Reticulate Irises: A Whole New World

Just over 40 years ago, the appearance of *Iris* 'Katharine Hodgkin' reconfigured the boundaries that had hitherto governed *I. reticulata* and its close relatives. A similarly revolutionary transformation is in process due to the fruitful hybridising endeavours of Alan McMurtrie (Toronto, Canada), the details of which he recounts here.

All Change

By crossing *Iris sophenensis*[*] with a diploid form of *I. danfordiae*, and then exploring the potential of the second generation seedlings, I have been fortunate to open a window on a whole new world for reticulate irises. Happily, the new hybrids (the first of which bloomed in 1994) are showing hybrid vigour, and in most cases have bloomed consistently year after year. As you might well expect, some have proved more vigorous than others, but the majority are 'good doers', whereas both the parent species are notorious for 'shattering', by which I mean producing lots of little rice-grain sized bulblets, along with main bulbs that are too small to bloom the following year.

The predominant flower colours in irises of this group (subgenus Hermodactyloides) are blue, violet and purple. Listing the exceptions, the well-known lemon-yellow *Iris danfordiae* (the non seed-producing, commercial form of which is triploid) has been cultivated since the 1870s. *I. winogradowii*, a much more restricted species from the Caucasus, does very well indeed in favoured gardens, and has produced several hybrids, the oldest of them E.B. Anderson's famous *I.* 'Katharine Hodgkin' which blends the egg shