybrids? The Clivia Farm is the place to obtain quality stock.

The collection started by Mr Cliff Grove in Western Australia is now in the hands of Pen

Left: C. *miniata* 'Relly Williams'
Below: Pale Australian C. *nobilis*

Henry, trading as Clivia Gardens. Pen is well known to us in the *Clivia* fraternity and she is steadily producing choice material for both the enthusiast and the landscaper by using the material started by Cliff and also adding her own acquisitions and selections. Pen's collection represents material from breeders worldwide.

Kevin and Coral Larsen, from Queensland, have had their *Clivia* collection described in the Australian horticultural magazines. The *Clivia* of Mr, Don Barrett, of South Australia, have also been showcased in a magazine article. I am told about *Clivia* breeders in other states that wish to remain in the background. They are enjoying their breeding work, the flowering season being sufficient reward for them. I can't wait to see the deep yellow being developed by a South Australian gentleman. 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 RSA, Japan, China, Europe and the US.

By far the majority of nursery-sold *Clivia* in Australia are the broad leaf hybrids. These are produced in the thousands, especially in Queensland nurseries. 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 *Clivia*. Whether they are Belgian Hybrids, European Hybrids, Sahin's Twins, or in more recent times, Japanese 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 *Clivia* in shady gardens, irrespective of what name it has or where it came from, has been going on for over 100 years. The position in the last ten years or perhaps even five years 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, other 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 year or so. With so much interest in *Clivia,* the supply of yellows has increased and the high prices of a few years back have dropped significantly. The gardening public is questioning the origins of the material and they expect a certain flower shape and colour. They can afford to ask around. It appears that 'the rare cream *Clivia*' is not so rare anymore.

C. *miniata* 'Aurea'

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 *Clivia* 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 *Clivia* 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. Variegated plants are a very specialised part of the horticulture marketplace, be it *Clivia* or other plants. I know, I collect them.

Then there are the peaches. Anyone who has looked through the wonderful photographs in the 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. It is going to create disappointment down the track. Certainly many true peach seedlings are being grown, but it remains an area of much needed research in Australia. Plant importation is one answer, and one of our Society members, Mr. David Bearlin, has made a concerted effort to obtain selected material for the Australian enthusiast. He has imported batches of selected *Clivia* including '**Vico Yellow'** (tissue cultured stock), **'Fukurin'**, **'Akebono'** and peach seedling material from **'Chubb Peach'** breeding. He has brought in other stock from Japan, South Africa, Belgium and the US. It may be higher priced than other nursery *Clivia*, but the material is here. 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? By 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. 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 Japan or South Africa. Names that tempt the novice. Names like **Vico Gold**, **Peacherene** or **Golden Age**. 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.

Which brings us to the cultivar name situation.

With such an increase in *Clivia* activity not only within Australia, but worldwide, the naming of plants is at a critical point. As part of my interest in the genus I have been researching the names given to *Clivia* in the past. It is noticeable that there is a major increase in named *Clivia* as a result of the formation of the Clivia Society. The Clivia Internet Group has also added to the ease of information dissemination. The 'Checklist' that I have produced is a start in the process of formalising the cultivar name situation. As expected, there are some duplicates, but not so many that we can't straighten the confusion out. Many of the people involved have contacted me with the assurance that they will help in any way. There has not been a formal registration of *Clivia* cultivars in the past, interested people have been naming *Clivia* and publishing articles and lists, but now we have a forum that will take the name situation forward. The increased development of newer types by the committed enthusiasts is going to see a greater naming of material. The Clivia Society has to regulate this in an orderly fashion. The committee set up by the Clivia Society will need the input from all enthusiasts to make this work. Please help us if you can.

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

THE GENUS CLIVIA IN ETHNOMEDICINE: USAGE, BIO ACTIVITY AND PHYTOCHEMISTRY

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Abstract

The herbaceous genus *Clivia* now comprises five species, four of which are employed in traditional medicine. Plants of this genus have been used by traditional healers in South Africa for the treatment of a range of ailments of both a physiological and spiritual origin, and have been implicated in human poisonings. The traditional use of the genus *Clivia* in southern Africa is overviewed, with attention focused on the important role of plants of this genus as protective charms, and as medicines taken internally. Interpretations of the Zulu name *umayime* are related to traditional applications. *Clivia* species form important components of *isihlambezo* and *inembe* mixtures, antenatal tonics administered to women with the aim of ensuring healthy foetal growth, or inducing and augmenting labour. Recent pharmacological studies have confirmed the uterotonic properties of plant extracts, so validating this aspect of traditional use. Consideration is also paid to unravelling confusion surrounding the identity of the species observed in trade at the various *muthi* markets located nationwide. *Clivia* species, like other amaryllids, possess a near-unique class of compounds known as isoquinoline alkaloids. The large range of such compounds isolated earlier from C. *miniata* and C. *nobilis* prompted our phytochemical investigation of the two lesser-known ethnomedicinal members C. *gardenii* and C. *caulescens*. From C. caulescens, hippeastrine, haemanthamine, 11 -(S)-hydroxyvittatine, lycorine and sternbergine were isolated, and from C. *gardenii* haemanthamine, haemanthidine in its free base and quaternary salt form, and the quaternary salt of tazettine. Although these studies were undertaken with a view to chemotaxonomically elucidating the 'C. *nobilis* complex' findings were unfortunately not definitive.

Introduction

Clivia of the tribe Haemantheae is a somewhat unusual amaryllid genus for most of its members are rhizome-bearing evergreen plants found within moist coastal and inland forests along the eastern seaboard of southern Africa. The exception of course is the recently-described C. *mirabilis* which in its Northern Cape habitat on the Bokkeveld Escarpment tolerates a much harsher climate than its close relatives found more than 800km away to the east (Rourke, 2002). In view of its highly endemic distribution in an area poorly populated by man, C. *mirabilis* has for long remained out of view of both taxonomists and 'Bossie Doktors' alike, and phytochemists for that matter. The Amaryllidaceae have long fascinated organic chemists who take an interest in a particular class of compounds known as isoquinoline alkaloids, which have long thought to be restricted to this particular plant family. However, quite recently, Mulholland et al. (2001) recorded the first verifiable anomaly when they found crinamine one such constituent, in *Dioscorea dregeana* (Disocoreaceae) the well-known Zulu narcotic. Isoquinoline alkaloids, otherwise known as Amaryllidaceae alkaloids, are generally highly bioactive, and have been extensively investigated for possible development as new pharmaceutical drugs. In recent years galanthamine has been singled out for its promise in the treatment of Alzheimer's disease; this has stimulated further interest in the chemistry of the Amaryllidaceae, the world centre of diversity for which is South Africa. Elsewhere, pronounced but lesser centres of diversity are located in Andean South America and the Mediterranean. By the time of publication of the thorough chemical review of Viladometetal. (1997) 110 different alkaloids had been identified from 62 South African species investigated, from a total Amaryllidaceae flora of about 18 genera and 280 species (Snijman 2000). Since the above review was printed, at least another ten South African species have been examined. Clearly though, much work is still to be done; such research is likely to reveal alkaloids new to science, with hitherto unknown potential as useful drugs.

The chemistry of both Clivia *miniata* and C. *nobilis* have been investigated previously and a wide range of isoquinoline alkaloids found (Table 1). Within this alkaloid class one can identify further sub-classes which on occasion help to define taxonomically, particular clusters of genera or species. In effect, chemistry can serve to confirm the relationships of particular plants: in this way isoquinoline alkaloids largely (with one exception!) define the whole Amaryllidaceae family. In similar fashion, within the 'homolycorine type' group of isoquinoline alkaloids one encounters a set of compounds with trivial names that reflect the history of their discovery: clivonine (Figure 1), clivatine, clivacetine, cliviamartine, clivonidine, cliviasine, clividine, nobelisine, cliviasyaline, miniatine and clivimine. These compounds, besides being isolated first from C. *miniata* and C. *nobilis,* have not yet been found in any other Amaryllidaceae taxa beyond *Clivia* (Viladomat *et al*., 1997), so providing us with good chemotaxonomic markers, at least to the level of genus. Further such chemical characters are also found within the lycorine type (cliviasindhine) and miscellaneous type (cliviahaksine, clivojuline and clivialine) alkaloid classes. We investigated the rhizome chemistry of C. *caulescens* and C. *gardenii* to determine whether there were further novel alkaloids to be found in these, and whether such finds were useful in elucidating the C. *nobilis* complex'. Nobilisine is a particularly unusual alkaloid and it was hoped to find variants of this type. Further taxonomic information can often be gleaned through careful consideration of the traditional uses of species. We thus offer an overview of the ethnobotany and known pharmacology of the genus, which further serves to explain its popularity in traditional medicine, and consequent decline in the wild.

Ethnobotany and bioactivity

Toxicity

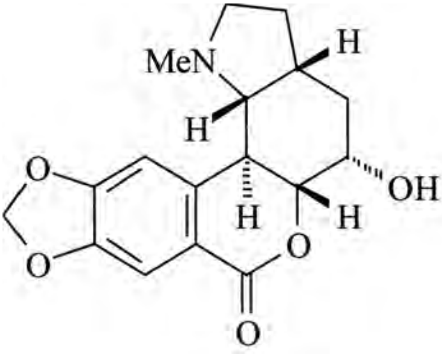
Plants of the *Clivia* genus are used by traditional healers in South Africa in the treatment of a number of ailments of a physiological or spiritual origin, and have been implicated in human poisonings. Juritz (1915) reported on the death in Willowvale in the southern Transkei of a sickly infant treated with *Clivia nobilis*. Further investigations by this author revealed that large quantities of a strong decoction of the plant produced only mildly emetic effects. Veale *et al*. (1992) considered ethnomedicines based on C. *miniata* to be potentially fatal if taken in large quantities, and noted vomiting, salivation, diarrhoea and depression of the CNS as the main poisoning features. All four north-eastern species are reportedly capable of causing dermatitis (Hutchings *et al*, 1996).

Table 1. Alkaloids isolated from four of the five species of *Clivia*

Class of isoquinoline alkaloid	alkaloid trivial name	*Clivia miniata**	*Clivia nobilis**	*Clivia caulescens*	*Clivia gardenii*
Lycorine	caranine	🟩			
	cliviasindhine	🟩			
	lycorine	🟩	🟩	🟩	
	sternbergine			🟩	
Homolycorine	clivacetine	🟩			
	clivatine	🟩	🟩		
	cliviamartine	🟩			
	cliviasine	🟩			
	cliviasyaline	🟩			
	clividine	🟩			
	clivimine	🟩			
	clivonidine	🟩			
	clivonine	🟩			
	hippeastrine	🟩		🟩	
	miniatine	🟩			
	nobilisine		🟩		
Haemanthamine	haemanthamine	🟩		🟩	🟩
	haemanthidine				🟩 **
	11-hydroxyvittatine			🟩	
Tazzetine	tazettine				🟩 **
Miscellaneous	cliviahaksine	🟩			
	clivialine	🟩			
	clivojuline	🟩			

* Vildomat *et al.* (1997); ** Isolated as an ammonium salt

Figure 1: The chemical structure of Clivonine, a compound only ever isolated from *Clivia miniata*. One of a number of unique *Clivia* alkaloids



A trader in the Ezimbuzini mutfii market with her wares

Mutfii trade

Large medicinal plant or *mutfii* markets are found around South Africa, through which enormous volumes of about 700 plant species move each year. Based on an extrapolation of figures derived from the Durban markets Mander (1998) estimated that approximately 20 000 tonnes of fresh plants are sourced from the wild each year to meet demand.

Representatives of four *Clivia* species are included in this number. *Clivia nobilis* may be found in trade in the Grahamstown markets (Tony Dold, pers. comm.). However, reports of trade in C. *nobilis* plants in the medicinal plant markets of Kwazulu-Natal (Cunningham, 1988), Witwatersrand (Williams *et al*, 2000) and Mpumalanga (Mander, 1997) likely refer rather to C. *gardenii* in the former two markets and C. *caulescens* in the latter.

Clivia traded in the Ezimbuzini market as *umayime.* This Zulu name refers to the perceived action of the plant in 'stopping or of making to stay' both diseases and misfortune. Each bundle costs R2.

Clivia nobilis finds its northernmost distribution immediately to the north of the Kei River (extending south to Alexandria) and so is unlikely to have historically been used by the Zulu. In support of the identification of material as C. *gardenii* is the report by Williams *et al.* (2000) that the common name for genus members in the Witwatersrand trade is *umayime*, in the Zulu vernacular. Additionally, most species (42.1%) traded at this site are harvested from Kwazulu-Natal (Williams *et al,* 2000). These authors determined Clivia spp. to be among the most commonly available taxa in medicinal plant shops on the Witwatersrand, with over 70% of traders stocking them. In the Durban markets, *Clivia miniata* (probably including C. *gardenii*) was, according to market traders, amongst the top 15 species most frequently demanded by consumers (Mander, 1998).

Protective charms

Clivia plants play an important role as protective charms: Gerstner (1941a) reported that the Zulu use the roots as a sprinkling charm to ward off evil (*intelezi yokuchela*) and as a love-charm emetic. Species of *Clivia* are included as chopped components in *intelezi* mixes (Figure 4) traded in the Durban markets (Cunningham, 1988).

An *intelezi* mix sold pre-chopped and mixed for a Durban clientele. *Clivia* leaf sections can be seen as a component.

The Zulu name *umayime* for *Clivia* spp. has been variously interpreted as 'it should stand still' (Williams *et al*, 1996), or 'the young women may stay at home' (Gerstner, 1941a). In both cases the connotation is of the plant preventing evil, of halting the course of a disease, of stopping or of making to stay (Pujol, 1993), whether used as a charm or taken internally. An example of a multi-component protective charm that includes C. *miniata* is here detailed; to help explain the inclusion of particular species in the preparation, brief interpretations of the respective Zulu plant names are provided. *Clivia miniata* (umayime; meaning 'to stop') material is combined with *Rhipsalis baccifera* (Cactaceae; (*Figure 5*)(*ugebeleweni*, meaning 'hanging on the precipice', an allusion to the perceived dangerous qualities of this species), *Haworthia limifolia* (Aloaceae) (*umathithibala*; meaning 'to get stuck") and *Adenia gummifera* (Passifloraceae) (*impinda* or *impindamshaya;* meaning 'to return the strike'). Occasionally *Stapelia gigantea* (Asclepiadaceae) {*uzililo*; a reference to mourning) is included in cases where it is wished to actually kill the enemy.

Two preparation and administration procedures for this combination of plants are known. In the first, the dried plant materials are mixed and ashed (ash called *insizi* or *iyezangoma*). After placing in the mouth, the ash is blown towards the sun, and the name of the enemy called out in order that any intended evil will befall them instead. Alternatively, the fresh materials are mixed and ground, and a decoction (*ukugoma*) prepared which is applied as a body wash to ensure protection against curses, which instead afflict the sender (Smith & Crouch 1999).

Rhipsalis baccifera, a component in a charm preparation which includes *Clivia*. The Zulu name *ugebeleweni* for R. *baccifera* means 'hanging on the precipice', an allusion to the perceived dangerous qualities of this species.

Internal use

The large range of isoquinoline alkaloids isolated from *Clivia* spp. are generally thought to be responsible for the observed bioactivity of the plant extracts. For example, extracts of C. *miniata* are active against Semliki forest, Coxsackie and measles viruses (Hutchings *et.al*, 1996). *Clivia miniata* rhizome preparations have been recorded as a remedy for snakebite (Bryant, 1909), specifically for the bite of the puff-adder (Smith, 1893), or associated pain (Pujol, 1993). Bryant (1909) further listed C. *miniata* as one of the Zulu emetic remedies for fevers known as *umkhuhlane*. To the south, the Xhosa use root decoctions of C. *miniata* for treating both barrenness and urinary complaints (Broster, 1982). *Clivia caulescens* has also been recorded as ethnomedicinally used by the Swazi, who know the plant as *hlakahla-wemahlatsi* (Dlamini 1981).

The leaves of C. *miniata* are included as a component of *isihlambezo* and *inembe* mixtures, antenatal tonics administered with the aim of ensuring healthy foetal growth, or inducing or augmenting labour (Bryant, 1909, Veale *et al*, 1992, Varga & Veale, 1997). The preparations typically take the form of aqueous infusions of the leaves. In one *inembe* mixture detailed by Gerstner (1941b) 29 different plants (including C. *miniata*) were mixed together with dried *umhlapho wehhashi*. This last element comprises the placenta of the horse and some crocodile's skin, a little part burnt, a little not! Of the use of an *isihlambezo* mixture Gerstner (1941b) recorded: '*This infusion is kept covered up in a clay pot by a pregnant woman, and from it she drinks a spoonful now and then during the last three months of pregnancy, which the* isihlambezo *is supposed to make successful, with easy delivery. This medicine must not be drunk by any other women or be looked on by another person except the inyanga, otherwise the child will take the likeness of that person, the reflection of the person in the water being presumably swallowed by the women in the drinking and transferred to the child."*

The uterotonic (uterus stimulating) activity of aqueous extracts of C. *miniata* leaves has been evaluated in the laboratory using an isolated rat uterine system (Veale *et al,* 1989). Extracts were shown to possess uterine smooth muscle stimulant activity which augmented the effects of sub-threshold and threshold concentrations of oxytocin. This compound is a hormone produced in the brain, and has been identified as an important agent in stimulating contractions of the uterus. Additionally, the *Clivia* extract was found to elevate the frequency of spontaneous uterine contractions in the rat system. The inclusion of *Clivia* preparations in antenatal ethnomedications may thus be based on such stimulant effects (Veale *et al,* 1989). However, the use of such tonics can result in foetal distress (Veale *et al.*, 1992), and an increase in the need for caesarian sections to be undertaken (Mabina *et al,* 1997). Rather surprisingly, the active uterotonic compound has been found not to be an isoquinoline alkaloid but rather linolenic acid (Sewram *et al,* 2001).

Materials and Methods

Plant materials

Clivia caulescens R.A.Dyer rhizomes (2.4 kg) were obtained from near Long Tom Pass in Mpumalanga and a voucher lodged for verification purposes (*Crouch* 758, NH). This particular material had earlier been confiscated by Mpumalanga Parks Board from an illegal *muthi* harvester.

Fresh whole plant material of *Clivia gardenii* Hook. (1.08 kg) was collected from Ngome, KwaZulu-Natal *(Crouch* 809, NH).

Extraction, fractionation and structure identifications

The details for these procedures are provided by Crouch *et al*. (in press).

Results

From C. *caulescens,* hippeastrine, haemanthamine, 11-(S)-hydroxyvittatine, lycorine and sternbergine were isolated, and from C. *gardenii,* haemanthamine, haemanthidine, in the free base and quaternary salt form, and the quaternary salt of tazettine (Table 1). The free bases of haemanthidine and tazettine were obtained on treatment of the salts with NaOH (Crouch *et al*, in press). None of these compounds are unique to the genus *Clivia* (Viladomat et al, 1997).

Discussion

Toxicity links

Earlier reports of toxicity of *Clivia* likely relate to the presence of the alkaloid lycorine. This akaloid is the most widespread of the Amaryllidaceae alkaloids, and is highly toxic (in a trial, 50% of dogs died when subjected to lycorine at doses of 41 mg per kg body mass [LD50 (dog) of 41mg kg-l]). Lycorine is frequently the cause of accidental human poisoning, especially following the consumption of *Narcissus* plants in Europe. This alkaloid causes scurvy-like symptoms in experimental animals and acts as a respiratory stimulant. However, from a positive medical perspective, this compound has also been shown to have moderate anti-tumour activity, anti-viral properties and to be a weak protozoicide (Hutchings *et al*., 1996, Dictionary of Natural Products 2001). Tazettine, the quarternary salt of which was isolated from C. *gardenii*, has been shown to have a LD50 (dog) of 71 mg kg-1 (Dictionary of Natural Products 2001).

Chemotaxonomic findings

From the homolycorine class of isoquinoline alkaloids only hippeastrine was isolated, and this only from C. *caulescens.* No alkaloids previously found only in C. *miniata* or C. *nobilis* were isolated and identified from C. *caulescens* or C. *gardenii* (Table 1). Further, no new compounds were isolated, precluding us from naming a 'caulescine' or 'gardenine' in honour of the sources! This rather disappointing outcome limits the chemotaxonomic value of the current work, so preventing us from being able to define authoritatively the components of the '*nobilis* complex'. It is noted though that within this 'complex', the following compounds appear uniquely produced: clivatine and nobelisine in C. *nobilis*; sternbergine, hippeastrine and 11-hydroxyvittatine in C. *caulescens;* and in C. *gardenii*, haemanthidine in its free base and quaternary salt form, and the quaternary salt of tazettine. Additionally, within the genus *Clivia*, the following alkaloids appear unique to C. *miniata*-, caranine, cliviasindhine, clivacetine, cliviamartine, cliviasine, cliviasyaline, clividine, clivimine, clivonidine, clivonine, miniatine, cliviahaksine, clivialine and clivojuline. This extensive list of constituents likely reflects the greater amount of phytochemical work conducted on C. *miniata*, on a greater mass of material of more widespread provenance and diverse physiological states.

Acknowledgements

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Second prize Yellow *Clivia miniata* grown from seed flowering for the first time Section, CCC 2002 Show. Breeder: Bill Morris. Grower: Mick Dower


21

Winner Orange *Clivia miniata* grown from seed flowering for the first time Section, CCC 2002 Show. Grower: Jaco Lötter

COLOR PIGMENTS IN CLIVIA

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Abstract

The anthocyanin flavonoids of *Clivia caulescens,* several specimens of C. *miniata* and one C. *nobilis* were examined in the flowers and the berries. Pigment in C. *miniata* seedling leaf bases were also analyzed. Different combinations of pigments were found in each of the examples investigated. The flower pigment in C. *caulescens* flowers was cyanidim 3-rutinoside. Pigments in C. *miniata* were pelargonidin-3-glucoside and pelargonidin-3' rutinoside. The proportions of the two pigments varied depending on the particular cultivar examined. In typical orange C. *miniata,* pelargonidin-3'glucoside predominated but in the peach colored flower pelargonidin-3' rutinoside was the main pigment. Both pigments occurred in almost similar quantities in the dark red cultivar **'Flame**™. Clivia *nobilis* flowers had both cyanidin and pelargonidin pigments. The berries of C. *caulescens* and C. *nobilis* contained both cyanidin and pelargonidin, while C. *miniata* berries only had cyanidins, irrespective of the cultivar examined. Clivia *miniata* seedling leaf bases had mainly cyanidin with very small amounts of pelargonidin.

Incorporating the pendent species genes into hybrids with C. *miniata* can be expected to widen the color pallet used for hybridizing.

Introduction

Although there is scant information in the scientific literature it is usually accepted that the color pigments in Clivia flowers and berries are reddish anthocyanins and yellow carotenoids. Detailed analyses of pigments in the various *Clivia* species and their locations in the plant do not seem to have been published previously except for a summary in Koopowitz (2002). Flavonoid pigments (anthocyanins) occur in three distinct regions of a Clivia plant. There is usually purple coloring at the bases of seedling leaves - the function of the pigment here is unknown although one might speculate that it helps camouflage seedlings growing amongst the leaf litter. Colors in flowers are obviously attractants to help guide pollinators to the flowers - why green tepal tips in species with pendant flowers? Colors in fruits are likewise deemed to be attractants for birds that might be involved in seed dispersal.

The chemistry of floral pigments is relatively well understood and most of the major genes underlying anthocyanin synthesis are known (Holton and Cornish, 1995). In this report we discuss some of the anthocyanin pigments found in Clivia *miniata*, C. *nobilis* and C. *caulescens*. We have not had the opportunity of investigating C. *gardenii* and C. *mirabilis.*

Methods and Materials

Microscopic Examination:

Microscopic examination of fresh flowers was carried out on free-hand sections of fresh living flower tepals. Sections were mounted on microscope slides in water and examined with an Olympus BH-2 compound microscope.

Antfiocyanin analysis-.

Pigments from seedling leaf bases, fresh fruits and fresh flowers were examined using HPLC. Three different cultivars of C. *miniata* were examined. *Clivia miniata* 'Flame™ has some of the most intensely red flowers currently known, C. *miniata* **'Morning Light**' a pastel peach cultivar and a "typical" orange-flowered form of the species were investigated. In addition, leaves fruits and flowers of C. *nobilis* and C. *caulescens* were also investigated. The flower colors in the last two species were typical of those species respectively.

Anthocyanins were characterized by HPLC and U.V. spectrophotometry (Griesbach *et al.,* 1991). Specific anthocyanins were isolated on a 7.8 x *300mm* column of 5μ Bondapak C18 using a 30 minute linear gradient of 0 to 10% (v/v) acetonitrile in aqueous 15% (v/v) acetic acid, followed by a 10 min linear increase to 20% (v/v) acetonitrile and finally held at 20% (v/v) acetonitrile for an additional 10 minutes. Flow rate was 1.0 ml min-1 and detection was by absorption at 540 nm. Isolated anthocyanins were then acid hydrolyzed at 100°C in 3 N HCl for 1 hour and the resulting anthocyanidins characterized by HPLC using a 20 minute linear gradient of 0 to 15% (v/v) acetonitrile in aqueous 1.5% (v/v) phosphoric acid and 15% (v/v) acetic acid and held at 15% (v/v) for an additional 20 minutes. Flow rate was 1.0 ml min-1 and detection was by absorption at 540 nm. Anthocyanins and anthocyanidins were characterized by co-elution with known standards and U.V. spectrophotometry. It was possible to distinguish anthocyanin 3-, 5-, and 3,5-glycosides by their absorption spectra in 1% (v/v) HCl in methanol (Jurd, 1962). A sugar at position 3 leads to a 12 nm hypsochromic shift in the λ_{max} A 7 nm hypsochromic shift occurs when a sugar is at position 5. A sugar at both positions leads to a 19 nm hypsochromic shift. In addition, anthocyanins without a sugar at position 5 have a distinct shoulder at 440 nm. Unacylated anthocyanins have a single peak in the ultraviolet; while acylated anthocyanins have two peaks. In the presence of aluminum chloride, anthocyanins with adjacent hydroxyl groups produce a 15-50 nm bathochromic shift in the λ_{max}.

The co-pigments were analyzed in a similar manner as the anthocyanins (Griesbach and Asen, 1990). The co-pigment analysis differs in the HPLC elution buffer (1% triethylamine at pH 3.0), gradient (0 to 20% in 20 minutes and held at 20% for 20 additional minutes), and detection wavelength (340 nm). The acyl groups (cinnamic acids) and sugars attached to the anthocyanin were removed during acid hydrolysis and were characterized by HPLC (Griesbach *et al.,* 1991). The acyl groups were further characterized by U.V. spectrophotometry (Jurd, 1962).

Proportions of pigments were compared by integrating areas under the curves after ignoring the initial surge of breakdown products.

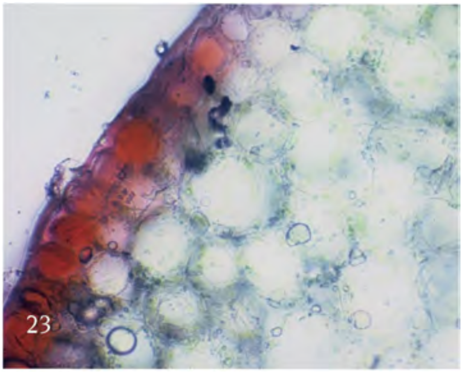
Results

Microscopy

Clivia miniata **"typical".**

In common with many other flowers anthocyanins are found primarily in the surface epithelium of the tepals. There is a bounding cell layer where the central vacuoles are filled with anthocyanin. This is typically a single cell layer. Beneath this is a parenchymatious layer that can be many cells thick. The outer layers of parenchyma may contain either chloroplasts or carotenoid bearing plastids. These pigments are confined to granular organelles suspended in the cell cytoplasm. It is not possible to see carotenoid chromoplasts or chloroplasts in the outer epithelium. That might be due to the presence of the anthocyanins, but examination of yellow C. *miniata* cultivars show the presence of carotenoids in the underlying strata but the epithelium is devoid of them. Carotenoid bearing organelles do not appear within the surface epithelium.

Internal cells making up the tepal have very irregular shapes making many small spaces for air pockets. These tiny air pockets may be reflecting and scattering light making a white background for the other pigments. Tests for the white leucoxanthin in *Clivia* have proven negative.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Section through the petal of an orange C. *miniata*. Note the anthocyanim - containing cells in the epithelium and the green chloroplasts in the underlying cells

Clivia *miniata* 'Flame' ™


25

This cultivar is sometimes called '**Merkins Flame'** and is among the most intense of the reddish C. *miniata* cultivars known to date. Microscopic sections through the tepals of this flower revealed that the anthocyanin layer extended inwards from the epithelium giving an additional 3-4 cell layers containing anthocyanin pigments.

Clivia *miniata* '**Morning Light**'


24

This is a pastel peach flower bred by James Comstock and is a potent parent for breeding peaches. Examination of the tepals revealed that anthocyanin was confined to the bounding epithelium as in normal orange C. *miniata*, but the concentration of anthocyanins appeared to be much more diluted.

Clivia miniata Bodnant Variety'


26

This creamy yellow flower lacks all pigment in the surface epithelium. No plastids were found in the epithelium either but chromoplasts were present in the deeper tissues.

Flower Pigments:

a. Anthocyanin

Clivia caulescens - see *Figure 1.*

This *Clivia caulescens* plant was grown from seed collected at God's Window, Mpumalanga. The flowers were of the normal orange color. The flowers contained only one anthocyanin component, *Fig. 1*, cyanidin-3-rutinoside (c-3-r).

Clivia miniata

"Typical" *Clivia miniata* - see *Figure 2a*. HPLC indicates two major anthocyanins in the flowers of typical orange clivias. These are both pelargonidins, pelargonidin-3-rutinoside (p-3-r) made up 27.89% and pelargonidin-3-glucoside (p-3-g) was 72.10%. A second plant with orange flowers yielded a similar pigment profile with p-3-r at 29.98% and p-3-g, 69.54%. In the second flowers there was a third unidentified peak of less than 0.5%.

C. miniata **'Flame** - see *Figure 2b.*

This is one of the most intensely red colored C. *miniata* selections to date. Pigments as in *Figure 2a* but here p-3-r makes up 56.59% and p-3-g 43.20% - ie, the concentrations are higher and both peaks are almost equal.

Clivia miniata **'Morning Light'** - see *Figure 2c*.

Bears peach colored flowers. Once again there were two pigments with the p-3-r making up 62.06% and the p-3-g being 37.94%. While we did not quantify the absolute amount of pigment present per weight of tepal, it was apparent during the initial extraction procedures that the peach colored flower had qualitatively much less pigment than either of the other types of C. *miniata* flowers.

Clivia nobilis - see *Figure 3*.

The coloration of this flower was a medium orange shade and similar to most of the C. *nobilis* in cultivation in the United States. This flower produced three distinct pigments. The major component p-3-r made up 73.13% of the pigment and c-3-r was 22.34%. A third unidentified peak accounted for 4.53%.

b. Copigments

These were only evaluated for two of the typical orange flowered C. *miniata*. They elicited a complex array of some 14 different co-pigments, see *Fig. 4*. Both flowers had similar arrays of co-pigments but these have not been analyzed further.

Fruit Pigments:

Anthocyanins in various *Clivia* fruits:

Clivia caulescens: The ripe berries of C. *caulescens* contained the same major pigments as found in the flowers. While c-3-r accounted for most of the pigment (83.21%) about 12.26% was p-3-r. See *Figure 5a*.

Clivia miniata: Fruits from several different cultivars of C. *miniata* were analysed.

Our earlier investigations utilized the fruit from C. *miniata* **'Flame'**™ and only c-3-r was found. A second set of fruits examined the following year also revealed only c-3-r.

Pigments were derived from the peach colored C. *miniata* **'Morning Light'** (See *Figure 5*(?) and the normal orange cultivar C. *miniata* **'Wide Body'** (see *Fig. 5c*). The latter appeared to have very small amounts of the two pelargonidin pigments.

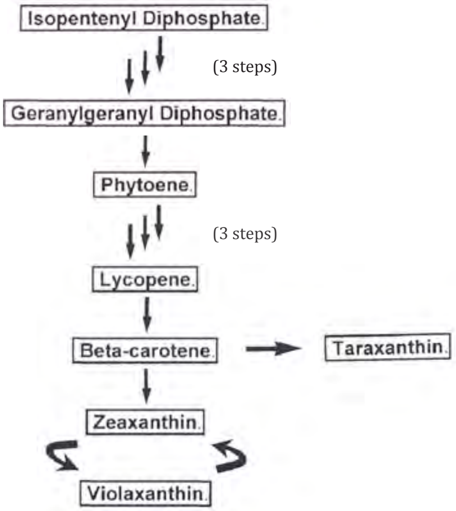
Clivia nobilis: The berries of C. *nobilis* contained mainly p-3-r (89.39%) and p-3-g (4.85%) with very small quantities of c-3-r (1.87% and c-3-g (3.88%). See *Figure 5d.*

Leaf Pigments:

Clivia miniata: At this time only a seedling from a normal orange C. *miniata* was investigated. The pattern of pigments found mimicked that of the fruit, (see *Figure 6)*, with c-3-r being the major component, and small amounts of the other pigments.

Discussion

There are several interesting points that arise from this work which are relevant for Clivia breeders who are striving to widen the color range. *Clivia miniata* carries two pelargonidins in its flowers and cyanidin in its berries while C. *nobilis* has lesser quantities of both cyanidin and pelargonidin in both its flowers and fruits. *Clivia caulescens* produced only cyanidin in its flowers and mainly cyanidin in its berries. The situation in C. *gardenii* and the newly described species, C. *mirabilis*, is not known but they should be investigated for floral pigments too. Differences in expression of pigments in fruits and flowers between and among C. *nobilis* and C. *caulescens* were unexpected. Perhaps the other species might also each do things differently.

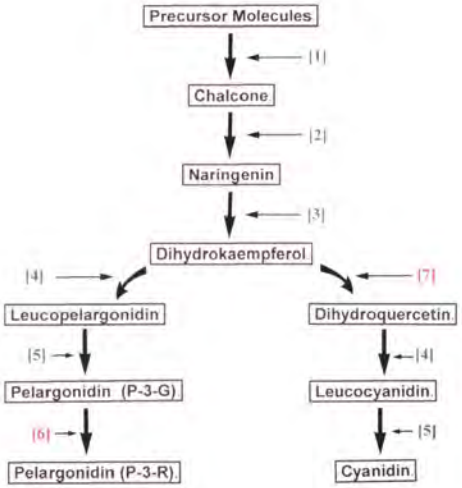


Pathway tor the major carotenoid pigments found in clivias. Lycopene is the first colored product produced and is pinkish. The three major carotenoids in both yellow and orange flowers are all yellow carotenoids; taraxanthin and violaxanthin can be interconverted to each other as indicated by the curved arrows.
(This plate from Koopowitz, H (2000) page 135)

Depth of red color depends on several factors, both the concentration of pigment in the central vacuoles of the tepal cells as well as the number of cell layers that contain pigment. The nature and concentration of the carotenoids also plays a major role. The greater the carotenoid concentration the more orange flower color should appear. The less the carotenoid content the pinker the flowers. A large number of carotenoids occur in *Clivia miniata* flowers (Matsuno & Hirao, 1980). Matsuno and Hirao found that the major yellow pigment was taraxanthin, but there were an additional six other carotenoids present with ≤-carotene, accounting for the second highest component. Taraxanthin is usually a rich yellow color but other pigments could account for the wide variation in cream, yellow and amber colors found in the yellow C. *miniata* hybrids.

In order to increase the color palette in Clivias it is important to incorporate the pendant species into the C. *miniata* hybrids and this should increase the range of pigments made in the flowers. The various pendulous species allow one to incorporate cyanidins into their tepals. It may be easier to get deeper red colors in this way. Several of the *cyrtanthiflora*-type hybrids I have seen have in fact had very deep red flowers. The array of co-pigments was unexpected. While some of these might represent breakdown products it is unlikely that all do. These products may open the door to additional colors. Investigation of the pigments in some of the new flowers with mauve - lavender tints in them would be very interesting.

There is a wider array of color in *Clivia miniata* fruits than in their flowers. It would be useful to compare the pigments in the various colored berries, *i.e.* pinkish berries and purplish berries to see what the differences are. But because these pigments are probably mainly cyanidins, perhaps those plants should be bred to species such as C. *caulescens* that express an appreciable amount of cyanidin in their flowers. As C. *caulescens* has more floral cyanidin than C. *nobilis* one might prefer to use the former for breeding.



Anthocyanin pathways. This a simplified anthocyanin pathway that ends in pelargonidin and cyanidin. Each number represents a specific enzyme (1 through 7) that catalyses the reaction to the next step. Only one additional enzyme (enzyme 7) is needed to make cyanidin instead of P-3-G. Enzyme 6 is unique to the P-3-R step.
(Taken from Koopowitz, H. (2000) page 130)

Because the pelargonidins and cyanidins are end points of a branching synthetic pathway it is not surprising that yellow flowered C. *miniata* always have yellow fruits. One might expect that there should be orange flowered C. *miniata* that have yellow fruit if the cyanidin pathway is blocked. Such plants are known. Some plants from a wild population of C. *miniata* from Centani, Transkei have normal orange flowers but produce yellow fruit (R. Ellis, personal communication). I examined these plants. The fruits are yellow but can sometimes have a slight blush to them. This blush may be due to spontaneous conversion of pigments in the pathway independent of the enzymes that normally catalyze them.

Seedling Clivias often have a variable amount of anthocyanin at their leaf bases and some seedlings are very heavily pigmented. Some seedlings lose this color rapidly while others do so more slowly at other stages of maturity. Seedlings under stress (e.g. those with poor root systems) are often heavily pigmented over the entire leaf. It should be possible to select and breed clivias with increasing amounts of pigmentation that is held for longer and longer periods of time. Such plants would be useful because they would make it possible to breed variegated clivias with pink stripes.

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Koopowitz, H. (2002) *Clivias*. Timber Press, Portland. 384 pp.

Matsuno, T. and Hirao, H. (1980) *Clivia* color pigments. *Garden Life* (Japanese) 12:30.

Winner Clivia with fruit Section, NCC 2002 Show.
Grower: Dawie van Heerden

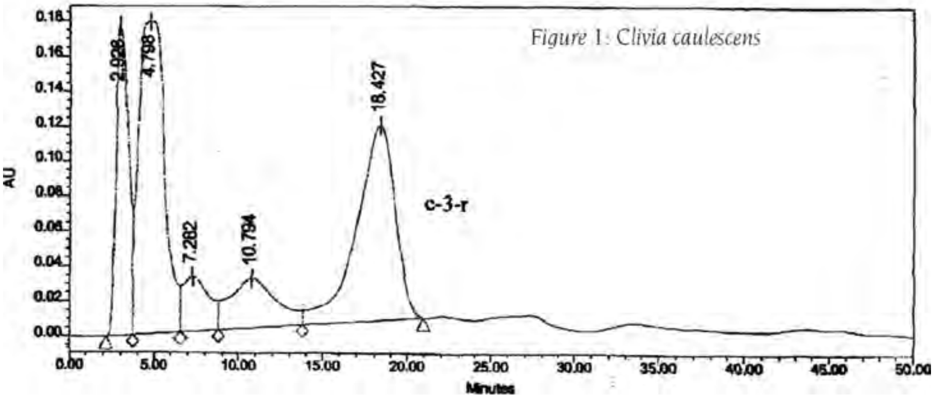

Figure 1: Pigments in Clivia caulescens flower. The peak between 1-6 and 20 minutes is cyanidin-3-rutihoside. Y-axis in this graph is pigment absorption in arbitrary units. X-axis is elution time in minutes. Initial 4 peaks represent breakdown products.

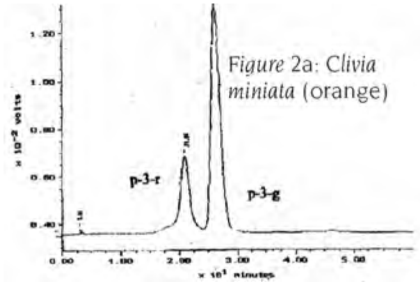

Figure 2a: Floral pigments in C. *miniata,* typical orange form. Initial peak is pelargonidin-3-rutinoside and second larger peak is pelargonidin-3-glucoside.

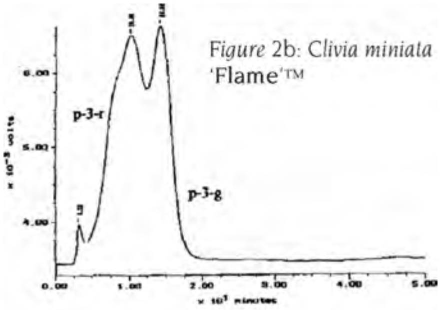

Figure 2b: Floral pigments in *Clivia miniata* '**Flame™**. Note that it contains the same two pelargonidins as in the typical orange Clivia *{Figure 2a*), but the proportions are different.

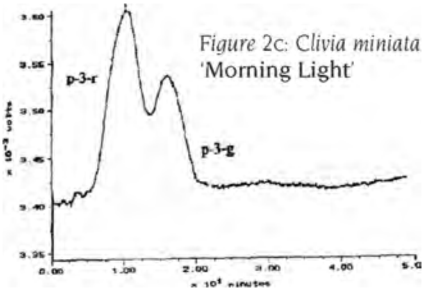

Figure 2c-. Floral pigments in Clivia miniata 'Morning Light'. Note that there is proportionately more p-3-r than p-3-g. Axes as in Figure 1.

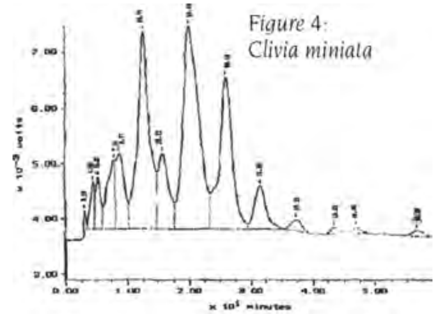

Figure 4. Unidentified co-pigments from a normal orange Clivia *miniata*. Axes as in *Figure 1*.

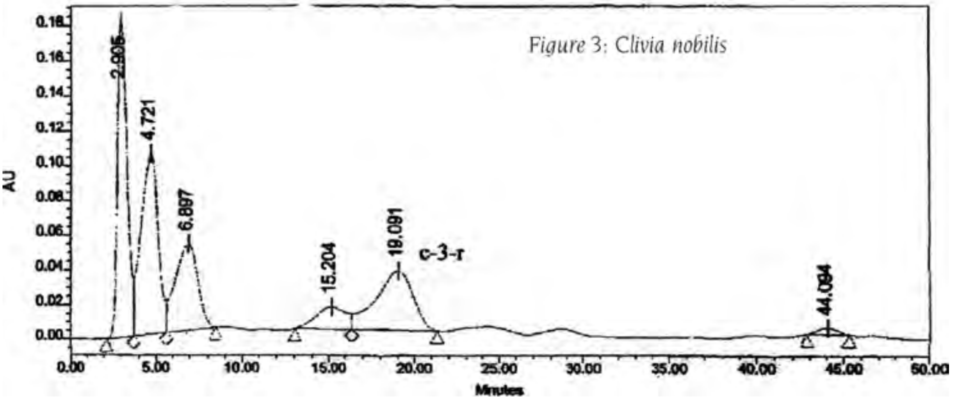

Figure 3: Floral pigments from a *Clivia nobilis* flower. Disregard the first three peaks, peak 4 is c-3-r and the 5th peak is p-3-r. Axes as in *Figure 1.*

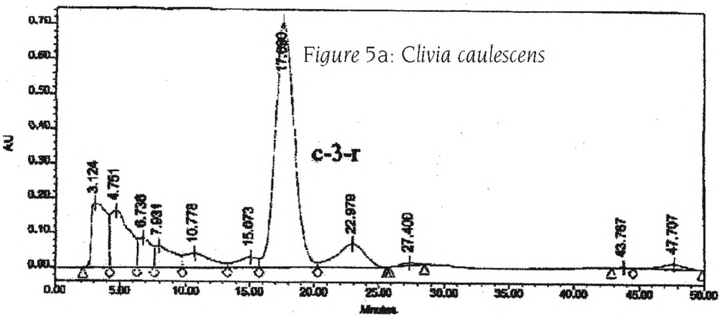

Figure 5a: *Clivia caulescens*, major peak is c-3-r.

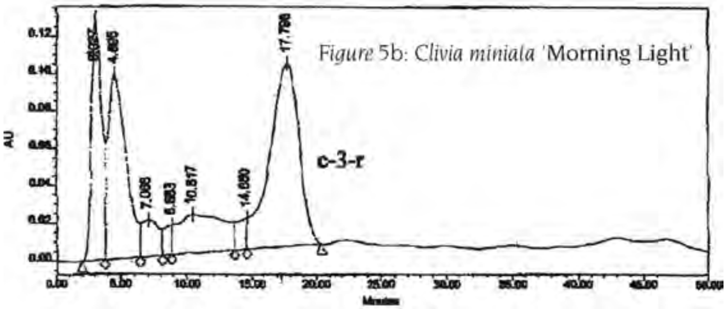

Figure 5b: Peach flowered C. *miniata* '**Morning Light**', major peak is c-3-r. Initial peaks are breakdown products.

Minutes

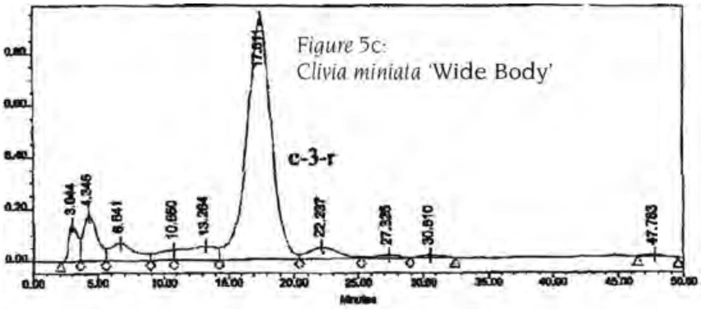

Figure 5c: Orange C. *miniata* 'Wide Body' major peak is c-3-r minor peaks are pelargonidins.

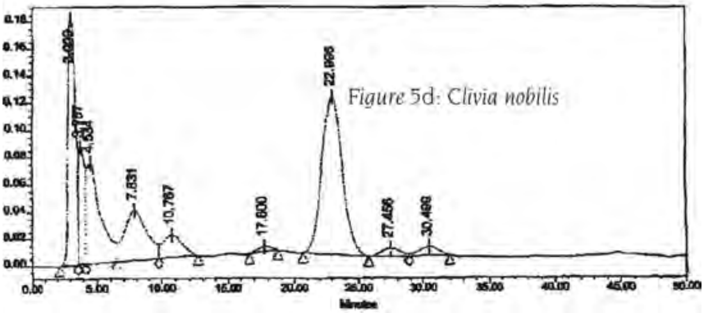

Figure 5d: *Clivia nobilis* fruit, major pigment here is p-3-r with minor amounts of c-3-r, c-3-g and p-3-g. Axes as in Figure 1.

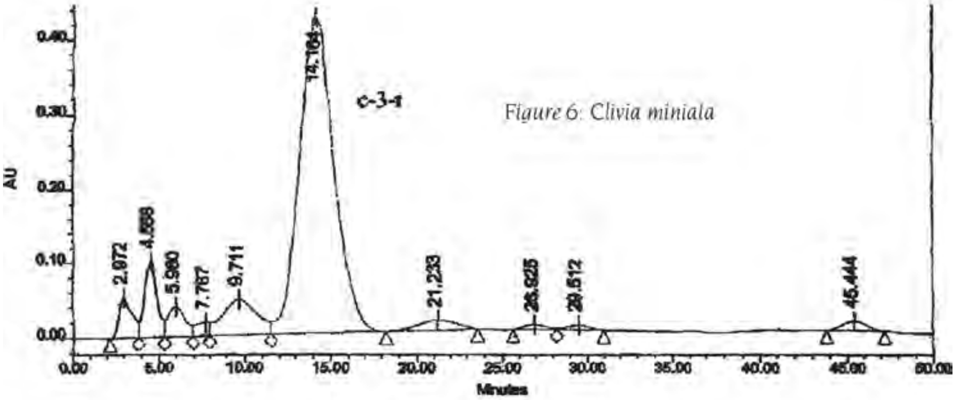

Figure 6. Anthocyanins from seedling leaf of a normal C. *miniata*. the major pigment here is c-3-r, with other pigments making up minor proportions. Axes as in *Figure 1* .

A NOTE ON C. *gardenii* STEM COLOUR

In this photograph are two C. *gardenii* offsets growing from the same rhizome. The stems of both are clearly pigmented. Yet the rhizome was cut from the rhizome of a yellow flowered C. *gardenii,* as illustrated in photograph 25 on page 37 of CLIVIA 2. It's flower is persistently yellow and does not change colour, even with age.

This bears out what Brian Tarr, Curator of the Natal National Botanical Garden, Pietermaritzburg, has always pointed out - unlike C. *miniata*, the stem colour of C. **gardenii** is not necessarily an indicator of the flower colour.

Eds.

Clivia nobilis with yellow fruit. Grower: Norman Weitz

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.

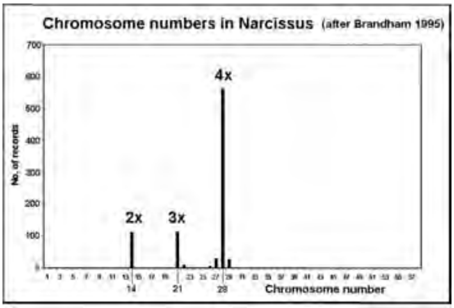

Figure 1.

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 broad leaf 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.

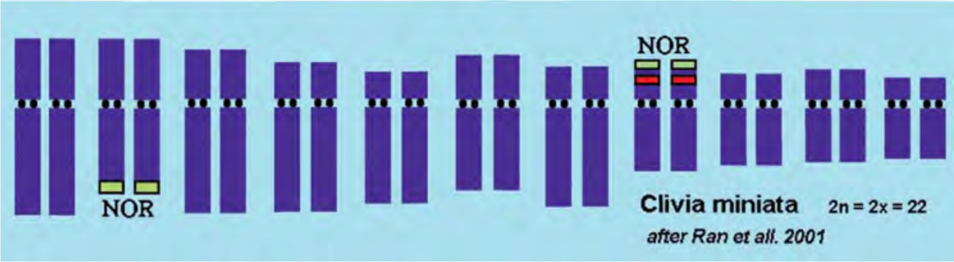

Figure 2. Genome of *Clivia miniata*

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 I5m! 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	ll	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).

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

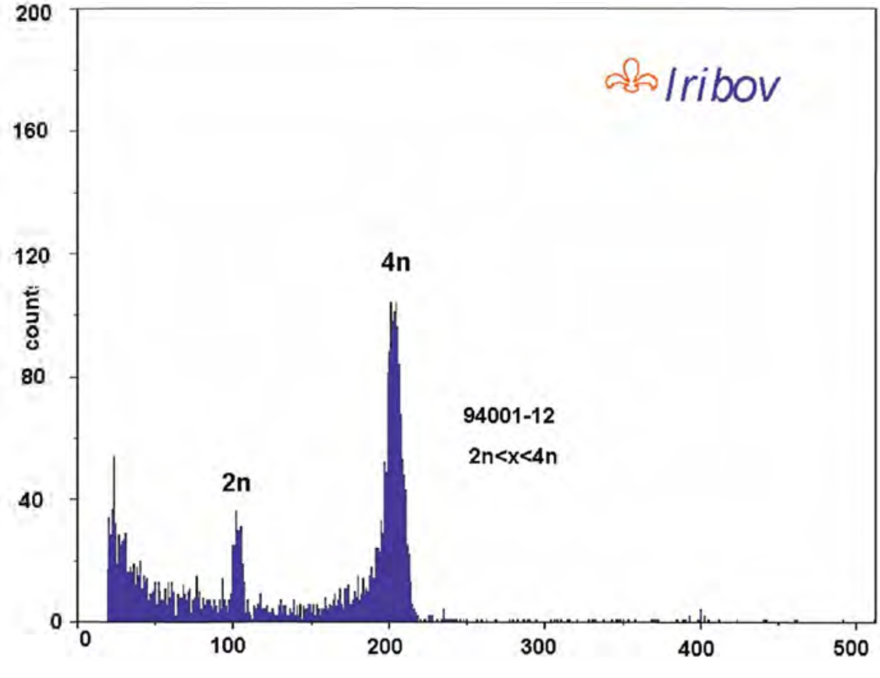

Figure 5. Flow Cytometer analysis *Clivia miniata* plant 94001-12 after colchicine treatment

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.)*.

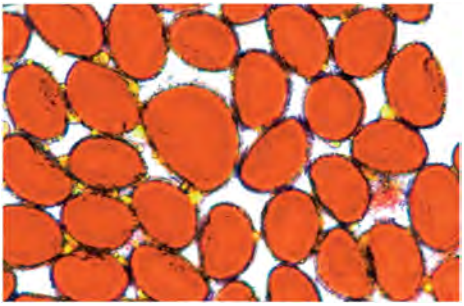

Figure 6. Pollen grains plant IK 01 with unreduced gamete.

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 *el 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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Above: C. *miniata* CCC Runner-up to Best on Show and Winner Own Breeding Section, CCC 2002 Show. Beeder and grower: John Winter.

Below: Runner-up to Best on Show and Winner yellow C. *miniata* with one umbel Section, KZNCC 2002 Show. Grower: Bertie Guillaume.


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RUNNERS-UP

Above: Runner-up to Best on Show and Winner broad petal cream to yellow C. *miniata* Section, Metro 2002 Show. Grower: Ernie Hobbs
Right: Runner-up to Best on Show and Winner C. *miniata* with two umbels at EPCC 2002 Show. Grower: Andre Calitz
Below: Runner-up to Best on Show and Winner C. *miniata* any other colour with green throat Section, NCC 2002 Show. Breeder and grower: Bertie Guillaume.

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LEAF FORMATION AND ITS RELATION TO FLOWERING IN CLIVIA MINIATA

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C van der Merwe - Laboratory for Microscopy & Micro-analysis, University of Pretoria

Abstract

Leaves *of* Clivia miniata *are produced in succession on opposite sides of the plant apex. The apical mristem producing the leaves consists of a dome-shaped group of meristematic (dividing) cells. The 'roof of the dome consists of two distinct cell layers and new leaves originate from the second and deeper cell layers, forming a ridge around the dome. The base of the ridge forms the leaf sheath, and the tip of the leaf blade develops from the rim of the ridge. Widening of the leaf blade is the result of cell divisions parallel to the long axis of the blade and leaf elongation the result of cell divisions between the leaf sheath and the leaf tip, perpendicular to the long axis of the leaf. The leaf tip is therefore the first part of the leaf to mature and is 'pushed' out from below by the addition and enlarging of cells.*

After reaching sexual maturity (after about 12 leaves) the apical dome is 'converted' into an inflorescence bud and a new vegetative bud is formed next to the inflorescence bud. The new and consecutive vegetative buds will each form four leaves before they, in turn, will be converted into inflorescence buds. Inflorescence buds are, therefore, products of the modular growth of the plant with each module consisting of four leaves and an inflorescence bud. Further development of the inflorescence bud and ultimately flowering, depends on environmental factors and nutrition.

Leaves are the carbohydrate factories of the green plant and without healthy, functioning leaves, no plant can grow properly. In the case of Clivia the leaves also contribute to the beauty of the plant, especially if they have a specific shape or colour. Understanding how leaves develop will not only give the growers a better appreciation of their plants, but will also allow them to manipulate and improve the quality of the plants.

The arrangement of the leaves of all *Clivia* species is **distichous**, meaning that they appear one at a time with the succeeding leaf situated on the opposite side of the stem *(Figure* 1). The *Clivia* stem bearing the leaves is a constricted rhizome and each leaf base forms a sheath enveloping all the younger leaves and the stem apex
(Figures 2 and 3). Due to the lack of stem elongation there are no visible internodes.

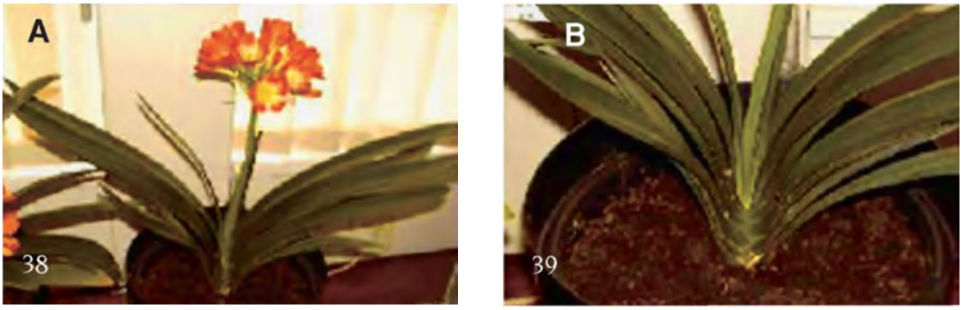

Figure 1: *Clivia* plant showing inflorescence with flush of young leaves (A) and distichous leaf arrangement (B).

If one would take a young *Clivia* plant and start removing the leaves from the base to the tip one would end up with a minute, dome-shaped structure known as the apical meristem (*Fig.* 2).

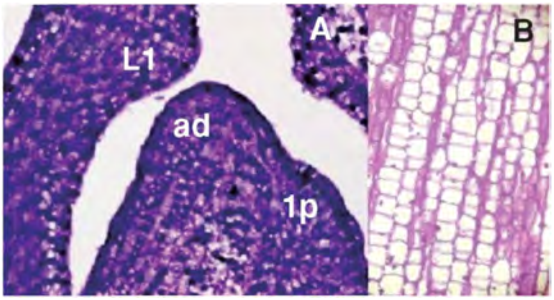

Figure 2A: Detail of *Clivia* apical dome (ad) in the process of producing a new leaf primordium (lp) and *Figure* 3B showing cell files after repeated cell division in the basal part of a young leaf

The cells of the apical meristem or apical dome are embryonic and their only function is to divide, and to give rise to new leaves *(Figure* 2A). The cells of the two outer layers of the apical dome normally divide perpendicular to the surface (anticlinal) and are therefore responsible for the increase of the surface area. During the formation of a new leaf by the apical dome, the first signs are periclinal cell divisions (parallel to the surface) in the second cell layer, followed by anticlinal divisions of the adjacent outer layer cells. The result is a small bulge or "outcrop" of cells that can now be designated as a leaf primordium. The outer cell layer of the leaf primordium will give rise to the epidermis of the new leaf, while the cells derived from the second and deeper cell layers will give rise to the central part of the leaf known as the mesophyll (*Figs*. 5 *and* 6). The vascular tissue derives from the third and deeper cell layers. During the formation of a leaf primordium, the greater part of the apical dome is 'consumed' and the remaining cells of the dome need a certain period of time to divide and restore the critical size of the dome before a new primordium can be formed on the opposite side.

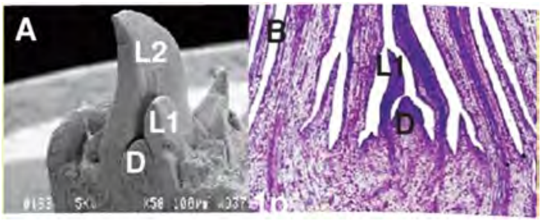

Figure 3: Sections of apical buds showing the apical dome (D) and youngest leaf primordia (LI & L2).
A was taken with a scanning electron microscope and B with a light microscope

Figure 4: Leaves that had to be removed to reach the apical dome in a seedling plant (A) and an older plant with an aborted inflorescence bud (B)

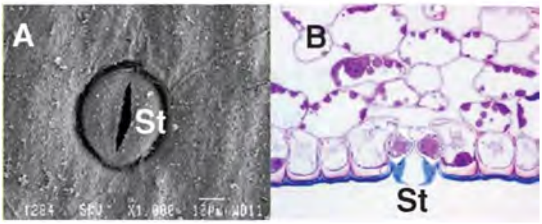

Figure 5A: Surface view of lower epidemis of *Clivia* leaf showing stomatal ledge (St) of sunken stoma.
Figure 5B: A subaxial cross section of the lower (abaxial) part of the leaf showing thick cuticle, structure of stoma and intercellular spaces between mesophyll cells

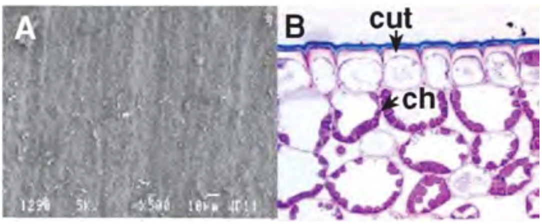

Figure 6: Surface view (A) & (B), cross section of upper surface of *Clivia* leaf, showing absence of stoma, thick cuticle (cut) and mesophyll cells packed with chloroplasts (ch)

Due to the distichous arrangement of the *Clivia* leaves the apical dome is "sandwiched" between the opposite sets of leaves and has the shape of a semi-disk, but for the sake of terminology, we will still call it a "dome". *Figure* 3A is a scanning electron microscopic view of one half of the apical dome of a young *Clivia miniata* plant, sandwiched between the two youngest leaf primordia. The outer leaves that had to be removed to get to the apical dome, are shown in *Figure* 4A. Each leaf consists of a leaf base (the leaf sheath) and the leaf blade. The sheath of every leaf had to be cut open before it could be removed. The sheath of the youngest primordium is already surrounding the apical dome which means that in three-dimensional view, the whole leaf primordium originates as an elliptical ridge around the flattened apical dome (*Fig*. 7), starting at the leaf blade end and progressing around the dome.

After initiation of a leaf primordium, cell divisions parallel and perpendicular to the long axis of the leaf causes the primordium to expand in width as well as in length. The tip of the lamina (leaf blade) develops as a result of rapid cell divisions and cell enlargement from the ridge of the sheath, concurrently with the elongation of the sheath. The leaf tip matures first while the formation and elongation of the leaf lamina is the result of actively dividing cells in a zone between the leaf tip and the leaf sheath (intercallary meristem). In this zone most cells divide perpendicular to the long axis of the leaf to form distinct longitudinally arranged cell files [*Fig*. 2B). In leaves still elongating this zone is visible as an etiolated (bleached) section covered by sheathes of the older leaves (*Fig*. 4).

The leaf lamina is therefore "pushed out" as a result of the activity of the intercalary meristem, and cell maturation takes place above this zone, progressing from the leaf tip downwards. The final length and width of the leaf depends on the rate and duration of cell multiplication and expansion, determined by the genetic composition of the plant as affected by the environment and nutrition.

Stomata develop from single embryonic epidermal cells in the zone of maturing epidermis cells, but are restricted to the lower epidermis in C. *miniata*. Each stoma consists of two guard cells surrounding the stomatal pore. The guard cells are sunken into the epidermis and are fitted with both inner and outer ledges, forming inner and outer 'lobbies' (*Fig*. 5) that play an important role in restricting transpiration. The function of the stomata is air exchange during photosynthesis and outlets for water vapour during transpiration and they are therefore linked to the inter-connected air spaces between the lower mesophyll cells. Mature epidermis cells have thick outer cell walls covered with a thick waxy layer known as the cuticle (*Figs* 5 *and* 6). The function of the cuticle is to restrict water loss through the leaf surface. The exceptionally thick cuticle covering the upper epidermis, together with the sunken stomata (guard cells positioned at a lower level than the ordinary epidermis cells) with prominent ledges on the outer walls of the guard cells, are typical characteristics of xerophytic plants (plants that are adapted to survive in dry areas). The mesophyll cells (cells between the upper and lower epidermis) particularly those adjacent to the upper epidermis, are packed with chloroplasts (*Fig*. 6B), rendering the leaves efficient carbohydrate factories.

It is impossible to talk about leaf formation in *Clivia* without considering the process of flowering. As already discussed by Honiball in *Clivia* Yearbook Three, the growth in *Clivia* that have reached the flowering stage is modular, with each module consisting of about four leaves and a terminal inflorescence. During the juvenile phase of the *Clivia* plant, the apical meristem (dome) gives rise to about twelve leaves before being transformed into an inflorescence bud. A new dome then develops next to the inflorescence bud (*Figs* 7, 8 *and* 9). Under optimal growing conditions, the new dome in turn produces about four leaves before giving rise to the next inflorescence bud. One module therefore consists of about four leaves and an inflorescence and as long as growing conditions remain favourable, the plant will produce two or more such modules per growing season. After the formation of an inflorescence bud and the new dome, there is a time lapse required by the new dome to grow to a minimum size before starting to produce new leaves. This slight delay in leaf formation can often be observed indirectly when the youngest leaves are distinctly shorter and softer than the older leaves. They also often appear more or less at the same time as the spring inflorescence (*Figs* 1 *and* 10).

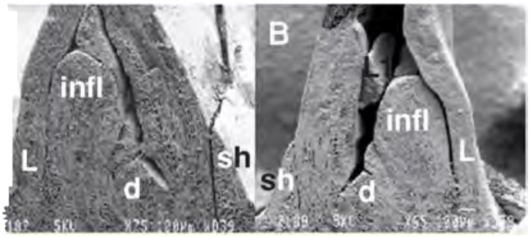

Figure 7: Mirror images of two halves of the same apical bud after dissection showing leaf primordium (L) and inflorescence bud (infl) of preceding module, and apical dome (d) of new module. Sh = sheath of leaf primordium marked L

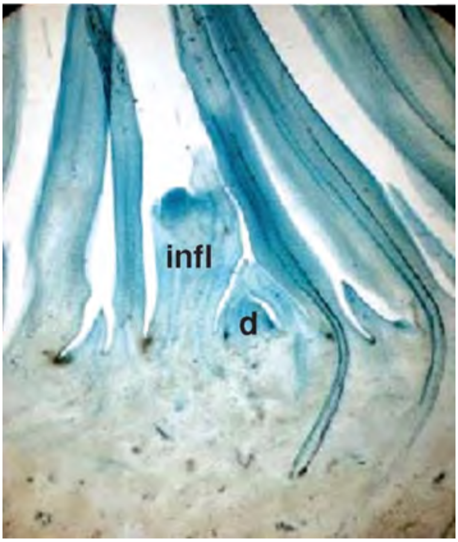

Figure 8: Logitudinal section of growing point of *Clivia* plant showing inflorescence bud (infll of previous module and apical dome (d) of new module.

The question now arises what happens to the inflorescence buds. This problem has not yet been solved, because many plants have to be sacrificed during the studying of inflorescence development. What follows is therefore partly a hypothesis based on a few observations. *Fig.* 4B shows an aborted inflorescence bud that was formed by a seedling plant after the 12th leaf (four leaves not shown). Before having been dissected, this plant was exposed to very unfavourable growing conditions (small container, water stress and some direct sun) indicating that favorable conditions are required for the survival of the inflorescence bud. A further sign of stress is that the same plant produced eight, instead of four leaves before the next inflorescence was formed. *Fig.* 2B also shows that after formation, the first inflorescence has grown to a stage where the scape (peduncle) as well as flower buds could be distinguished. *Figs.* 7, 8 *and* 9 clearly show that, after initiation, the inflorescence bud keeps on growing. Flower buds continue to develop but the scape remains relatively short. It seems as if most of the initial growth of the inflorescence is the result of cell division during the formation of the different parts.

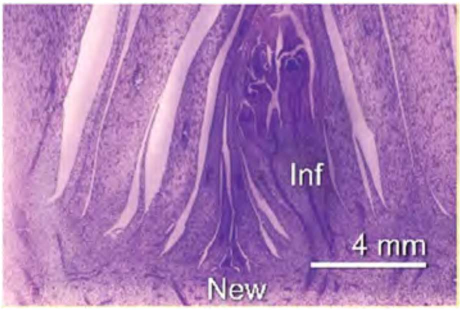

Figure 9: Section of growing point of *Clivia* plant showing inflorescence bud (inf) at a more advanced stage of development than the one in *Figure* 8.

Similar to leaf development the elongation of the scape is also the result of the activity of an intercalary meristem at its base, followed by cell elongation. Before starting to elongate however, the scape cells must be triggered by a period of low temperature.

Figure 10: *Clivia* plant showing reduced scape of older inflorescence and normal scape in younger inflorescence.

Cells may lose their capability to enlarge if they mature before expansion, that is, before the cold period that would trigger them to start elongating in a similar way as shown in *Figure* 2B.

'Untimely' inflorescences appearing amongst the leaves without scape elongation would be an illustration of the latter condition. Evidence supporting this statement is the fact that this condition is usually associated with inflorescences situated towards the base of the plant, between older leaves, like the spent inflorescence in *Figure* 10. The younger inflorescence in *Figure* 10, situated between the young leaves, produced a normal elongated scape probably because the young scape cells were triggered by the winter cold before they had lost their ability to elongate.

Other, more complicated factors are also involved in the process of scape elongation, but at this stage it seems as if the age of the scape cells play a very important part in the whole process. There are still many questions about flowering in *Clivia* and many more plants will still have to be dissected to provide the answers. The continuation of this research is therefore of the utmost importance.

Best on Show, Metro Interest Group 2001 Show, Grower: Tino Ferero, The incorrect photograph appeared in Yearbook Four on page 39,

A selection of the slides shown in 3-D by Jim Comstock at the International Clivia Conference.

Left: *Clivia* interspecific cross '**Juliette**'.

Below: C. *miniata* **'Red Mix**'.
Breeder: Joe Solomone.

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Opposite page:

Top: *Clivia miniata* '**Lovely Rita**'.
Bottom: *Clivia miniata* tea party.

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Top, left: C. *miniata* '**Antz**' spider form.
Above: Floret of C. *miniata* '**Affliction**' with some keeled petals.
Above, right: C. *miniata* '**Josh**'.
Below: C. *miniata* '**Blushing Bette**'.
Right: C. *miniata* '**Being Peach**'.

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C. *miniata* orange mix group. Breeder: Joe Solomone.

C. *miniata* '**Ruby**'

Above: C. *miniata* ‘**Box**’ multipetal

C. *miniata* ‘**Flame**’ group

Below: C. *miniata* ‘**Adam**’

C. *miniata* ‘**Dawn**’

Above: C. *miniata* '**Ramona**'

Below: C. *miniata* interspecific‘Goodwill’

C. *miniata* interspecific **'Hunting**'


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VARIEGATED CLIVIA IN JAPAN

Shigetaka Sasaki

Introduction

Mr. Nicholas Primich read a paper on variegated *Clivia* at the International Clivia Conference in 1998. I feel highly honoured to be able to publish this article on the same topic as he did. In his paper Mr Primich explained various aspects of variegation that are common in all plants. He tried to answer positively all the queries that we have when we try to understand variegation. If I had not read his article, I would not have known about the existence of air blisters that appear in the leaves of C. *nobilis*. I wonder whether this fact indicates the possibility of creating a new type of variegated *Clivia*.

As I wrote in Clivia Yearbook 3 (p. 24), we classify variegated *Clivia* into 7 types in Japan, namely, Shima-fu, Fukurin-fu, Akebono-fu, Negishi-fu, Naka-fu, Tora-fu and Genpei-fu. These are all illustrated on pages 24 and 25 of that Yearbook. Fu means variegation in Japanese. I would like to share more information about the 7 types of variegation and on which of their characteristics are inheritable. They are illustrated in the accompanying photographs.


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C. *miniata* Naka-fu

Inheritable Characteristics

Within the 4 types of variegation, Fukurin-fu, Negishi-fu, Naka-fu and Genpei-fu, are variations of Shima-fu that are found in the seedlings. Sometimes, typical Shima-fu plants change their variegation into one of those 4 types. Akebono-fu and Tora-fu are not variations of Shima-fu. There is also a Tora-fu plant called "Taiho", but this is caused by a virus infection (*Figure*1).


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Figure 1: C. *miniata* Tora-fu 'Taiho'

In breeding variegated Clivia, Shima-fu, Negishi-fu and Akebono-fu are inheritable characteristics, but other variegation types will not be inherited in the next generation. I have heard that Akebono-fu can also be inherited through the pollen parent, but I am not sure of this because there is no data available of the breeding results.

Breeding high quality variegated *Clivia*

I would like to explain how to breed good Shima-fu plants as an example of breeding high quality variegated clivias. A few months after the pollination of Shima-fu plants, you will find white stripes on the surface of the berries. But the variegation varies in every berry; some berries are totally white in colour, some berries have lots of stripes, and some berries have few stripes that look almost green.

According to what is reported by Clivia breeders in Japan, as well as Mr. Nakamura, I can say the following: you can take any variegated berry as an example, the seeds that are covered by the white portion of the berry peel tend to germinate with totally white leaves. Of course those seedlings will not grow and will die. On the other hand, the seeds that are covered by berry peel with lots of thin stripes will tend to show the same good leaf variegation after germination.

When Mr. Nakamura harvests the seeds named "best variegated", he chooses only the seeds that are covered by peel with lots of thin stripes. So, what plant is most suitable for getting good berries with lots of thin stripes? This is just my opinion, and it has not yet been proved, but I believe that plants with very thin stripes on the leaves in the flowering stage are most suitable for getting good berries.

Figure 2: Variegated Berries

You will notice that the variegation on the leaves runs through the flower stalk and reaches up through the berries. So I think that the variegation of the leaves and stalk influences the variegation of the berries. Refer to the picture of a variegated *Clivia* with variegated berries. (*Figure* 2). You can see that the white colour on the right side of the leaf runs through the stem and reaches up through the right side of the berries. On the other hand, the green colour on the left side of the leaf runs through the stem and reaches through the left side of the berries.

In keeping with this concept, you will notice that the berries of Fukurin plants tend to have white berries; also the seedlings tend to have no pigmentation (*Figure* 3).

Best variegated berries

Figure 3: Fukurin berries

It seems that the white parts of variegated leaves tend to get larger, as the plant ages. Therefore, when we try to breed the best variegated seedlings, I would recommend that you do not use plants with overly white leaves as maternal plants, but rather use plants with well balanced, striped leaves as the maternal plants. For example, the percentage of stripes should be 30 % of the total surface of the leaf.

In Japan, dwarf clivias are very popular. So we often use variegated Hime-daruma as a mother plant for breeding variegated Daruma, and use broad leaf Daruma as a pollen plant for getting broadleafed plants (*Figure* 4).

Figure 4: Best Shima-fu

Negishi-fu

The word "Negishi" comes from the name of a cultivar of *Rofidea japonica*, which is known as a traditional pot plant in Japan. Japanese *Clivia* enthusiasts often use cultivar names of Rohdea for naming clivias. Negishi-fu was bred from crossing Shima-fu plants. When we see Negishi-fu plants, some plants have very small green points running on yellowish green leaves. Or some plants have very thin green stripes running on yellowish green leaves. We call both types "Negishi-fu". There are variations in Negishi-fu plants. Some plants show Negishi-fu only during the young leaf stage, and then the variegation and the yellowish-green leaves change into the usual darker green leaves as they get older. Some plants maintain the variegation and the greenish yellow leaves after they mature. There are various types of Negishi-fu plants, but the characteristics of flower stalks and berries are common to all the plants. Flower stalks and berries of Negishi-fu plants are yellowish-green, with rare green pigments (Figure 5). We can recognize the type easily when we check flower stalks and young berries. As the berries mature, the greenish-yellow colour changes into purplish-red. Negishi-fu plants are still rare in Japan. I think they will become more popular in the future.

Figure 5: Negishi-fu

Negishi-fu is an inheritable characteristic. The seedlings rarely show pigmentation on the leaves, and we cannot tell the difference from albino seedlings, but the leaves start to show a yellowish-green colour as they grow older. This fact is also common with Akebono-fu seedlings.

Akebono-fu

Akebono plants are a mutation in crossing the usual green plants. When *Clivia* breeders discovered Akebono variegation, it seemed to them like the image of the sun rising over the horizon. So this variegation is named after the classical word that means "sunrise" in Japanese. This word “Akebono" has been continuously used as a cultivar name for variegated plants like *Rohdea japonica* or *Neofinetia falcata* in the Japanese horticultural world since the Edo period (which was from the early 1600's till the late 1800's).

We will see some variation in Akebono plants. Some plants show Akebono variegation only in the young leaf stage, then the leaves become completely green, as they grow older. Other plants maintain Akebono variegation after the leaves age. Some plants show Akebono variegation only on the front of the leaves, and the back of the leaves look green.

As for the variegation pattern itself, there are also variations:

1. Plants with several white bands on each leaf.
2. Plants with a large white band in the middle of the leaf, while the tip and the base remain green.
3. Plants with white at the leaf tips.
4. Plants with a slightly white colour at the tip and base of the leaves.

C. *miniata* Akebono-fu

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C .*miniata* Akebono-fu

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C. *miniata* Akebono-Daruma

Unfortunately, we have not found plants with a stable variegation pattern. It seems that the variegation pattern sometimes changes on the same plant.

When we use Akebono plants as the maternal parent, the Akebono variegation will be inherited in 100% of the offspring.

Akebono seedlings are easily damaged because they rarely have green pigment (chlorophyll). We have to be careful when we grow them. One Japanese breeder told me how he grows Akebono seedlings. He keeps them in a humid place for 2 - 3 years. This keeps the leaves green. When they are big enough, he moves the plants to a drier place so that they will develop Akebono variegation.

I cannot tell you much more because the knowledge about Akebono breeding is very limited. But I am sure of one thing; it is better to grow them in a darker place than usual. Akebono variegation is very vulnerable to sunshine.

Akebono plants have the following characteristics in their flower stalks and berries: The berries do not show variegation at all (Figure 6). The flower stems have an unusual pigmentation. It seems that Akebono variegation totally covers the stems. This characteristic of the flower stems is similar to Negishi-fu plants. This makes me wonder if the Akebono variegation and the Negishi variegation have something in common.

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Figure 6: Akebono-fu Berries

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Figure 7: Daiohkan-nishiki

Strange variegations in *Clivia*

The flower (*Figure* 7) is called "Daiohkan-nishiki" and is owned by Mr. Tsuruya. This is a mutant Clivia found when breeding variegated Daruma plants. The petals also have variegation, a very rare thing. Only the flower tips look orange, and there are green stripes that are similar to the leaves. As you know, there are plants with "green flowers". I have heard that the "green flower" is a kind of temporary deterioration, and it seems that this type of plant has normal flowers under normal conditions. However, the owner of "Daiohkan-nishiki" reports that it has the same type of flowers every year. I have heard that the ovary of green- flowered plants is wrinkled and not round shaped compared with that of normal flowers. However, "Daiohkan-nishiki" has round ovaries. It seems that this flower is not a temporary mutation. In addition, I have heard that the offsets of this plant also have the same type of flowers as the original plant.

Tora-fu owned by Mr. Mitsuhashi

This is a new type of variegated *Clivia* in Japan. There are lighter green bands on the leaves that are slightly raised. The breeder is not known. This variegation is inheritable. So if you use this plant as the maternal parent, the variegation will be inherited by the next generation. It may be possible to breed a new type of variegated *Clivia* by crossing this plant with other variegated clivias.

Finally, I am very interested in the white stripe on the leaves of *Clivia mirabilis* that was recently found as the fifth species of *Clivia*. This variegation has the potential to produce a new type of variegation beyond the 7 types of variegation in C. *miniata*. I have a request for Dr. John Rourke and the other people who are studying this new species. I would like to suggest that they try a breeding program of crossing C. *mirabilis* with various variegated C. *miniata*. I am willing to provide variegated plants as breeding material for such a breeding program.

C. *miniata*. Breeder: Margot McNeil. Grower: lohan Conradie.

VISITS TO SPECIAL CLIVIA PLACES

after the International Clivia Conference

Conrad Calitz, Stellenbosch, South Africa

"Good Heavens!", "Wonderful!", "My magtie - ongelooflik!", "Now ain't that something!", "Wow!". All around us echoed the surprised voices in several languages, in wonder at what lay a few yards in front and below us - the magnificent splendour of *Clivia miniata* in their natural habitat.

Amongst huge gray sandstone blocks, below a ragged canopy of riverine forest, someone had switched on these glowing candelabras. Some brightly gleaming in a shaft of sunlight, others less vivacious in the background. Large open trumpets in all the sunset hues - dark, glowing orange, light apricot, pink fringes, proudly high above the lush green foliage. The ground a rich gray-brown leaf litter, with green moss and little ferns unfurling their tiny fronds, their brown beards glistening with dew. High above, the forest birds twittered, catching the excitement below. An occasional butterfly fluttered its erratic course - perhaps undecided which of these beautiful flowers to visit first.

After falling in love with *Clivia* a few years ago, I had been looking forward to this conference, show and visits. But nothing really prepared me for the splendour of seeing my first *Clivia* in nature. We had traveled for two hours from Pietermaritzburg by bus, southward through the rolling hills of trees and sugar cane and through plantations to Umtamvuna Nature Reserve on the border between Kwazulu-Natal and the Eastern Cape. The river carved a deep canyon through the sandstone layers of the plateau and on the upper west-facing slopes this colony of healthy *Clivia* has survived the ravages of land clearing for agriculture, fires, muti gatherers and *Clivia* collectors.

From the gate in the secure fence at Clearwater Cottages, a faint path crosses an open field with dainty grasses dancing in the breeze. Some tiny creamy orchids shyly hugged the ground; a few bright purple *Agapanthus* and deep pink *Watsonia* led the eye onwards to the forested hills and the bright blue sea a few kilometers away. The path suddenly dropped past a ridge of deeply fissured rocks into the canyon.

The descent into Umtamvuna Gorge.

The descent frightened some, but the allure was too strong. Several older and less agile club members were able to easily do the walk, amongst them Gert Wiese, at almost 81 years. The path is stony and, especially under the trees, covered with thin moss, but is quite safe and easy. Just about 50 meters after entering the forest slopes you see the first clumps of *Clivia* - large, vigorous plants with long leaves, growing on the few flat spots, in nooks and crannies of rough tree trunks and leaning branches. Some even in a few centimeters of leaf litter on top of a rock or in partially rotted tree trunks.

I immediately understood the right conditions for *Clivia*. The forest was cool and fresh, with a lot of damp rocks, but no standing water.

Brian Tarr later told us, that in his experience, *Clivia miniata* only occurs on the west facing slopes, always associated with sandstone (which by the way, although much hotter and dryer, is also the environment in which the *Clivia mirabilis* grows in the Oorlogskloof). I have always believed in adding some sand to my growing medium and the natural habitat seems to confirm this.

C. *miniata* in the Umtamvuna Gorge.

The *Clivia* enthusiasts from several countries as well as us Capies and Valies, felt like children in a toyshop. Where to look first and "Oh, look at that!" but "hands off"! Instead the cameras clicked like a final at Wimbledon!

The Umtamvuna Nature Reserve of 3147 *ha* is about 8 *kms.* north-west of Port Edward. It has several walking trails and a wide river about 200 meters below the cliffs. According to tourism pamphlets, it is home to 259 species of birds and more rare and endangered trees than any other reserve in South Africa. Lots of accommodation is available at several places around the reserve.

C. *gardenii* growing in a swamp on Braemar Farm.

After Umtamvuna we travelled along back roads to several sites at Braemar Farm and at the Microlight landing strip where C. *gardenii* grow, also the Swamp C. *gardenii.* Many tall, healthy plants grow in black oozy mud (I remember it very well, - after a careless step it covered my foot and ankle for the rest of the day.) They were not in flower, but the meter long leaves and some green seed heads showed that they were thriving.

C. *gardenii* growing at the Microlight landing strip.

After some further travels along the back roads and another locality of C. *miniata* and C. *gardenii* as well as a beautiful waterfall showering over a very high cliff, we had a long sumptuous lunch at a Trafalgar Lodge. Later, the long drive back to Pietermaritzburg had many of us dozing off, but certainly dreaming of the real, natural *Clivia* we had seen for the first time. The visitors from Belgium, Holland, USA and Japan were all astounded, and all agreed on a heartfelt thanks to Andy Forbes-Harding for taking us to see these treasures.

Narrow petal *Clivia miniata* from Umtamvuna

OTHER LOCALITIES:

Day visits to these natural areas and farms were organized for the 3 days following the Conference. The first day, two hours South was the absolute highlight. The second day took us about 2 hours North and the third an hour South from Pietermaritzburg.

That first night some very heavy rains fell with loud thunderclaps making the Capetonians very jittery. There was also some local political unrest, so the next day's visit to Kranskop could not go through completely.

We therefore had more time for the visit to Pieter van Rooyens' farm (aptly called 'Gem'), an amphitheatre set in smooth emerald green hills. As the bus could not traverse the muddy road, Pieter and his daughters ferried us in the backs of bakkies (LDVs) into the valley where the neat farm buildings nestled under huge trees, flanked by old sheds and kraals built from warm brown sandstone blocks. Some of the younger and fitter visitors walked in, with frequent stops at a variety of other flowers in the veld.

The farm garden, developed over decades, houses some beautiful shrubs and climbers, but the 'gems' are the multitude of flowering *Clivia*. They are everywhere, packed in terraced shade houses, growing in every corner, patio, stoep, passage and room of his large house, as well as in the lush garden under the large trees and beautifully tended flowering shrubs. Even the large catering room was lined with dozens of show quality plants in flower, to the envy of the visitors. The seedlings even had their own porcelain baths! . Pieter's 'red' strains are particularly beautiful.

Two of the C. *miniata* which grow near Pieter van Rooyen's farm

The hospitable van Rooyen family all jumped in to serve a very tasty tea and lunch. Pieter also showed us *Clivia* in habitat on another part of his property, again in a beautiful indigenous forest on the sandstone bouldered slopes of a high hill.

On the way back we called in at Otto's Bluff, one of the ridges surrounding Pietermaritzburg. A long, winding driveway under tall trees has been planted with thousands of *Clivia*, and many were in flower. This creates a beautiful river of green and orange. (In the Botanical Gardens, an old winding furrow has also been shored with *Clivia* and other shaded plants, creating a delightful feeling of being close to and walking with the plants.)

Our heartfelt thanks to Brian Tarr for his excellent informative, humorous and knowledgeable commentary during the whole day, not only on the flowers, but also the ecology, history, culture and personalities. If he tires of his good work at the NBI and growing beautiful *Clivia*, he should become a tour guide. (How about an annual *Clivia* route, Brian?) He brought to our attention the *Clivia* for sale at the *muthi* stalls in the main street of Greytown, but warned the avid collectors amongst us to please not buy any of this kind anywhere. Buying this would enlarge the pressure on the natural populations, as the vendor's stocks are replaced with even more plants.

On the third day the bus and several cars again travelled south, calling first at the Chubb's farm. The variety and quality of plants were amazing, I noticed a pile of **Chubb Peach** plants with bare roots being packed into a large, hard suitcase for transport to Japan. In a few years we shall surely find superior peach, apricot and pink strains returning from Japan. But it is also a compliment to the quality of Sean's plants.

We travelled further south to Roly Strachan's farm at High Flats near Ixopo, where a sight reminiscent of the Dutch bulb fields greeted us - a field of flowering *Clivia* stretching on both sides of the road right up to and around the farmhouse. We estimated that the two, 20 x 400 meter strips contained some 100,000 heads of *Clivia*! Later, the afternoon sun shining under the clouds and flowing under the trees created an ethereal glow of peach and orange. My wife and I were fortunate to spend the evening and night with Roly and Barbara before continuing our journey back home. We walked down to the main road through the sea of *Clivia* several times, each time noticing new unusual specimens, even several multipetals and multicoloured tepals. The variety in his plants was as amazing as the sheer numbers. No wonder Roly can sell seeds by the *kilogram* and amongst them you are sure to find some of nature's wonderful crosses and selections.

Roly Strachan's sea of *Clivia*

Driving away the next day and even now, thinking back, we agreed that the three days visiting these special places, with these special people, being guided and entertained by these special hosts was indeed ... well, SPECIAL!

Dear reader, please pardon the 'flowery' language used above. If, through the words, you can feel and share something of the majestic beauty and serenity of this area with its many little pieces of Clivia *paradise, your patience is rewarded. Better still, go and visit these places and also the other floral wonders of South Africa, preferably in the company of the local experts. Even better, would it not be possible for Brian Tarr, Sean Chubb, Andy Forbes-Harding and the other experts to conduct regular tours to these localities? We have wine, art, cheese and many other routes, why not a* Clivia *route?*

THE CAULESCENS TOUR

SEPTEMBER 2002

Ken Smith

During my trip to South Africa for the Conference at Pietermaritzburg, I had the opportunity to be part of the Caulescens Tour organised by Connie and James Abel. It was a valuable experience.

I had been in South Africa for a week visiting the Cape and had seen a lot of clivias and had met many of my clivia friends. The tour was set to depart from the Abel's residence early on Monday morning, September 2nd. The trailer was loaded with the luggage and the bus was loaded with the group of clivia enthusiasts from around the world. The bus headed off from Pretoria at approximately 8am on its way to Magoebaskloof. We travelled through some very dry country and to me the scenery was not unlike Australia, except for the Aloes.

We reached the Motel at 2.30pm so that the trailer could be left and we were on our way again through some Afromontane forest vegetation on route to the first C. *caulescens* habitat. I was intrigued to see some very mature specimens of *Quercus, Fagus* and *Malus*, and a large stand of *Sasa palmata*. Upon reaching the site the bus was parked and we had a walk of several kilometres to view the clivia in habitat. What we saw was *Clivia caulescens* carpeting the forest floor as well as the odd specimen growing epiphytically on the moss covered tree branches. The view of the valleys was spectacular. With Illie Gaceui I ventured into the forest to photograph some flowering specimens, and then it was back along the track to the bus. The drive out of the forest as the light faded was a very interesting one. Well done Justin. Once back at the Magoebaskloof Motel we were able to rest and revive ourselves with pre-dinner drinks. The meal was fantastic.

Day two was a planned trip to see the McNeil Collection at Ofcolaco. It was a warm, sunny day that became warmer as the morning progressed. Margot McNeil met the bus at the entrance to the Legalameetse Nature Reserve. Several four-wheel drive vehicles had been organised to take the tour party through the scrub to the clivia planting, almost all *Clivia miniata*. For me, this part of the tour was extremely satisfying. I had researched the McNeil collection when I was doing my university studies and now to actually be in the midst of this important *Clivia* collection was special indeed. The whole party had a guided tour of the collection. We listened intently to Margot and soaked up the spectacle of the mass planted *Clivia* that changed with every turn of the pathway.

While some took refreshments, those that wanted to purchase plants were able to select out the plant in flower, negotiate a price, and providing a suitable piece could be dug, ended up with some choice clivias. For those readers that have enjoyed the images of the 'Four Mary's' *Clivia*, you should see it *in situ*! I am so glad I was part of this tour. I know some of us stayed too long with Margot, but the time wasn't enough for me. James had a schedule to keep so it was time to go back down the rutted track through the thick scrub. We joined the others on the bus and headed for Mariepskop, our next C. *caulescens* habitat site.

By mid afternoon we had arrived at the offices of the Mpumalanga Reserve where the trailer was to stay while we took the bus up to the top of the area. Our host for this visit, Mr. Winners Mashego, joined the bus and explained about the redevelopment of this pine and eucalypt forest back to indigenous forest trees. He also helped in getting clearance through the Air Force site on our way up. The drive to the top was steep but well worth it for the view once there. *Clivia caulescens* was seen growing under vegetation along either side of the roadway. I was surprised to see it growing in fairly exposed conditions, under shrubs and on rocky outcrops, at the top of the site. Cleaned seeds of *Clivia caulescens* were scattered all along the concrete roadway and the group discussed at length as to how they got there. (Probably rodents - see Connie and James Abel article, page 67, penultimate paragraph. E*ds*). It was a very relaxing time. After a slow descent to pick up the trailer, it was off to Graskop, which was to be the starting point for day three of the tour.

We set out for God's Window after breakfast, stopping along the way at several places to see more C. *caulescens*. The Pinnacle was amazing. Fantastic scenery was to be the order of the day. The C. *caulescens* habitat was different here to that of the forest on day one. The habitat was most surprising and to see the C. *caulescens* growing in the leaf mould on top of the rocks was an eye opener indeed. Huge plants with long stems. We also ventured into the thicker vegetation to view C. *caulescens*, still with the large stems, growing under the shrubbery. Lunch was at Bourke's Luck Potholes, on the Blyde River, where we were able to marvel at nature's handiwork. Quite a bit of shopping was done at the various stops during the day, as well as at the curio shops back at Graskop.

Day four, the day we were to leave Graskop for Pretoria, started out cool and overcast. We stopped at several scenic viewing points during the return trip. Our stop at Sabie gave me a chance to compare the horticultural planting at an old church with those that I am familiar with in Australia. I was aware of a lot of similarities. After the drive back to Pretoria the tour finished at the Abel's where we all had a meal and viewed the *Clivia* collection of Connie and James. A great way to finish the tour.

I was pleased I had joined the Caulescens Tour. So many things to see and learn: the C. *caulescens* in habitat of course, but also the countryside and the places we visited. A special part of being on the tour was the opportunity to interact with the other participants and to learn a little more about each of them. Even helped celebrate a wedding anniversary! James discussed suggestions for improving future tours, so if any of you were planning a trip to South Africa for the 2006 Conference, I would recommend you consider being part of a habitat tour like the Caulescens Tour.

The Caulescens Tour group.

C. *caulescens* growing lithophytically.

POOR MAN'S PEACH

Nick Primich

When I first started with clivias in the early 1980's I obtained three orange *Clivia miniata* from the wild. These three plants came from three different farms, and unfortunately I did not take care to note which plant came from where.

The one plant that I had named "**Wild Type I**" was the least prepossessing of the three. It had 20*mm* wide leaves or even less. The flower was small and insignificant, yet the other two plants passed into oblivion and this one gave me much of interest. It did not take long to grab my attention. When I selfed it, I noticed that one seedling had a light green leaf base. I was aware at this stage that this was the sign of a yellow flower, so carefully put the plant to one side. When it flowered it was indeed a yellow. Alas, even in those days of few and far between yellows, this one was a calamity. A small, pale insipid flower, with almost grass-like leaves. However, I selfed it and put it aside.

I duly planted the seeds and was most surprised when they all turned out with brown leaf bases. Over the years we had become aware that there were different types of yellows insofar as breeding goes. I always avoided "**Natal Yellow**", as there was a big mix-up there, and even today the picture is not quite clear.

I had obtained yellows from as many backgrounds as I could, but none of the pollen that I tried could produce a yellow seedling from this plant. It was a vigorous plant and soon produced offsets which I handed out to various breeders. Not one of these people ever informed me of success in producing a yellow seedling.

My next surprise from **'Wild Type I**' was when I crossed it with a yellow. I noticed the seedlings' bases had quite a variation from a good brown to a pale green. I discarded the dark bases and carefully tended the paler ones. I noticed some of the green ones took on a pale shade of brown as they aged.

The time came for them to flower, and they all opened yellow. Some of them had much improved flowers to those of the mother, but the surprise came when some of them started to suffuse with a pale orange. Gradually at first, and some even became a normal looking orange. Strong light accelerated the process. As we all know, the anthocyanin does not develop properly in the dark.

I had another plant, as far as I knew unrelated to this one, which opened pale orange, and the colour would gradually darken. One or two members told me they also had similar plants. Again light would speed up the process, and darkness would stop it.

As I no longer breed clivias I am not able to find out if a true-breeding line can be established from the peaches from **'Wild Type I**'. These are the plants that I called "**Poor Man's Peach**". They had quite a variation among them, but some were very lovely plants. Perhaps the new owners will do something with them.

Top, left: F2 caulescens Top, right: FI ‘**Swamp**’

Above, left: ‘**Yoshi**’ Above: ‘**Cinderella**’

Left: ‘**Warmheart**’

Below, left: F3 **‘Moon**’ Below right: ‘**Dainty**’


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A selection of Interspecific *Clivia* bred by Wessel and Rudo Lötter

Above, left: **Pink Sensation**'.
(The incorrect photograph was published on page 48 of *Clivia Four*.)
Above, right: ‘**Ballerina**’

Right: ‘**Virna**’

Below, left: '**Rosy Cheeks**'
Below, right: ' **Chandelier**’


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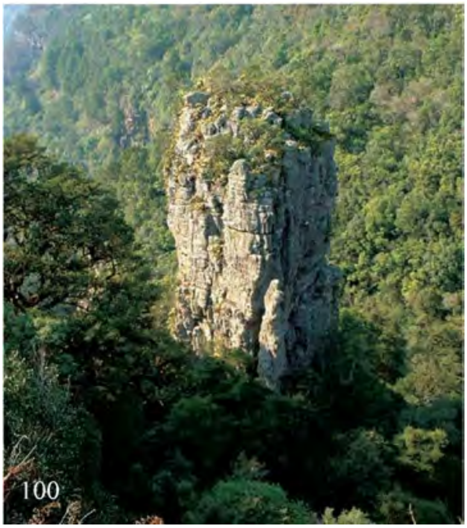
SOME OBSERVATIONS ON CLIVIA CAULESCENS

Connie and James Abel

The range of *Clivia* from the southernmost C. *nobilis* to the northernmost C. *caulescens* spans nearly 10 degrees of latitude and from sea level rises to about 2000m on the peaks of the eastern escarpment. C. *caulescens* occurs between 23°S and 27°S, overlapping with C. *miniata* in the south. However, this apparent inverse correlation between degrees S and altitude is almost certainly a temperature effect, with the Eastern Cape Province being temperate at the coast and the Limpopo Province being generally warm to hot, with the sub-tropical forest (and its C. *caulescens* with it) found at high altitude in the mountains for coolness. In the photo of Marieps Kop the C. *caulescens* are found on the top and sides of the distant peak, on eastern and southern aspects.

Rondavels and Mariep's Kop

C. *caulescens* are surprisingly tolerant of direct sun - there are many plants without shade at the top of the Pinnacle.



The Pinnacle

As with all the habitats that we have seen, C. *caulescens* populations occupy small areas of only a few hectares at most. Millenia ago the sub-tropical forests of southern Africa were very much more extensive, and one can assume that clivias would have had a similar distribution. As the climate has changed the forests have shrunk, and so have the habitats of C. *caulescens.* The individual populations are now isolated along the escarpment, from one to many kilometers apart. This may help explain differences in the plants in the various habitats, with each population having developed in isolation.

From a conservation viewpoint, C. *caulescens* do not seem to be valued for traditional (medicinal or spiritual) purposes by the indigenous folk. Another reason why many C. *caulescens* populations must be totally safe from human depredation is their inaccessibility on the high cliffs. The most striking feature of

C. *caulescens* is, naturally, the stem. The populations that we have seen show a wide variation in this respect, with the longest stems being at God's Window. On the habitat tour in September 2002 we were fortunate to find a stem of 2.2*m.* Several enthusiasts have commented that this must surely be a sign of extreme age. Within C. *caulescens* perhaps, but we do not believe that the stem in any way indicates that C. *caulescens* grows to a greater age than the other species - it simply elongates to a greater degree, so that one can have a gap of 20*mm*+ between leaf scars. We have seen bare stems in all three of the other common species, but in those cases the leaf scars are very close together and the stem has been short. It is likely that all species 'grow' at about 4 to 8 leaves a year and one would need to count leaf scars to judge the age.

Clivia caulescens at God's Window

All species can grow epiphytically on tall trees or lithophytically on rocks, and C. *caulescens* particularly so. In those positions they are subject to dry spells, but they are drought resistant due to the root structure with its thick outer layer of velamen cells, which act like blotting paper in soaking up and storing every bit of available moisture.

In this respect they are similar to orchid roots, which also have velamen. However, they seem to us to be purely opportunistic epiphytes. The seed is heavy, unlike the extremely fine seed of orchids which can be blown large distances by slight breezes. No *Clivia* seed was ever transported into a tree by the wind. They have been seen to be taken by monkeys (samango and vervet) and birds (Knysna loerie in particular), but it is unclear whether they are simply dropped during feeding or pass through and are later deposited with a nice kick-start nutrient mix. If they fall on a nice flat branch they thrive with the roots securing themselves in moss and ferns. We have only once seen an epiphytic *Clivia* (a C. *gardenii* near Kranskop) with roots clinging to the bare side of a branch as orchid roots do.

Why are *Clivia* not more prolific? We have visited a number of C. *caulescens* habitats in October/November, which is the main flowering time, and at maximum there have been 15% of mature stems with flowers. We would have thought that all stems would try to produce a flower each season, and have no idea why they do not.

And rodents are also important in distributing seed. During the recent C. *caulescens* trip to Marieps Kop |mountain] we were puzzled to see many nicely cleaned seeds lying on the hardened road surface, and assumed that they had rolled there from the verges. We then spotted a seed on top of a flat rock with no possible parent plant within metres. We decided that the berry must have been taken by a rat or a mouse which found a nice open eating spot, ate off the berry skin and left the seed. This theft of seed has been seen frequently in Pretoria gardens - if berries are suddenly missing a bit of searching will reveal a neat pile of seed under the leaves, with the rats having done the work and the undamaged seed ready for planting.

With C. *caulescens* habitats being on the escarpment the bonus in visiting them is that one travels through some of the most scenic parts of the country.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Above: Winner pastel C. *miniata* Section KZNCC 2002 Show. Grower: Pat Gore.

Above, right: C. *miniata* '**Salmon Sensation**'. Breeder and grower: Michael Jeans.

Right: C. *miniata* '**Golden Amber**'. Grower: Elroy Janse van Rensburg.

Below: Winner Interspecific *Clivia* Section KZNCC 2002 Show. Grower: Natal National Botanical Garden.


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PROMOTING EARLY FLOWERING OF CLIVIA MINIATA SEEDLINGS

Ian Brown

Too many growers are waiting patiently for five years and more for their *Clivia miniata* seedlings to flower from seed.

One cannot know before a seedling flowers whether it's breeding has produced the desired flower colour or shape or whether it should be kept for further breeding. The advantages of getting it to flower as soon as possible are obvious.

Some growers use stratagems such as confining the roots in too small a pot or keeping the plants very dry for four months before the Spring flowering time, in the belief that the plant will 'feel' threatened and flower to ensure that its kind will at least survive by producing seed!

This is a myth. In fact Robbertse and van der Merwe point out in another article in this volume that stress caused by pot bound roots can cause the plant to abort its dormant floral buds. Dehydration can also cause bud abortion and will do no more than slow the growth of the plant. In fact here in Cape Town our Clivia are exposed to heavy rains before the flowering season, yet they flower well.

Honiball has pointed out (in the *Clivia Yearbook* 3, p.30) that the plant must develop through a juvenile stage before it will be sufficiently mature to produce a floral bud which can develop into an umbel. That juvenile stage encompasses development of its first 12 leaves.

It struck me, therefore, that the key to successful growing of early flowering C. *miniata* lay in promoting sustained, rapid, but healthy, growth during the juvenile stage to achieve production of those first leaves as soon as possible.

I set about achieving this and here are a few of my experiences.

For a few years I monitored selected seedlings and recorded the date when each new leaf appeared. I found that I could achieve 3 or 4 leaf growth in year one and another 5 or 6 in each of years two and three. I also found that good, strong root growth is essential for leaf development.

This was achieved by ensuring that the seedlings were grown in containers which did not restrict their root development. However, the container must not be so big that the roots will probably not fill it in that season. Rather transplant it into a larger container as soon as the roots fill the container.


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Figure 1: One year old seedlings with four leaves each.


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Figure 2: Seedlings left for one year in seed tray. In this cramped space only two leaves have formed.

The growing medium should always drain well and be well aerated and rich in vegetable matter. This must be kept barely damp (test it from time to time by pushing your finger into the pot) and not so wet that this could cause root rot. There must also always be sufficient light to promote growth without exposure to sunburn. Warmth is also required to promote growth. This is not usually a problem in the Southern Hemisphere but may require artificial aids in greenhouse culture. However, too much light or heat seems to retard the growth of small seedlings. James Abel has commented that both minimum and maximum temperatures are important as they limit or stop growth. Heating in winter to 18 degrees is considered to be too expensive for South African enthusiasts, but evaporative cooling to limit summer temperatures to 30 degrees is inexpensive if a tunnel with a wet pad is available.

The first two years are critical. If a plant has not grown 9 or 10 leaves after two years, it is unlikely to flower in year three.

Figure 3: Two-year-old plant in 20*cm* pot

Trial and error has led me to use the following growing program:

1.Seeds are sown in August/September. Before then it is often too cold and wet in Cape Town.

2. Use a fairly deep seed tray or pot. I find a depth of about 10*cm* is ideal.

3. Always use a well drained medium. A mix of two-thirds milled bark to one-third coarse compost (with no manure) works well. I use this for all sized plants.

4. As soon as the seed starts to wither away, start fertilising. I alternate **Kelpak™** (seaweed concentrate) and **Supranure™** 3N:2P:1K(22) i.e. (11 %N; 7,3%P; 3,7%K) weekly with occasional doses of **Chemicult™** (6,5%N; 2,7%P; 13%K). All are watered on. This would be too rich in nitrogen for flowering sized plants but gets small plants to produce good leaves and roots.

5. In April I transplant the seedlings (1 to 2 leaf size). These go two at a time into plastic bags of about the size of a 17cm pot.

6. I don't do much fertilising between May and July as it's too wet! From 1 August I use the same fertiliser progam as for the seed trays.

7. In April (18 months) I put the seedlings individually into 17*cm* or 20*cm* pots and leave them in these until they flower.

8. These plants are now treated like all my mature ones and are fed **Phostrogen™** (14:10:27) (an oxide formulation - see footnote. *Eds)* fortnightly from August with a very occasional dose of **Chemicult™**. I cut back on fertilising in December and January (often away on holiday!).

9. Of late I've put a little **BounceBack™** into my pots. This is an organic fertilizer made from steam sterilised chicken manure with 30*gm/kg* N :15*gm/kg* P:1 *gm/kg* K. (an Australian formulation - see footnote. E*ds.*)

(Note: All the fertilisers mentioned also contain varying amounts of micro and trace elements).

Generally one needs to produce as many leaves and roots as possible in the first two years. At flowering time each year one can check progress: hopefully 4 leaves in the first year, 9 to 10 in the second year and 14 to 16 when they flower in year three. Whatever you do, allow plenty of root space. Plants that are pot bound in their first three years will not be strong and vigorous enough to flower.

Seed that is imported from the Northern Hemisphere can well flower here after 2½ years and should flower after 3½ years. I had my first flower in September 2002 from seed sown in this millenium. This was seed from Mike leans sown in April 2000.

These C. *miniata* have been selectively bred in Europe for early flowering. We also have plants, however, which have better flowers or colours but mature more slowly, often taking 5 or 6 years to flower from seed. I have found that, whether my seedlings are from early or late maturing strains, they invariably mature more quickly when their growth is promoted in this way during their juvenile stage. The late maturers may not flower in 3 years but they can flower in 4 instead of 5 or 6 years.

You will find that, even when seedlings from the same parents are given exactly the same treatment, some grow better or faster than others. This is because even siblings have different genetic make-ups. You can thus identify the genetically weak seedlings bred from the same parents by their weak growth and cull them, unless they are promising for other reasons - for example unexpected green stemmed seedlings from champion parents which do not have yellow flowers.

A parent which produces vigorous seedlings when crossed with one plant, can produce weak seedlings when crossed with another plant. This again is a matter of how genes inherited from each parent are rearranged in their offspring. Some plants are also better pod parents than pollen parents, and vice versa.

Encouraging seedling growth in this way enables you, therefore, to find out far more quickly what the breeding characteristics of your individual plants are, and facilitates selective breeding.

Footnote: Fertliser Formulations

In a 1996 Newsletter Bill Morris commented on a fertilisation recommendation by Gerhard Reyneke at the first Clivia Conference in 1994. Among other points he noted the use of a 1.0.1(36), which in international terminology would indicate only 2% plant food. James Abel explained that in a typical formulation in South Africa *e.g.* 4:3:4(33), the first three numbers refer to the ratio of elemental N:P:K and the fourth to the total percentage by weight of N.P.K in the product. Thus that product would have 12% by weight N (i.e. 4x33/(4+3+4), 9%P and 12%K.

However, most countries specify their fomulations on the oxide equivalent forms of P - Phosphorus pentoxide (P_20_5) and of K - Potassium oxide (K_20).

To convert the elemental specification used in South Africa to the oxide based specification divide the P percent by 0.43 and the K percent by 0.83.

To convert oxide based specifications imported into South Africa to the South African elemental equivalent multiply the P number by 0.43 and the K number by 0.83.

The international use of the oxide contents is historic, but misguided (in the South African view) in that the 'oxygen' is not a plant food and may in fact not even exist - on the international basis Potassium chloride would be 0.0.60 (it contains 60% K_20 or 50% K), giving an impossible 110% chemical content since it contains 50% Cl.

We record our appreciation of James Abel's guidance in the preparation of this note.

E*ds*.

Clivia miniata bicolour. Breeder: Y. Nakamura

BEST ON SHOW

Left: Best on Show and Winner broad petal Orange *Clivia miniata* Section CCC 2002 Show. Grower: Felicity Weeden.

Below: Best on Show and Winner broad petal Yellow *Clivia miniata* Section EPCC 2002 Show. Breeder: Yoshi Nakamura. Grower: Charl Malan.

Right & above: Best on Show and Winner dark orange to red broad petal Section Metro 2002 Show. Grower: Pikkie Strumpher.

Below: Best on Show and Winner long broad leaf *Clivia miniata* in flower Section NCC 2002 Show. Grower: Dawie van Heerden.

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A CLEAN SLATE

Keith Hammett, Auckland, New Zealand

I came to horticulture as a teenager via competitive flower shows in England. In the immediate post-World War II era ornamental horticulture enjoyed great popularity and specialist societies were strong in terms of both membership and the level of competition offered at flower shows, national and local.

The training and encouragement offered to me by top exhibitors of various flowers led me to obtain degrees in botany and plant pathology, and subsequently to travel to many parts of the world to study diverse aspects of horticulture.

I have continued to exhibit competitively and to judge flower shows in a variety of countries.

As I write, the *Dahlia* show season in New Zealand is less than a week away and I have blooms developing which are destined for the show bench.

However, despite my continuing enjoyment of exhibiting I have from time to time had cause to question what exhibiting does to the plants being exhibited. It is well known that congenital defects have developed in various breeds of cats and dogs where undue emphasis has been placed on certain cosmetic attributes.

During 2002 I had the privilege of being involved in the formation of the New Zealand Clivia Club and to stage the first specialist *Clivia* exhibition in this country. This was reported on pages 24 and 25 of *Clivia Society Newsletter* Vol. 11 No. 4 Summer 2002, and a picture of our non-competitive show is presented here.

A display at the New Zealand Clivia Club Show 2002

As yet the club has to hold an inaugural meeting and the members will need to determine what form the club should take and what to do. To this extent we have a clean slate. It is therefore perhaps worthwhile to pause and look at the track record of similar organizations to see what they have achieved. This is especially important at this time, as many long established specialist plant societies worldwide are in decline in the face of competition from many new recreational activities and changes in lifestyle.

In my experience there are two broad types of plant society, collector and exhibitor. For example in clubs and societies devoted to broadly defined interests such as Cacti and Succulents, Alpine plants or to genera that contain many species the emphasis is often on bringing together large collections. Much effort is put into discussing the variation that exists in the plant or group and on the growing conditions needed by each. It is useful to think of such societies as collector societies.

In contrast, for other plants the predominant focus of the enthusiasts is almost exclusively on holding competitive shows. Here the interest is to determine how closely growers can produce blooms to match a commonly agreed set of ideals. Such societies are closer to sports clubs and the real interest is on how well individuals are able to manipulate the plant.

Of course different plants are better suited to manipulation than others. Dahlias are supreme sports plants as there is a great potential to manipulate the bloom, both with regard to quality and timing. In contrast there is relatively little that can be done with a *Rhododendron*.

The *Clivia* has the potential to cover both areas of interest and more, provided that we keep sight of what we are doing. It is important for all organizations to regularly review what they are achieving and to beware of what is happening to kindred organizations. If this is done we may just avoid some of the pitfalls.

For me diversity is essential. Different approaches to a subject reflect local climate, culture and aspirations. Standardization is important to the extent that we need to communicate with each other. For example, it is useful to have a commonly accepted definition within C. *miniata* to distinguish a peach from a pastel or a picotee from a bicolour. Beyond this it is healthy for people to explore areas of development which appeal to them.

Classification

We could probably devise a broad classification which took into account characters like leaf width, broad/narrow, ratio of length to width, tepal shape etc., which could be agreed upon to facilitate communication worldwide.

Such a framework is useful in staging an exhibition, competitive or otherwise. However, what we must guard against is the unwitting imposition of arbitrary value judgments e.g. broad tepals are superior to narrow, trumpet shaped blooms are preferred to tulip shaped blooms per se. It is here where I start to have a crisis of conscience with regard to competitive exhibition.

So often once exhibitions of plants and flowers become competitive people lose sight of where they are taking the subject of their interest. Exhibition, like commerce, does influence breeding direction.

In essence an exhibition is an opportunity for people to compare plants side by side [collector motivation]. It can also be a means to encourage good husbandry and presentation of well-grown specimens (skill in growing motivation). The problem arises in balancing these two elements.

As an example, *Dahlia* shows in Britain are essentially elitist and are organized so that requirements for each class are demanding (*e.g.* 6 cultivars, five blooms of each, 6 vases). In this environment the comparative growing skills of each exhibitor are of more importance than the flower. In contrast American *Dahlia* shows tend to be inclusive and attempt to encourage maximum participation at the same time displaying the range that the *Dahlia* offers. There are lots of classes calling for just single blooms; this enables the less committed or people with more modest means to participate.

Show Schedule

The classification defines the different types of plant and allows essentially similar plants to be compared. This is comparable to the weight divisions in boxing that ensure the combatants are matched for size.

It is however the schedule that is all-important in determining the direction and emphasis that a society adopts with regard to competitive exhibition. This in turn influences the breeding and longer-term development of those plants that attract a specialist following.

In Britain the form of *Dahlia* blooms and the strength of their stems are the dominant features, while colour is of little consequence. Because of this, schedules are framed almost entirely in terms of form and size. As a consequence white and yellow blooms predominate at British shows, as they are easier to match in multi bloom exhibits. In contrast American schedules organize classes to cover the colour spectrum as well as size and shape of blooms. This has done much to retain the colour range and diversity of the cultivated *Dahlia*.

In the *Clivia* world there is similarly a clear difference in emphasis between Eastern and Western cultures. In China the focus of interest is on the leaf and plant shape, seemingly to the exclusion of the flower, whereas in the West flowers are important.

C. *miniata* 'Sir John Thouron'

Judging criteria

Once shows become competitive it is necessary to establish judging criteria. Such criteria ideally define the elements that make a bloom or plant aesthetically pleasing. The problem is that it is difficult to frame such guidelines without at the same time unwittingly imposing a straight jacket. Again using Dahlias as an example, with the exception of Collerette and Waterlily types most other groups, irrespective of floret form or size, have become spheres on sticks.

It would be all too easy for C. *miniata* used for exhibition to become footballs on sticks. While such blooms can be undeniably beautiful in their own right they are less useful in floral arrangements and the problems of transporting such blooms would limit their potential as a commercial cut flower.

The other thing to remember with judging rules is that they come into play most consciously when judging plants or blooms that have obvious faults. A truly aesthetically pleasing exhibit tells you, you do not have to go and look for it.

The organization of competitive shows is a fine balancing act between classification, schedule writing and judging criteria as together they influence the long-term development of the plant. Once an exhibition culture is established it can be difficult to change direction or introduce new ideas. It is important that new forms can be displayed so that breeders can determine whether their developments have arrived at an appropriate time or place to be accepted.

In the same way that discussion of competitive shows has already taken up much of this article, exhibition based societies most frequently lose sight of any other area of activity. Publications are dominated by show reports and names of exhibitors, while discussion of the plant rarely gets past how to produce prize-winning blooms or plants. Other aspects are marginalized.

Show plants often become bad or inappropriate garden plants. While a good Daruma specimen can be a great pot plant it will not match something like the inter-specific hybrid C. *caulescens* x C. *gardenii* as a landscape plant, either aesthetically or functionally. Exhibition based societies frequently equate a good garden plant with a failed exhibition plant and pay scant if any attention to the use of their plant in a garden setting.

While the concept of perfection is an illusion, plants under intense breeding pressure can start to approach the contemporary paradigm of perfection. When this happens, there is nowhere much for breeders to go. This can be discouraging, especially for newcomers. Interest wanes and societies fossilize, becoming little more than social clubs for the old timers.

There are many facets of interest to be covered in a plant like the *Clivia*. At this time many plants are under threat in the habitats where they have evolved. Custodianship of specific wild sourced accessions of the various species is an important role for any club devoted to a genus. We have a responsibility to pass on species, unsullied, to future generations. The curation of collections is not easy and certainly not short term. Responsibility needs to be widely spread both between individuals and countries. There are many cases where a small collection in another country has acted as a Noah's Ark for various plants and animals.

Interestingly, while societies devoted to ornamental plants are dealing at their core with aesthetics, very seldom is there any discussion as to the beauty of individual cultivars, or the components that contribute to that beauty. This lack is especially noticeable at a time when a plethora of magazines are devoted to the connoisseurship of food, wine, interior decoration and comparable areas of aesthetic interest. Fortunately the *Clivia* has the very exciting area of inter-specific hybrids for discussion.

So far, the *Clivia* movement in South Africa has done very well in not allowing competitive exhibition to dominate its activities and in being outward looking. It is healthy that different ideas prevail in the North, South and East. Publications have been of a high standard, covering a broad sweep of activity and the daily exchange of ideas worldwide on the e-group initiated in South Africa has been a healthy adjunct.

However, we should not become complacent, the teenage years are ahead in South Africa, while in New Zealand we are just starting, so it is a good time to pause and assess what we wish to achieve in the years ahead.

Winner narrow petal *Clivia miniata* Section CCC 2002 Show. Grower: Riël Lötter

NATURAL INTERSPECIFIC HYBRIDS IN CLIVIA

C. *miniata* X C. *caulescens* hybrids from Mpumalanga

John Rourke, Compton Herbarium, Kirstenbosch

Hybridization through man's deliberate intervention has played a pivotal role in Clivia breeding during the past one hundred and fifty years. Now there are not only first generation interspecific hybrids but a whole series of back crossings, resulting in plants of complex parentage, using the four species that have until recently been available to growers.

However, natural hybrids, that is, hybrids found in the natural habitat where two species grow sympatrically, flower simultaneously, and have by chance been cross-pollinated by birds or insects, have not yet been reported in *Clivia* literature as far as I am aware. I was first alerted to the presence of naturally occurring *Clivia* hybrids by Willem Froneman, horticulturist at the Lowveld National Botanical Garden in Nelspruit in the eastern Transvaal province of Mpumalanga.

When the Lowveld Garden was established in 1969 some *Clivia miniata* plants collected in the wild on The Bearded Man were planted out in the garden. (The Bearded Man is a 1455*m* high peak on the Swaziland-Mpumalanga border, capped by a patch of Afromontane evergreen forest, inhabited by both C. *caulescens* and C. *miniata*). At the time the plants were collected all were in a vegetative state and were assumed to be C. *miniata* but on flowering one or two hybrids appeared bearing flared tubular flowers. Clearly, they were natural hybrids taken unsuspectingly from nature when not in flower. Could there be any more of these natural hybrids still growing in their natural habitat?

I made several trips to The Bearded Man to examine the *Clivia* populations there, but never succeeded in finding any hybrids. An interesting form of *Clivia miniata* predominates at this site. Growing at nearly 5000 ft (1455*m*) above sea level this form presumably has a higher degree of cold tolerance than the Transkei or Natal forms that occur in coastal forest at sea level. Individually the flowers are much larger than Transkei *Clivia miniata*, but the umbels are usually fewer flowered and flowering occurs much later, usually from mid October to November. In part this is a response to a cool, elevated habitat but it is also genetically fixed as plants brought back to Kirstenbosch have continued to be late flowering. These features alone make The Bearded Man populations of C. *miniata* particularly interesting.

Figure 1: Pale, blush pink form of C. *caulescens* from The Bearded Man, Mpumalanga.

On the moister southeast facing side of The Bearded Man summit, C. *caulescens* can also be found, growing on steep rock faces. It too flowers in late spring and early summer. A most unusual, arresting colour form - a pale blush-pink, occurs at this site (*Figure* 1). Both species were observed flowering in late spring but despite a careful search no hybrids could be detected.

Then, an opportunity arose to make a winter visit to The Bearded Man. Neither C. *caulescens* nor C. *miniata* were in flower in late July but to my great surprise several obvious natural hybrids were in full bloom. They were a delicate pale blush apricot, clearly betraying the pale blush-pink genes of the adjacent C. *caulescens* in their parentage.

Most significantly, the examples I saw were all very old plants with well developed rhizomes just over 50cm long - another legacy of C. *caulescens* in their parentage. They had probably been growing there undisturbed for well over 50 years, if not longer.

Two hybrid plants were selected from the wild population for cultivation at Kirstenbosch, both with pastel flowers. These have been grown on for several years and have flowered annually at different times between May and July and on one occasion in November. Both are exceptionally robust and vigorous with showy umbels carrying between 27 and 29 flowers (*Figure* 2).

The presence of such hybrids in nature immediately raises the question of pollinators. Orange-red tubular flowers like the normal colour form of *Clivia caulescens* are almost invariably pollinated by sunbirds although reliable confirmed sightings have not been reported in this particular case. Would sunbirds be attracted to pale pink forms? The best we can do is to assume that the likely pollen vectors in bringing about a C. *miniata* x C. *caulescens* cross (or *vice versa*), at this particular locality, would have been sunbirds.

Figure 2. Natural hybrid (C. *miniata* x C. *caulescens*), from The Bearded Man, Mpumalanga.

Another interesting feature of these hybrids is the shift in flowering time from late spring (both parent species) to early or mid winter (hybrids). Precisely why these hybrids should flower several months earlier than either parent is not clear but it certainly provides a useful extension to the flowering season. Willem Froneman tells me that some of his wild-sourced natural hybrids from the same locality flower several times a year but that there is no predicting as to when flowering spikes will be produced.

One might also expect to find natural hybrids between other species although I have not personally observed any and to the best of my knowledge none have been reported. *Clivia miniata* and C. *gardenii* grow together at numerous sites in Natal and the Transkei but their significantly different flowering times virtually preclude naturally occurring cross pollination from taking place. The only other possible combination is C. *nobilis* and C. *miniata*. These do have flowering times that overlap. I have observed these species growing sympatrically at just two sites; one, at Qora mouth in the Transkei, the other in the lower Kei River valley at the confluence of the Gaguga River and an unnamed stream. In both instances no obvious natural hybrids could be found. It is of course entirely possible that like the C. *caulescens* x C. *miniata* hybrids from The Bearded Man these would bloom outside the main September flowering period and would therefore not have been evident at the time of my visit. But this is mere conjecture until field observations prove otherwise.

Observations on naturally occurring *Clivia* hybrids in wild populations are woefully scarce as are reliable data on pollinators. This is an open field where sound observations and photographs of pollinators in action by naturalists and wildlife photographers can contribute much to our knowledge of Clivias in the wild.

Interspecific *Clivia:* Grower: Mick Dower.

NOTES ON POLLINATION AND POLLEN TUBE GROWTH IN *CLIVIA* MINIATA

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Some information about the structure and function of the *Clivia miniata* pistil (stigma, style and ovary) is supplied in an article in the *Clivia Yearbook* No 3. *Figure* 4A in that article shows the stigma papillae (hairs) on one of the three lobes of the stigma and *Figure* 4B shows pollen grains adhering to the stigma papillae after hand pollination. In the present communication, we provide illustrated notes on pollination, germination and pollen tube growth in the stigma and style and also include a revised concept of the *Clivia* stigma.

In discussions amongst Clivia Society members, questions like when and how frequently to pollinate are often raised. During the past flowering season (September 2002), Marine, one of the students in our Department spent a day in my garden pollinating freshly opened flowers. Before pollinating a flower, the stigma was inspected to make sure that three stigmas had separated (stigmas with style lobes not yet separated are not receptive) and that 'natural' pollination has not happened. Since there was no insect activity on the flowers, no steps were taken to cover the pollinated stigmas. Pollinated flowers were collected one hour, two hours, five hours, twelve hours and twenty-four hours after pollination in an attempt to determine the rate of pollen germination and pollen tube growth. The style and stigma of each flower was carefully removed from the flower and preserved in a solution containing acetic acid, chloroform and alcohol for a few days. They were then softened in concentrated solution of Potassium hydroxide and cleared in commercial **Jik** (liquid chlorine solution). The cleared styles were then stained with Aniline Blue and observed with a fluorescent microscope fitted with a digital camera.

On the day the pollination was done, Pretoria experienced a cold spell, with the day temperature plummeting to 15ºC. In spite of the cold weather, all stigmas collected one hour after pollination, except those that were not yet fully receptive at the time of pollination, contained germinated pollen grains with pollen tubes well established within the stigma.

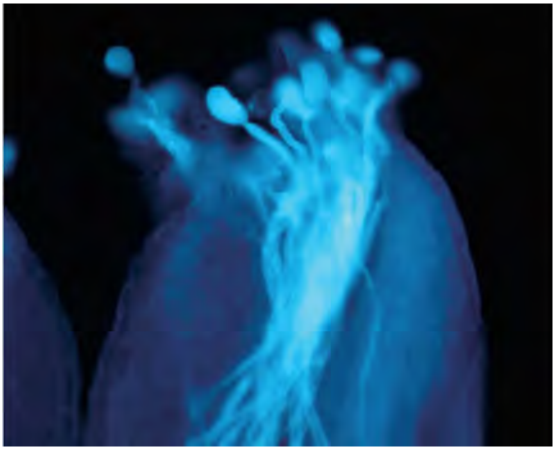

Figure 1: One style lobe penetrated by pollen tubes coming from pollen grains on the stigma

Five hours after pollination the pollen tubes had already reached one third of the length of the style on their way to the ovary (*Figure* 1) and had reached the ovary after 24 hours.

In the previous article it was mentioned that the *Clivia* stigma is three-lobed. In this investigation it became clear that it is actually

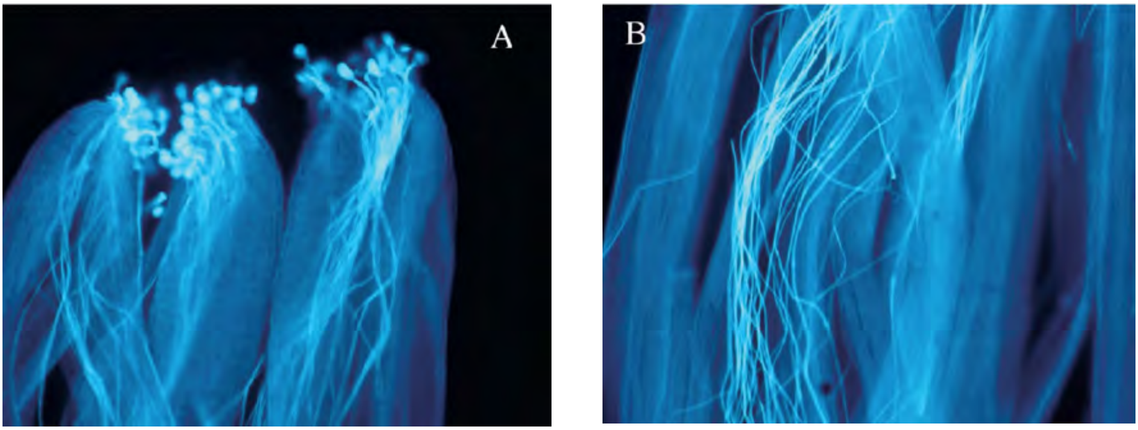

Figure 2. Fluorescing pollen tubes in *Clivia miniata* stigmas and style. Material collected 12 hours after pollination. A showing germinated pollen grains on stigmas and in style lobes. B showing pollen tubes one-third the length of the style down to the ovary.

the terminal end of the style that divides into three units, each terminating in a separate stigma. The *Clivia* flower, therefore, has three separate stigmas, each operating independently from the others (*Figure* 2A). The implication of this is that each stigma can be pollinated with a different kind of pollen. In the style the three bundles of pollen tubes coming from the three independent styles, remain separate. Although not yet confirmed in this study, it could be possible that the pollen tubes from one stigma will serve the ovules in the corresponding ovary locule. (See *figure* 2 page 17 in *Yearbook* 3)

Looking at the number of pollen tubes growing down each style lobe (*Figure* 2) and considering the number of ovules to be fertilized per locule, one single pollination operation should be quite sufficient for a good seed set, provided viable pollen is used and receptive stigmas are pollinated.

C. *miniata* '**Floradale Apricot**'. Breeder: Gerald Muller. Grower: Mick Dower

A VISIT TO MR. YOSHIKAZU NAKAMURA IN JAPAN

Charl Malan

I left Grahamstown on Friday 15 March 2002 in great anticipation of my long overdue visit to my *Clivia* friend, Mr Yoshikazu Nakamura. The journey by air took me via Johannesburg and Hong Kong to Tokyo where I arrived 20 hours later on Saturday.

The plants which I took with me as gifts were cleared very efficiently by the Plant Quarantine Office at Narita Airport and an hour later I was met by two friends of Mr. Nakamura's, namely Masashi Yamaguchi and Shigetaka Sasaki. Masashi had handled all English /Japanese translation in my preparations for the trip and had most kindly offered to put me up in his home in Yokahama City He also accompanied me and interpreted for me during most of my visit.

Shige likewise provided all transport during my stay and is an excellent driver. Both of them are fervent *Clivia* enthusiasts and from the moment they met me we went on a *Clivia* roller coaster!

From the airport we drove straight to Shige's flat to see his *Clivia* collection. The route took us around the sweep of Tokyo Bay and on this clear night, the dazzling display of lights was wonderful. Shige stays in a suburb of Tokyo and keeps an astonishing number and variety of *Clivia* in his flat. As he is unmarried, no one seemed to mind!

Shige and Masashi run the 'Clivian' website and Shige in particular is planning to breed *Clivia* at some stage in the future. He has a most impressive collection and makes use of Mr. Nakamura's expertise in his breeding programme.

Shige dropped Masashi and myself at 01:00 at Yokohama City and after a shower I got to bed at 01:30 on the Sunday.

Masashi stays with his parents in a beautiful three-story house, I was allocated a comfortable room on the ground floor where I found the following:

A futon bed in the middle
A Buddhist temple set in one wall
Two Clivias in full flower on the floor
Wonderful artworks throughout.

Needless to say, I did not fall asleep for some time as a result of the 20-hour flights and excited anticipation of the next day"s visit to the *Clivia* Breeding Plantation. I woke up early and went for a walk in the neighbourhood. Other early risers were walking dogs, going to work, preparing the park for baseball practice, and so on. Window boxes, both in and outside were in full flower and it was obvious that Spring was in the air! All over the neighbourhood, I saw small container gardens at entrances to houses and the most common denominators were - guess - *Pelargonium* and *Aloe!*

The cherry blossom spectacle was only just beginning and during my stay I only saw one tree in full bloom: what a sight!

The weather was wonderful throughout my stay and the heavy jacket that I carried wherever I went, was totally unnecessary. By the way, I only met Masashi's parents then as we had come in too late the previous evening.

Shige arrived, and at 09:30 we were on our way to Chiba. We grabbed breakfast at a takeaway - cold tinned coffee is very popular and a supply is always available.

Once again we drove through Tokyo, which is one endless metropolis. Once we crossed into Chiba Prefecture, the city began giving way to countryside. The peninsula consists of rolling hills with rice paddies in the valleys (dry in March), and indigenous forests on higher ground. Bamboo of all sizes and descriptions abound in these forests. I saw beautiful golf courses, Olympic training facilities used by athletes from all over the world and the Japanese enjoying a wonderful sunny and warm day in the open.

Charl Malan at *Clivia* Breeding Plantation

We finally arrived at the *Clivia* Breeding Plantation, where Mr, Nakamura and his father met us. Yoshi was very excited and couldn't wait to show us all the *Clivia* in flower. For the next two hours we examined virtually every *Clivia* in the collection. He had moved several plants into a special warm tunnel to open their flowers in anticipation of my visit. Particularly impressive were the Vico hybrids - large yellows and oranges with the latter in wonderful varied colours. It is obvious that this strain is his favourite for breeding top quality flowers, and the range produced is amazing.

Apart from the flowering plants, the popularity of variegated plants in Japan is reflected in the huge breeding stock and many seedlings on display.

I made some interesting observations and picked up handy tips. Plants in Mr. Nakamura's large glass house are kept under a very dry regime, to combat the inevitable problem of disease associated with overwatering, excess humidity, etc. The temperature in winter is manipulated by the use of a coal fired heating plant.

We exchanged gifts and I took many photographs. Next we departed for the coast with Mr. Nakamura who was going to host us to lunch and show us some *Clivia* sights on the way. We meandered through a beautifully forested district until we reached the sea. The coastline is quite steep and in many places on the coastal road we drove through tunnels. The sea was a beautiful turquoise colour with small fishing harbours in every cove.

Mr. Nakamura hosted us to lunch in a traditional Japanese seafood restaurant. Most of the fare on the menu was swimming in a large aquarium in the foyer and as dishes were ordered the chef would net what he needed: a fish, crayfish, clam, etc.

We took off our shoes and were seated at a low table in one of the rooms in the restaurant. The menu was exclusively Japanese and my hosts offered to order for me. We were immediately served hot green tea and also ordered beer. My food on a tray consisted of the following:

> A small bowl of fish soup
>
> A large dish containing savoury rice on top of which were two large fillets of white fish grilled in a puffed out batter (tempura). Around this dish were arranged smaller dishes with dried fish sauce, small blocks of turnips, various other sauces and condiments such as sliced tomato
>
> A side dish of two grilled maasbankers (horse mackerel).

I could immediately see that it was far too much for me to handle but I battled through it with a small teaspoon and cake fork, which were the only Western utensils available. The fish was delicious.

Mr Nakamura, Shige and Masashi ordered dishes, the main ingredients of which consisted of raw fish of different descriptions. They are super deft with the chopsticks and finished their meal before I was halfway through mine!

Through all this we had discussions about my family origins. They were absolutely fascinated with the Huguenot history and the fact that the Malan family has been in South Africa for 11 generations.

At a neighbouring table a family of father, mother and daughter consumed copious quantities of beer with trays of food similar to those of my hosts, but they were also served a fish dish arranged on a large platter placed in the centre of the table. The centre of the arrangement was a rock cod, which I had seen in the aquarium earlier. Its fillets had been sliced into thin slivers and replaced on the fish and were now being picked out with chopsticks.

The name of the restaurant is Funayoshi 'good ship', and is situated in a village with the name of Arnatsukorninato - 'Small Port of Heavenly Seaside'.

The coast around there is popular with the Japanese for watching the sun rise at New Year.

From there we proceeded further East until we reached the flower market which Mr Nakamura had promised to show us.

The shopping centre is situated at the waters edge and had a large number of *Clivia* on display (not for sale), but also a large number of plants for sale. Many of the plants were in full bloom and ranged from large multipetals, through akebono variegated to seedlings of all descriptions.

I purchased a broadleaf Akebono seedling (±18 months) for 3 000 yen, i.e. all of U.S$23.00. There were many more expensive plants, way beyond my means. Akebono variegation is extremely popular in Japan and for the uninformed it refers to horizontal, instead of the more common vertical, variegation in the plant leaves. Mr. Nakamura bought quite a few multipetal plants.

There were many South African plants on sale including a *Gloriosa* hybrid with cerise pink and yellow flower petals, the whole colour range of *Zantedeschia* and beautiful zonal Pelargoniums of all descriptions.

All too soon we had to leave. Outside a cool wind had sprung up and we were greeted by a wonderful sight - large numbers of small brown kites were hanging in the sky. This must be a marine bird species, which I think I've seen in books on Japan.

Although it was 5 pm, Mr Nakamura decided that we must visit a *Clivia* friend of his in the nearby hills. We eventually turned off the main road onto a narrow elevated concrete road onto which our car barely fitted and it took all of Shige's skill to negotiate this road, which meanders through rice paddies and ends on a farm up in the hills.

Mr. Nakamura found his friends, husband and wife, still at work in their tunnels of *Clivia*. Mr.Nakajarria is probably Japan's largest grower of multipetal *Clivia* and has a huge collection - we toured only 4 of the larger tunnels! The quality and size of the flowers are impressive and we were able to buy a few seedlings.

By the time we bade them goodbye, it was almost dark, and it took another hour's driving to get back to the *Clivia* Breeding Plantation. There we washed and packed my plants under spotlights rigged up by Mr. Nakamura. He then took us to dinner in nearby Yokohama City in a Spur style restaurant where we did not have to take off our shoes! The menu was a huge laminated plastic book with a photograph of every dish. I chose a pork schnitzel and my hosts again had traditional meals with varieties of Sushi / fish, eggs, etc.

Mr Nakamura insisted that Shige and I visit him again on the next day. We finally bade goodbye to Mr. Nakamura who had followed us in his bakkie (LDV), and headed for home. Shige dropped Masashi and myself at home at 02:00. After showering, I climbed into bed at 02:30. My head was still spinning from the flights and sleeping was difficult. I woke at


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Masashi, Yoshi, and Shige

06:00 and again spent a while outside. It was my 47th birthday and a glorious, warm and sunny day.

Masashi could not accompany us on the Monday, as he had to work. His mother cooked us breakfast, after which we bade our farewells. Shige picked me up at 08:30 and again we headed out to Chiba. At the *Clivia* Breeding Plantation we did another detailed tour of the Glasshouse and discussed the merits of many plants in some detail. I was most fortunate to receive some wonderful plants as gifts.

We said our final goodbyes and Shige and I proceeded to Narita Airport where we had lunch and he saw me off at 15:00. I arrived back in Port Elizabeth the next afternoon.

A mad, exhausting but wonderful 5 day trip!

Thumbnail photograph 119, p. 83: Winner Miniature *Clivia* not in flower Section KZNCC 2002 Show. Grower: Yoshikazu Nakamura.

Below: Winner C. *miniata* any other colour with a green throat Section. Metro 2002 Show. Grower: Pikkie Strumpher.


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CLIVIA MUTATIONS AND MODIFICATIONS

Wessel Lötter

Colour

In my article on *Clivia* mutations and colour variations, (*Clivia Yearbook* 1998), I explained flower colour to be the combined effect of anthocyanin in the epithelium (upper layer) and carotenoids in the mesophyll underneath.

Further information has now revealed that:

a. The anthocyanin in *Clivia* is synthesized in to two end products, namely pelargonidin in the flowers of C. *miniata* and cyanidin in the berries and seedling bases. Some of the tubular species however contain both pelargonidin and cyanidin in the flowers.

b. Colour of the flowers is also influenced by the pH of the cell. A lower pH (acidic) produces darker shades and a higher pH (alkaline) paler shades.

By extracting the pigments from the cells, one can make a solution that changes colour according to the pH. When experimenting with *Clivia* pigments, a solution with pastel flower pigments changed to red by adding acid. Yellow flowers showed no change because they do not contain any anthocyanin.

There are 6 genes that influence the pH in the cell. To find out what role intracellular pH plays in the expression of flower colour, scientists inserted a jumping gene on the pH-6 gene. This abolished the function of the pH-6 gene and resulted in very pale flowers. When the jumping gene jumps out of the pH-6 gene's position the function of the gene is restored and spots appeared. It was concluded that paler flowers could be the result of a mutation on one of the 6-pH controller genes.

Griesbach, who has been working for 15 years to solve the flower colour puzzle, states that the colour is influenced by the interaction of pigments, cell pH, light and temperature. The slightest fluctuation in any of these factors will cause the colour to alter. Griesbach used petunias for his research, proving that specific shades of colour resulted as the combined inheritance of pigments and cell acidity.

When Griesbach and Koopowitz did specific work on the genus *Clivia*, they confirmed that the colour is drastically influenced by the pH in the vacuole. They have also found that there may be more than ten co-factors influencing the colour in a single *Clivia* flower and that the pelargonidin in a *Clivia* flower can be divided into two types: Pelargonidin-3-glucoside and pelargonidin-3-rutinoside. The ratio of these two in the cells can also influence the colour.

Pastel coloured flowers are therefore not necessarily the result of a single factor, but may vary genetically from one pastel to another. They remain scarce and are not easy to breed in numbers. The exception is Chubb Peach, which is a single gene mutation on the same locus (position on the chromosome) as group 1 yellows. As it is dominant over group 1 yellow, it is now being bred in significant numbers.

Attempts to breed pastels by crossing Chubb Peach to other pastels such as Naude's Peach and Wittig's Pink resulted in mostly orange flowers. Another example of how different these pastels may be was demonstrated by crossing Natal Yellow as pod parent to two different pastels. All the crosses with Naude's Peach were very pale, about midway between Naude's Peach and orange. In vast contrast the Meyer's Peach crosses with Natal Yellow were dark orange-red. The inheritance suggests that Naude's Peach is co-dominant and Meyer's Peach recessive.

The green in the throats of some flowers is not an additional pigment but is due to the

C. *miniata* '**Naude's Peach**'.

C. *miniata* '**Meyer's Peach**'. Note the dark orange-reds in the background from which it originated.

C. *miniata* '**Natal Yellow**' x '**Naude's Peach**' (left) and '**Natal Yellow**' x '**Meyer's Peach**' (right)

presence of chlorophyll. Chlorophyll can appear in any parts of a plant that is in contact with light. Chlorophyll is present in many developing flowers and is usually broken down as the flower matures. In the throats of *Clivia* flowers, chlorophyll appears as green stripes that contrast well with yellow, pastels, orange and even reds. Many modern day lilies have large green throats and are very popular. We still have a long way to go to increase the green in the throats of *Clivia* and a lot to learn about the inheritance of chlorophyll in the flower.

Chlorophyll is present in plastids within the cytoplasm of the plant cells. Plastids possess their own DNA and this is inherited independently of the nucleus genes. As very little or no plastids are transmitted by pollen to the progeny, the inheritance of green throats maybe maternal.

An apparent problem with green in the throat is that it is not always persistent. In many of these phenotypes it tends to disappear with aging. Others do not always flower green throats every year, indicating possible environmental influence e.g. fluctuations in temperature or light intensity.

The green throats, which the late Gordon McNeil bred, he named **Green Girl**. Bill Morris obtained seed from these in the early 80's. These seedlings flowered with a green throat every year and it is persistent. Bill wrote that the seedlings from a green throat pod parent also flowered with a green throat. This confirms maternal inheritance.

Yellow *Clivia* (group 1) have yellow berries, except for the Howick yellow, which has peach coloured berries. Howick yellow might be a very pale peach, which appears yellow, as a seedling from Howick x yellow flowered peach. Natal Yellow (group 2) sometimes shows red spots on some of its tepals. The berries are always heavily spotted when left on the plant, indicating an incomplete mutation or a 'leaky' gene.

This defective gene at the beginning of the anthocyanin pathway seems to have a different effect on the final products: pelargonidin and cyanidin, as the berries are always heavily spotted and the flowers mostly yellow.

We know that yellow flowers with red berries exist and also orange flowers with yellow berries. This is caused by a differentiation in the anthocyanin pathway to produce either cyanidin or pelargonidin as end products. The first few steps in the anthocyanin pathway for these two pigments are the same. A mutation at the beginning will cause yellow flowers and berries. Further in the pathway genes alter the pathway to produce pelargonidin in the flowers and cyanidin in the berries. The pathway now becomes two pathways. If a gene becomes non-functional in the cyanidin pathway the berries will be yellow but the flowers will still be orange. Likewise if a gene mutates in the pelargonidin pathway the flowers will be yellow and the berries red.

Modifications

Every living organism possesses modifying genes, these enable it to adapt to environmental changes through natural selection. Man has always exploited these genes to alter living things to his own taste e.g. domesticated animals and agricultural crops. *Clivia* is no exception, for instance the **Daruma** cultivar has been selected for short broad leaves. Modifying genes enabled Clivia breeders to select for broad leaves, multipetals and many more unusual strains.

Regulatory genes can also cause some modifications. These regulatory genes are responsible for the structural differentiation of the different parts of the plant for instance sepals, petals, stamens and the ovary with its pistil. Many double flowers are the cause of modified regulatory genes, where the stamens have become petaloids. The so-called green flowers, which are more leaf like in appearance, may well be the result of such a modification. These green flowers usually fail to open properly and persist on the ovary after pollination.


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Multipetals are possible because of modifying genes, note that the stamens also increased (photo by Yoshikazu Nakamura).


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This double flower appears to be a combination of multipetals and a modification of some of the many stamens into petaloids. Note the anthers at the tips of some of the petaloids.

In many cases the inheritance of modifying genes is co-dominant. Further breeding with unusual phenotypes such as green flowers and multipetals will teach us more about their breeding behaviour. What the future holds for *Clivia* depends on the breeder's ability to recognise and select for appealing traits. There is no doubt that many more modifications will appear.


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Winner C. *miniata* Peach with two umbels Section KZNCC 2002 Show. Grower: Bertie Guillaume.


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C. *miniata* pastel. Breeder and grower: Roly Strachan.


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Winner orange C. *miniata* Section KZNCC 2002 Show. Grower: Coenraad Vermaak.


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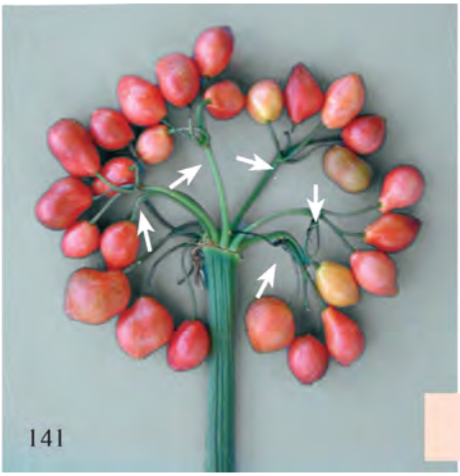
Above: Winner yellow C. *miniata* with broad petals Section NCC 2002 Show. Grower: Pat Gore.

Left: Winner C. *miniata* peach Section KZNCC 2002 Show. Grower: Marie van der Merwe.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Clivia mirabilis fruiting inflorescence showing five secondary branches (pseudo-umbellula) each bearing four to five berries.

SECONDARY PSEUDO-UMBELS IN CLIVIA MIRABILIS INFLORESCENCES

John Rourke,
Compton Herbarium, Kirstenbosch

The occurrence of secondary flower heads in the inflorescences of certain petaloid monocotyledons is an unusual and quite rare condition. *Agapanthus* does occasionally produce secondary structures but this phenomenon has not yet been reported in *Clivia* as far as I am aware. The inflorescence in *Agapanthus* is technically a pseudo-umbel while the secondary branches are referred to as pseudo-umbellula (Muller-Doblies, 1980). Precisely the same terminology applies to *Clivia*.

Fruiting inflorescences of C. *mirabilis* were collected at Oorlogskloof by Northern Cape Nature Conservation staff in February 2003. The seed was then sent to Kirstenbosch as part of a newly initiated programme to cultivate and distribute this species to growers world wide. Among the fruiting heads received were five berry bearing heads that were found to have small secondary pseudo-umbellula branching from the main umbel.

Normally in *Clivia* the umbellate inflorescence contains a number of flowers borne individually on flower stalks (pedicels) arising at the apex of the inflorescence stalk (peduncle). In the aberrant examples between three and five small secondary peduncles were produced at the apex of the main peduncle, carrying between four and eight flowers. The secondary peduncles ranged from 25-30*mm* in length, while the pedicels were usually between 15 and 20*mm* long, rather shorter than the pedicels in a normal inflorescence.

These secondarily branched inflorescences were apparently collected from different parts of Oorlogskloof, so this curious morphological character is not unique in the population. It remains to be seen whether the characteristic of producing secondary pseudo-umbellula is an inheritable one or whether it is merely the result of a developmental abnormality that crops up randomly. We propose to keep the seeds from these inflorescences separate in order to observe their future development so as to monitor the possible inheritance of this character.

Reference

Muller-Doblies, D. 1980. Notes on the inflorescence of *Agapanthus*. Plantlife. *Amaryllis Year Book* Vol. 36: 72 - 76.


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C. *miniata* '**Westonbirt Perfection**'. Grower: Mike Jeans.

WAS THE PLANT NAMED CLIVIA NOBILIS IN 1828 'SURREPTITIOUSLY OBTAINED' FROM KEW?

John van der Linde

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. 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.“* (1)

The plant flowered for the second time in July, more or less the time one would expect a *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 *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 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 reguested 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 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. Burchett's 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. If 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."*

'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. lames 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.(2)

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 Amarylllidaceous 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 reguested 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)ohn Rourke helped me, also Prof. Donal McCracken, who is researching the life of lames 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 (1 182)

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.*

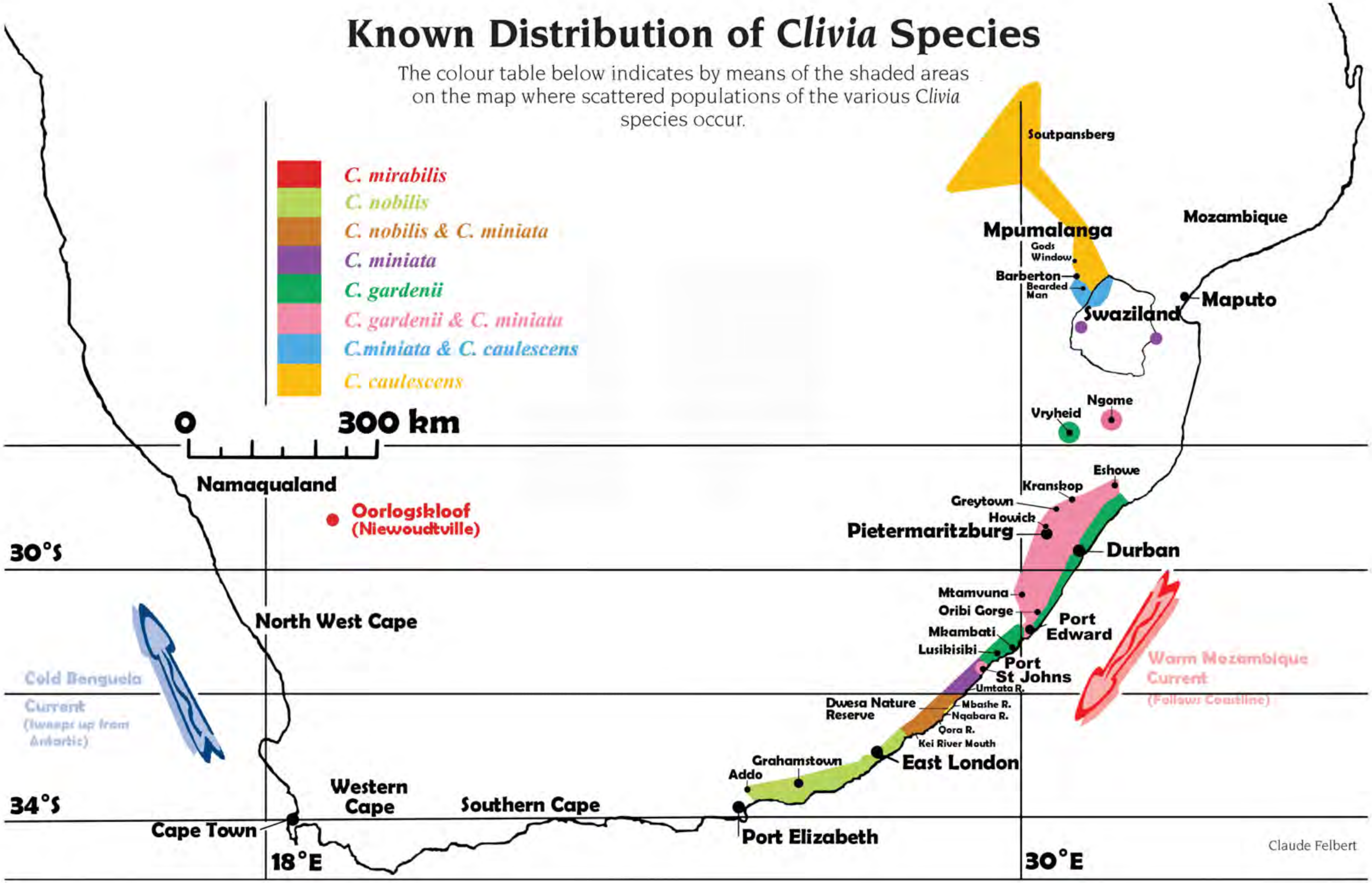
I also looked, without success, for some mention of this episode in a number of books on Hooker and Lindley.

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 Ait on, William Hooker and John Lindley', in Newsletters of the Clivia Society (Vol. 11, nos. 3 and 4 of 2002).

Known Distribution of *Clivia* Species

The colour table below indicates by means of the shaded areas on the map where scattered populations of the various *Clivia* species occur.



Claude Felbert

FIRE AND THE DISTRIBUTION OF CLIVIA IN SOUTHERN AFRICA

Dee Snijman

Dr. Snijman is a senior researcher in plant systematics at the Compton Herbarium, National Botanical Institute, Kirstenbosch

Introduction

The very recent discovery in the north western Cape of *Clivia mirabilis*, occupying a habitat quite unlike those of the other four species of *Clivia* from equable eastern regions of southern Africa, has generated considerable interest since it first became widely known in May 2002. The nearest populations of any of these clivias are those of C. *nobilis* some 800km to the east of Nieuwoudtville, near Grahamstown. What makes this discovery so remarkable is that despite more than a century of botanical exploration in the Cape, no records of wild clivias have yet been found in the southern Cape (see distibution map on pages 96 & 97), even though the warm-temperate evergreen forests there appear to offer suitable habitats for their growth.

In his description of the species, John Rourke ruled out the possibility that the Oorlogskloof clivia had become established in the north western Cape relatively recently through long distance dispersal of seed. Instead, he speculated that the north western Cape clivia was probably a survivor of the warm and moist climate that prevailed widely some 20 million years ago, when much of the interior of southern Africa was covered by subtropical vegetation (Rourke 2002a, 2002b). About 13 million years ago, the cold Benguela Current, however, developed along the West Coast. The climate became more arid and the subtropical forests retreated eastwards, whereas in the west C. *mirabilis* withdrew to well-protected, sparsely wooded patches of vegetation.

Using DNA sequence information from the chloroplasts of all five *Clivia* species, Ferozah Conrad and Gail Reeves (2002) analysed the pattern of relationships within the genus. Their work showed that C. *mirabilis* is the closest genealogical relative of the ancestor of *Clivia* and as such appears to be a remnant of a once more widespread ancestral species.

The Puzzle of the Southern Cape

To understand more fully how C. *mirabilis* came to be isolated in the north western Cape it is interesting to ask why clivias are unknown in the southern Cape. What conditions have prevailed in the past - and still prevail - that may have led to the extinction of an ancestral clivia from the southern region and why were the plants themselves unable to cope with these conditions? I propose that the impact of fire on the Cape forests since the development of a mediterranean-type climate in the south western Cape and the inability of clivias to cope with fire have been the major factors that have led to the natural distribution of clivias today (Snijman In press).

Struggling with Fire

My study of other genera of southern African Amaryllidaceae has made me appreciate how important the bulbous habit has been to their success in the harsh environments of the north western Cape and Namaqualand. For instance *Haemanthus*, a close relative of *Clivia*, and *Cyrtanthus* both occur in the northern western Cape, yet they are also richly represented in the western and southern Cape. They are typical geophytes and possess an underground bulb that becomes dormant during the unfavourable dry months when the aerial parts of the plant die back to ground level. In this way the buds are insulated below ground from environmental extremes and particularly against fire, which is such an important feature of the Cape Region. In several amaryllids, the commonly called fire-lilies, this adaptation has become so finely tuned that they actually depend on fire for flowering - a response that may allow them to exploit pollinators and set seed before other plants have begun to recover from the fire. With their evergreen habit, however, clivias are not at all equipped to survive fire - if exposed to the sun and heat their leaves are damaged and the short rhizome offers few reserves for vegetative regeneration. In effect, clivias share none of the benefits of dormancy by which their bulbous relatives manage to survive intense, dry season fires.

In addition, the seeds of *Clivia* are recalcitrant, which means they fail to dry off and enter dormancy and thus cannot be stored. In nature the inability to build up seed stores over time makes plants like clivias, which are unable to regenerate rapidly by vegetative means, especially susceptible to unfavourable conditions and may ultimately lead to the local extinction of isolated populations. In short, the morphology of clivias at every stage of their life suggests that they lack any specialised features that are tolerant of fire.

C. *mirabilis*.

Forest Fires

Modern evidence shows that most vegetation types in South Africa have burned at one time or another. The frequency with which this takes place, however, differs greatly among different veld types (Edwards 1984). In general, the greater the interval between fires, the greater the fuel load and the more intense the fire will be (Frost 1984).

The Oorlogskloof Canyon in the semiarid north western Cape has probably seldom burned, since the fuel loads in the scrub forest, where C. *mirabilis* grows, are too low to sustain fire. Furthermore, the sheer 30 metre cliffs that cap the canyon provide an unbroken barrier to the occasional fires that break out in the arid fynbos on the Bokkeveld plateau above. Moreover, the slopes on the opposite side of the Oorlogskloof River are covered by widely spaced, succulent shrubs that are non-flammable, hence the potential for fire in the kloof itself is negligible.

In the east, summer-rainfall grasslands surround the evergreen forests along the coast and Great Escarpment. Here the intensity and duration of the dry winter season and frost period determine how inflammable the grasslands are during autumn, winter and spring. The narrow coastal strip from the eastern Cape to Kwazulu-Natal, which is home to four *Clivia* species, has no severe dry season, however, and the absence of frost results in the grasslands here being less flammable than those further inland (Edwards 1967). When coastal grasslands burn, the fires are cool and make little impact on the adjacent forests. Clivias are slow-growing, long-lived plants and the dense stands of clivias that flourish in the lightly shaded gaps of these forests suggest that they have persisted here for hundreds of generations, undisturbed by fire.

Unlike elsewhere, the fynbos in the southern Cape becomes extremely dense and tall and forms extensive corridors between the forest patches. From historical records it is known that fires driven by bergwinds have devastated large areas in the southern Cape. The greatest forest fires on record occurred in the southern Cape in February 1869 and burnt along the coastal areas from Swellendam to Uitenhage (Edwards 1984), This event provided graphic evidence of the extensive spread of fynbos fires under particularly hot dry weather conditions following several wet seasons of fuel accumulation and the impact they have on forest patches. Other evidence of the occurrence of fire has come from fossil charcoal deposits found in seemingly mature forest throughout the southern Cape. Carbon dating of these deposits indicated that they came from trees burnt approximately 8 500 to 1 400 years ago (Scholtz 1983). There is also good evidence that the incidence of recurring high intensity fires has led to the extinction of many tree species that used to occur in the forests of the Cape (Cowling *et al* 1996). Furthermore, studies using recent data on the species composition at the forest margin and core also indicate that fire is important in influencing the diversity in the southern Cape forests, particularly in their understoreys (Watson & Cameron 2001). Altogether these findings suggest that fires have had a major impact on the floristic and structural composition of forests in the Cape Region.

Conclusion

Finally, until someone finds populations of clivias growing naturally in the southern Cape, I suggest that recurring intense fires in the fynbos have served to isolate clivias in the north western Cape from those along the eastern coast of southern Africa. In this scenario it seems that C. *mirabilis* has persisted at Oorlogskloof for hundreds of generations, untouched by fires that probably destroyed its ancestor which once occupied the southern Cape during more favourable times.

Acknowledgements

Wessel Pretorius and the Northern Cape Directorate for Environment Conservation are thanked for help when visiting the Oorlogskloof Nature Reserve. Colin Paterson-Jones kindly improved the manuscript.

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Winner narrow petal orange C. *miniata* Section, EPCC 2002 Show. Grower: Willie le Roux.

INSECT CONTROL ON CLIVIA

THE ORGANIC AND CHEMICALLY FRIENDLY WAY

Johan Gerber

Johan Gerber is the Manager: Chemical Product Development of Straathoffs

Insect populations hardly ever kill plants, but some species can be very destructive to the general performance of plants, and more specifically affecting leaf and flower production adversely. Most of these insects have natural enemies that can keep them under control if they are present in low numbers. Many of them are very important sources of food for wild life, *e.g.* caterpillar larvae for bird species. However, when insect numbers increase dramatically, it is time to act to safeguard plants.

Gardeners have many products to select from that they can use to combat pests. There are organic or biological and chemical insecticides. Select those products which have the lowest, or no impact on non-target organisms.

Chemical insecticides often have the disadvantage that they are harmful to beneficial insects, wildlife, birds, fish, etc., and can also harm humans when inhaled or ingested or when absorbed through the skin. Furthermore, insects can develop a resistance to chemical insecticides. This results in a temptation to use even more toxic chemicals, some of which are not registered for use in the garden, which puts the public at risk of air and water pollution in the urban environment. These chemicals can also cause secondary poisoning of mammals when crops and foodstuffs absorb them.

The aim of organic and biological pest controls is therefore primarily to make the plant unattractive to insects or to kill insects by smothering rather than poisoning them or, when poisoning is necessary, to use natural ingredients which biodegrade (break down) and become harmless a short time after achieving their objective.

Products that are pest specific or those which are very unlikely to cause secondary poisoning and are not persistent in the environment are normally more environmentally friendly.

Red spider mite, mealy bug, and various other insects:

Margaret Roberts Organic Insecticide is an organic broad-spectrum insecticide for the control of very small-bodied insects. It has a preventative and controlling effect and can be used on all ornamentals, herbs and edible crops. Its active ingredients are garlic juice and canola oil. Garlic has a repelling effect, preventing insects from landing on host plants, whereas the canola oil kills small-bodied insects and insect eggs on contact by suffocation. The formulation is completely non-toxic to humans, wild life, birds, fish and beneficials (frogs, lizards, chameleons etc.).

Small-bodied beneficial insects can be killed on contact, but no poisoning through the skin or secondary poisoning is possible. Edible crops can be harvested 24 hours after the last application.

This product is officially registered for the control of **aphids, red spider mite** and **whitefly**, but will also kill insects like **mealy bug** and **scale** on contact. It has no killing action on the bigger leaf and flower eating insects like **chafer beetles**, but the garlic will assist in preventing adult moths of caterpillar species from laying their eggs on host plants

Ludwigs Insect Spray is available as a more 'toxic' organic broad-spectrum insecticide. It also contains not only garlic and canola oil but also natural pyrethrum. *Pyretfirum* in the formulation extends the insect spectrum from mainly small-bodied insects like **aphids** to bigger leaf and flower eating insects like **chafer**

beetles. The pyrethrum comes from the chrysanthemum flower and adds to the toxicity of the organic formulation. The main advantage of pyrethrum is that it biodegrades completely within 24 hours, leaving no poisonous residues on crops sprayed.

Pyrethrum has an effective stomach poisoning action for 12 hours after application, which means that it can kill bigger bodied chewing insects when they feed on the plant within that time. It kills on contact and therefore it can be hazardous to beneficial insects, including ladybirds and bees. Secondary poisoning is very unlikely, however, because the active ingredient breaks down completely within a very short period. Thus it is non-persistent in the environment and target insect cannot build up any resistance to it.

Biological control of Lilyborer:

By far the most environmentally friendly way of controlling leaf-eating caterpillars is with ***Margaret Roberts Biological Caterpillar Insecticide***. This is a daughter registration of the world's leading biological insecticide ***Dipel*** **DFTM**, a product of the Valent Biosciences Corporation. Its active ingredient is a bacterium, which causes the active feeding larvae to stop feeding directly after ingestion. It is completely harmless to birds, fish, wild life, beneficial insects, humans and pets.

You can protect your precious *Clivia* plants against the destructive larvae of **lilyborers** by spraying your plants with this insecticide every 7 to 14 days using 5*g* (10 *ml*) per 10 *litre* water. It is highly effective against young larvae that are actively feeding, but does not control larvae that have stopped moulting.

Edible crops can be harvested directly after the last application. It will also control active feeding larvae of **orange-dog caterpillar** on citrus, **American bollworm** on tomatoes and cabbage, **diamond-back moth** larvae on cabbage, **semi-looper** worm on green peppers (all present from September to March), as well as **lawn caterpillar** on lawns (present from January to April).

Ludwigi's Rose Spider Mite is very effective in controlling **red spider mite**. It's active ingredient Etoxazole and is one of the safest chemical miticides. The toxicity towards humans and non-target organisms like birds fish and wild life is very low. It is harmless to bees as well as natural enemies of red spider mite. One to two applications per month are sufficient for optimum control of red spider mite. It kills the eggs and immature stages of red spider mite and various other mite species like **European red mite** as well as **Bryobia mite**.

It is ideally used at an early stage of infestation *i.e.* when small numbers of adult males and high numbers of eggs are present.

Organic feeding:

For general feeding of *Clivia* in your garden or containers, use **Margaret Roberts Organic Supercharger**. It contains all the macro- as well as the micronutrients together with a growth stimulant.

Its formulation is virtually identical to that of **Nitrosol™**, a leading brand of organic plant food, the main difference being the addition of a comfrey extract to increase the organic content and to improve the odour.

Dilute 10*m*l (a bottle cap full) in 3 *litres* water. It can be applied with a fine rose watering can or a pressure garden sprayer. For feeding of all plants, apply the diluted mixture to the soil surface as a drench. Wet the soil and plants thoroughly. Repeat every two to four weeks for optimum results. Regular feeding results in stronger healthier plants that are less susceptible to disease. More frequent use is sometimes desirable and will not harm the plants or damage the roots if used as directed.

Before sowing seeds, soak the seeds overnight in a diluted mixture of Organic Supercharger to boost germination.

Ludwig's Spray Stay. Rain or irrigation can wash away the expense incurred and the trouble taken to prepare and apply sprays before they have done their job. ***Ludwig's Spray Stay*** prolongs the adhesion and overall period of effectiveness of insecticide, fungicide and nutrient sprays by ensuring that they stick onto the plant and that their erosion by rain, irrigation or the weather is reduced. It is based on an organic extract from pine trees, which is emulsified and therefore mixes easily and stays mixed. It is compatible with all horticultural and agricultural sprays that have been tested by the manufacturers.

Such a sticker is also essential for best results when spraying onto wet leaves or onto smooth, waxy, hard leaves such as those of *Clivia*. Therefore you should always add Spray Stay to your sprays (12.5*ml* per 10 *litre* spray mixture). Only one hour of no rain or irrigation is needed after spraying to ensure the protection.

This article covers only products manufactured in South Africa by Straathoffs. We would like to extend it in the next Yearbook to cover organic and biological insecticides manufactured elsewhere, including their natural active ingredients. To that end we have provided the active natural ingredients of the South African products, both to enable the South African members to compare them with overseas products available here, and to encourage overseas members to provide us with information on other such products available, for publication in the next Yearbook.

Eds.

PERSISTENT MEALYBUGS

John Winter

Mealybugs are soft bodied flattened oval insects which are greyish white or pink and up to 4*mm* long. A white fluffy wax is secreted from the insect's body which also conceals the eggs. They live on the underside of leaves, in inaccessible places, such as in leaf axils and some species of Mealybugs attack the roots as well. They breed continuously in the warmer months of the year.

These sapfeeding insects excrete honeydew which make the leaves of infested plants sticky. Being sapfeeding, Mealybugs can transmit virus diseases. Heavy infestations cause a loss in vigour and plants may eventually die. Mealybugs tend to be more troublesome when plants are grown in a dry growing medium and closed environment.

Broad spectrum insecticides for the control of small bodied insects, applied thoroughly to the entire *Clivia* plant, are effective in controlling light infestations of Mealybugs. However once Mealybugs have established themselves on a *Clivia* plant, particularly in all the inaccessible places such as in leaf axils and on roots, repeated application of these insecticides never seems to successfully eradicate the infestation completely.

An application of **Confidor**^{R} (1ml/ **1** *l*.), applied as a drench, will then be 100% effective for a year. It becomes effective within a month of application, ie as soon as the plant has absorbed the active ingredient. Confidor^{R} is a systemic suspension concentrate insecticide, manufactured by Bayer, and the active ingredient is Imidacloprid (chloronicotinyl).

Mealybugs must also be sought and destroyed under pot rims, where they hide!


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Winner C. *miniata* medium broad leaf in flower Section, KZNCC 2002 Show.
Grower: Geoff Meyer.


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Third prize yellow C. *miniata* first flowering from seed Class, CCC 2002 Show. Grower: Johan Botha.

INFLORESCENCE BUD ABORTION
AND THE IMPORTANCE OF GROWTH MODULES WHEN DIVIDING AND FEEDING CLIVIA MINIATA

Mick Dower in consultation with Hannes Robbertse

It is necessary to divide well-developed suckers from mature *Clivia*, not only to provide clones of a desirable plant, but also to ensure that the plant continues to produce high quality flowers. (Grobler and van der Merwe p.24)

However, experienced growers hold quite divergent views on when clumps of C .*miniata* should be divided. Some growers believe that this can be done at any time. This seems to be the most generally held view - provided only that the weather conditions are favourable, particularly as raw cut surfaces are vulnerable to fungi and bacteria. Fungicides and anti-bacterial cleansers are not always effective in hot humid weather.

Others believe strongly, however, that clumps should be divided only in May, to ensure that the divisions will flower in that season.

One grower found that the divisions of a newly acquired clump, which he divided in December 2001, did flower in 2002. I found that, whereas none of the divisions of a clump of the Floradale Transkei Yellow which I divided in December 2001 flowered in 2002, all the mature divisions of a polychrome pastel, which I divided in April 2002 and of a Kirstenbosch Supreme, which I divided in June 2002, did flower in September/October 2002

At the International Clivia Symposium held at Pietermaritzburg in September 2002 Professor Hannes Robbertse read a paper prepared by himself and Chris van der Merwe on growth modules and mentioned that severe stress caused flower bud abortion. That paper is published elsewhere in this volume.

I consulted Hannes on whether stress caused by dividing suckers from C. *miniata* could also result in abortion of newly formed flower buds in that plant. He advised that '*it is true that any severe stress would cause abortion of the inflorescence bud, and the younger the bud the more sensitive it would be to stress conditions. I have seen many aborted buds in plants I have dissected'*.

He explained what Honiball (p.52, referring to research done by De Smiedt *et al* 1996 and by Bell and Bryan 1991) had reported, namely that the growth of C. *miniata,* like many other bulbous plants, is sympodial - *i.e.* by successive development of lateral leaf buds behind the apex, as more fully described by Hannes in his article on leaf growth and illustrated in *Figure* 6 on page 52 of Honiball. In the juvenile stage 12-13 leaves are produced, usually at shorter intervals than the growth modules in the mature plant. Honiball tells us that it has not yet been established whether any flower buds are produced then, but Ian Brown has noted that a first flower can be produced after the fourteenth leaf (including leaves which have died off). This seems to indicate that at least the last growth spell in the juvenile stage does produce a flower bud.

When that stage ends growth occurs in modules. Such a growth module comprises four leaves followed by a terminal bud - *i.e.* a bud at the top of that growth spell which ends that growth spell. That bud remains quiescent (dormant) until it is stimulated by a favourable environment (more particularly a sufficient difference in day and night temperature) to develop into an inflorescence .

Following that inflorescence bud formation the growth of that module ceases, but in favourable cultural conditions, it may be followed in the same season by another and even a third growth module, each from below the apex and on the other side of the previous module and each ending in a quiescent terminal flower bud. More than one of these quiescent buds, if sufficiently developed, can be stimulated by drop in temperature to develop into umbels within close succession, resulting in two or even three umbels flowering from the same crown in the same season.

Honiball goes on to point out that unfavourable climatic (particularly temperature) conditions may inhibit the development of such a growth module and in particular, for the purposes of this article, that damage caused by diseases or pests may result in the death of dormant buds so that the plant does not flower. In their article, Hannes and Chris point to sunburn, severe dehydration and root restriction in too small pots as other causes of stress which will cause bud abortion. This may explain why suckers in big clumps do not flower satisfactorily - when a mature sucker is freed and repotted it will probably flower in the same season. It is important to remember, though, that suckers are in fact young plants and can revert to the juvenile stage for some time before they will be ready for flowering.

Regarding pot size, conservatory growers in the Northern Hemisphere may have a different experience because I have seen C. *miniata* with suckers thriving and flowering well in small pots in Mike Jeans' greenhouses in England. It may be that these plants have adapted to chemiculture in small pots.

Hannes has observed in Pretoria that C. *miniata* normally have two growth flushes per season - one in spring during flowering and the second in late summer to autumn. He advises that '*the development stage of the leaves that are formed during the flush should give you an indication of the development of the inflorescence bud. That would mean that when dividing the plants in Spring, it would be better to wait until the youngest of the four new leaves has reached a 'reasonable' size. Too early division may cause flower bud abortion. The same would apply to late summer division*'.

While most C. *miniata* may have growth flushes in spring and autumn, I have noted that there are some which regularly have growth flushes in mid-summer. One of these is the **Floradale Transkei Yellow**. This could explain why its buds were aborted when I divided it in December 2001. In some plants, therefore, untimely division may affect all dormant inflorescence buds, not only the bud being formed in the growth module taking place at the time when the plant is divided.

Other plants divided during a growth spell may abort only the inflorescence bud then being formed and not the further developed dormant bud(s) from previous growth spells I have also noted some C. *miniata* growth flushes in May so that the advice to divide in May only may not be correct for every plant.

The conclusion would therefore be to follow Hannes's advice if you do not want to put the dormant buds at risk - do not divide any plant during a growth flush but only after the fourth leaf of that flush is well developed. However because these growth flushes take place in different plants at different times, every plant should be treated as an individual - you should not do all your dividing at the same time. And if the plant is carrying seed, it could be advisable to delay division until May/June when the seed will be mature.

Since stress can cause inflorescence bud abortion, it also follows that the stress caused by division should be kept to a minimum. Letting the divisions 'dry out' before potting them up must surely add to that stress. One should not divide in hot humid weather, and always treat the cut surfaces with fungicide. The divisions should be potted up right away **I add Sporekill™**(as a cleanser) and **KicStar**™ (as a growth stimulant to counter the transplant shock) when watering them in.

Remember also that, while too severe root restriction can cause stress, excessive root development can delay the production of flower spikes. Take care, therefore, to use pot sizes which restrict excessive root development, and use **KicStart**™ sparingly because it stimulates root development.

These growth modules may also be a guide for nutrition programs. In an accompanying article Ian Brown advises on the nutrition and environment which will promote the growth of C. *miniata* in the first 1 2 - 1 3 leaf stage. I have also found that during that stage regular feeding (whenever new leaves appear) of Calcium nitrate (2 level teaspoons in 10 litres water used as a drench) promotes stronger leaf growth than the Ammonium nitrates found in most fertilizers.

Feeding programs for mature plants (*i.e.* those which have reached or passed the 1 2 - 1 3 leaf juvenile stage) must ensure that the plant has the right nutrition available:

- Firstly at every growth module, to promote strong leaf growth followed by the full development of an inflorescence bud;
- Secondly, when changes in ambient temperature during winter stimulate inflorescence buds to develop into umbels, to optimise the quality of the umbels which will be produced; and
- Thirdly, to improve seed production after pollination.

Dr. Piet Vorster has cautioned on the Internet that well-balanced nutrients should be used. That is the case where C. *miniata* grow in nature - in well-drained and well-aerated mediums rich in vegetable matter.

A plant will only take up the nutrition which it requires and over-feeding can result in a build-up of chemicals in the growing medium, which can poison the plant.

References:

Grobler & van der Merwe: Vegetative Propagation of *Clivia-. Clivia Yearbook* 4, page 24.

Honiball: Manipulation of Flowering Period and Shoot Multiplication in *Clivia miniata* Regel: Clivia *Yearbook* 3, page 30.

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Third prize C. *miniata* multipetal Section CCC 2002 Show. Breeder: Y. Nakamura. Grower: Toy Jennings.

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C. *nobilis* from Featherstone Kloof. Winner species other than C. *miniata* Section CCC 2002 Show. Grower: John van der Linde

THE NAME GAME

Kenneth R Smith

Most of you would be well aware of the cultivar name situation with Clivias. Many of the articles produced in the newsletters and the Yearbooks list both obscure and well-known forms. It was Nick Primich who started the idea of a list being compiled, to which I added any names I had in my files. Nick pushed for the Clivia Club to become the International Cultivar Registration Authority (ICRA) for the *genus Clivia* in 2000. Not much happened in the way of registration, even though the Clivia Club was evolving into the Clivia Society. It was in June 2002 that I was appointed International Registrar. The name gathering continued to the point of being able to compile a 'Checklist of named Clivias' in August 2002. When the draft publication was printed it contained 542 names. I made copies available to the various Clubs in South Africa during my trip in September 2002. The international delegates were able to take copies with them and I sent some copies to other interested parties. The idea being that everyone was able to provide feedback on names and details. This has been happening. So much so that I have an extra 100 names to put into the revised Checklist. Herein lies the problem.

The purpose of the ICRA (*i.e.* the Clivia Society) and the Registrar, is to make available a register of known material. A list of names. Okay, we are getting there on that front, but also what is occurring is the increased 'naming' of Clivias, quite often without regard for what might already exist in the market place. No real problem when you consider that they may be totally different names and easily recognisable cultivars. Just add them to the list, I hear you say. This can certainly be done. The real problem is when two different *Clivia* people name their respective plants the same name. Now we have a potential problem. This has occurred already based on my findings, and I am certain it will continue. So, I ask, how can we avoid this happening in the future?

Several avenues are open to us. If members of the various Clubs liaise with their committees, all information will be forwarded to me. Updates can be made and the naming of new plants can be kept in check. This is all very well for people working within the *Clivia* fraternity, but the need is greater than that. We have to ensure that the worldwide horticulture industry knows what is happening with *Clivia*. The Society needs to produce a more informative 'Checklist and Register'. Very preliminary discussion has been held regarding this and the idea is acceptable. The compilation of information and images for each cultivar or strain is harder, but will be done. Which leads us to the problem of how much information is required. Ideally, lots of detail needs to be gathered about the cultivars to make the Checklist valid and useful. In some instances the name is all we have, yet for other plants, a lot is known about them. Now that we have people actively developing hybrid Clivias, the time is right for getting this information into a published format. The more information known about a named *Clivia*, the better the Checklist will be.

The sort of detail in a book like 'Clivias' by Harold Koopowitz is just what we need. Letters and anecdotal material are also useful as they help piece the puzzle together. Nursery catalogues, old or new, are one of the best ways to map the history of a plant, especially as they can give dates of introduction to the marketplace. Whilst the internet is not considered a valid publication for a cultivar name as far as the International Society for Horticultural Science (ISHS) is concerned, it is certainly a quick and efficient means of disseminating information. The Society's committee dealing with Registration will rely on email communication to discuss ideas and send information back and forth. The ISHS has made the point that a registration system must be user friendly and this will dictate what sections are included on a registration form. What form, you ask?

For us to put in place a workable registration system, we have to get as much information at the one time as we can. This allows us to 'register' the *Clivia* name, issue a certificate, and most importantly, ensure that the name is not duplicated when others apply to register their *Clivia* name. All sorts of ideas come to mind when this is mentioned, things like what do you do about the existing named Clivias, how quickly will an application be processed, what costs might be involved? There are other questions, and I hope that this article prompts you, the reader, to share the questions or ideas that you have with us. I am thankful that many friends have been sending me information and I encourage the flow of information. I am just asking that we formalise the process.

The quality spin off to the registration of named Clivias is in the value of providing a description of a plant that will aid enthusiasts, and hopefully reduce confusion in the marketplace. Yes, I know, all we have is a list of names, but it will provide a basis for breeders to select material to work with, knowing that the information given relates to a certain plant or strain. It may also serve to educate the horticultural community interested in Clivias by providing valuable information on the plant. I am sure it won't stop the practice of calling a seed grown *Clivia* the name of the parent plant, but it may help reduce the incidence.

Making information available to the Registration Committee will help our cause. Please send any details you have about old 'lost' cultivars, existing cultivars, or potential cultivars and cultivar-groups to:

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C. *miniata* named '**Doris**' by David Conway

C. *miniata* named '**Doris**' by Jim Holmes

By way of explaining how the naming of cultivars can become confusing, I have included information and pictures of some cultivars. The first two are cultivars from David Conway and Jim Holmes. Perhaps many readers know of the Conway clone **"Doris'?**

It is a deep red form, named by David for his mother, Doris Wells Haviland, in 1992. Listed on Jim Holmes' Cape Seed and Bulb website is another Clivia named '**Doris**', this time a yellow selection from Jim's New Dawn breeding programme. Both fine Clivias, but with the same name. Another example is the Clivia from Conway called '**Julia**', named after his wife's Great Grandmother, Julia Ann Cole, in 1999. It is a variegated foliage yellow flowered selection. Loukie Viljoen has named a beautiful green throated pastel after his wife Julia. Again, both fine Clivias but with the same name.

C. *miniata* named 'Julia' by David Conway.

C. *miniata* named 'Julia' by Loukie Viljoen.

I must say that I have had a lot of support from the *Clivia* fraternity about the name issue. The three gentlemen just mentioned have given their permission to both list their plants as well as providing suggestions to reduce the naming confusion. Most of the issues are being addressed and will be corrected. My thanks to those people who have given me valuable information already. We have to move past the checklist stage and into the Registration of cultivars. I have included information from the ISHS website to give you an idea of the information required for registration. You can see the amount of detail required to get the registration correct. We need your help.

Registration form

All registration forms should request at least the following information and material:

A The ***names and addresses*** of:

1. the **ORIGINATOR** (it may be necessary to distinguish the HYBRIDISER and the person who grew a plant on to its first flowering from the Originator)
2. the *NOMINANT* who invented or coined the name (may be the same as Registrant).
3. the **INTRODUCER** (to help distinguish private distribution from commercial introduction)
4. the **REGISTRANT** (person completing the form).

In each case the relevant ***date***(s) should also be requested (the year is usually sufficient).

B If the **cultivar** or cultivar-group has been previously established but not registered, the name of the person who originally published the name, together with details of the publication or full reference to its date and place of publication. A copy of the printed page(s) should be requested which might be added to a PORTFOLIO of the cultivar.

C If the ***name*** to be registered is a transliteration from a language not using the Latin alphabet, the original form (characters) of the name or epithet should also be requested.

D For hybrids, the ***parentage***, when known should be listed or, for sports, the identity of the parent plant or cultivar on which the sport occurred.

E The ***location*** of the original find, if the cultivar results from a plant or plants found growing in the wild.

F Particulars of any associated ***trade marks***, plant ***patents***, or ***Plant Breeders Rights.***

G ***Awards*** received, with dates and the name of the awarding body.

H A **full description** including, where applicable, details of colour - a reading from an RHS Colour Chart is now a widely used standard and is strongly recommended. The precise edition of a colour chart should always be stated in publications of an ICRA.

I The registrant should give an account of the likely ***diagnostic characters*** that differentiate the cultivar or cultivar-group from any closely related cultivars or cultivar-groups known.

J A ***photograph*** of the plant and flowers should be requested to be stored in a portfolio of the cultivar.

K The preferred ***method***(s) by which the new cultivar will be ***propagated***.

L An explanation of the ***etymology,*** derivation or meaning of the cultivar name, especially if this is not immediately apparent from other information given on the form.

Registration forms should stress that although the ICRA will ensure eventual establishment for all registered names, their precedence is not fixed until establishment, at which point the name will have a date. Registrants may thus wish to publish new names themselves following registration, to ensure that precedence of their cultivar name is not affected by any delay in publication by the ICRA.

Ken Smith is the International Registrar for the genus *Clivia*. His appointment in June 2002 was through the Clivia Society. The Society is the International Cultivar Registration Authority (ICRA). It was appointed by the International Society for Horticultural Science (ISHS).

The purpose of the ICRA is to promote fixity and stability in the nomenclature of cultivars and cultivar-groups within designated plant groups and to produce and promote authoritative checklists and registers of all names known to have been in use in such groups.

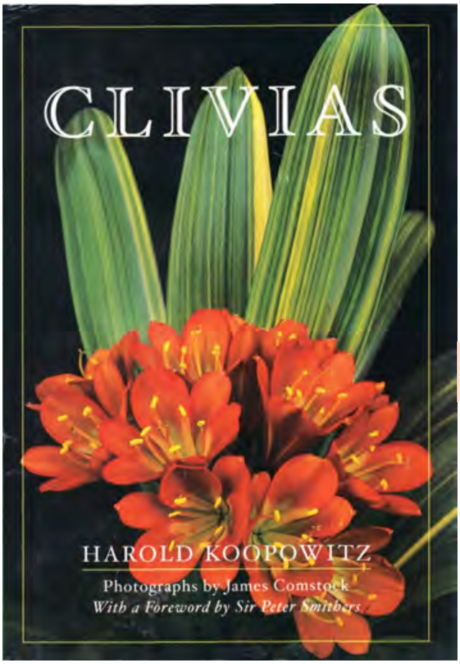
The primary functions of an ICRA are:

1 to register cultivar and cultivar-group names in the genus and to ensure their publication and establishment.

2 to record, publish and make available full lists of cultivars and cultivar-groups, whether they are in common use or are part of the historical record so as to provide the world community with authoritative listings of names.

3 to maintain records in as great a detail as is practical, of the origin, characteristics and history of each cultivar and cultivar-group in the genus.

Winner 2nd prize C. *miniata* any other colour with green throat Section, NCC 2002 Show. Grower: Johannes Smith



REVIEW : CLIVIAS

by Harold Koopowitz,
with photographs by James Comstock
and a Foreword by Sir Peter Smithers.
Timber Press, Oregon

Nick Primich

Every once in a while comes one of those golden moments when one really enjoys something that one is doing. That happened to me when I first read through Harold's book. I had known of him for a long time when I was a collector of all and sundry forms of bulbs. I had heard he was a South African who lived at Irvine. I actually met him a year or two back at Pietermaritzburg Clivia Show where he asked me to read through a paragraph or two concerning my doings in the Clivia Club. He had a proof copy of his book that we had all heard a lot about. I think I sat down right away and read for about an hour or so. There were no photographs in the proof copy, and I was not too sure at that stage how I felt about his writing.

The other day I was handed a gleaming copy of the newly released book flown out by airmail, and I fell upon it like a starving lion. THIS TIME I KNEW EXACTLY HOW I FELT ABOUT IT. This was great, this is what a *Clivia* collector needs. Look, one never ever agrees 100% with anyone about anything, but what I disagree with Harold about in here is really small potatoes. He has aimed his book at the middle of the target. Not too much technical detail, but just enough to fill some explanations out. The layman need have no qualms that he will be assaulted with a ton of technical Hooha just because the book is written by a professor at a university.

A goodly selection of excellent photographs, lames Comstock impressed me with his photographs of clivias many years back. When he came out here to the International Clivia Conference in 1998 I got a hold of him, and elicited some detail on the techniques involved in such photography. He promised to send me an article, which he duly did and it appeared in your Clivia Club Newsletter a couple of years back.

Harold covers just about everything I could imagine, but of course he had to leave out many names of important people in the *Clivia* world. His space is limited, and he also had to leave out many great *Clivia* photographs as the publisher put a strict limit on these. This book fills a great need as a primer for one starting out with clivias. It will also satisfy many desires and longings in the hearts of established *aficionados.* I will note one small criticism, and that is the index could have included people and places, and suchlike. He has an easy relaxed style of writing that puts the message across clearly and succinctly.

If I were you and I had not yet ordered my copy, I would hasten to rectify the omission, as I am sure they will sell out. There will, I am certain, be other *Clivia* books in time, some more technical, some more illustrative, but until then this book will be more than a stop gap, it will be the standard by which the others will be judged.

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Clivia miniata '**Emma Leslie**'. Breeder and grower: Mick Dower

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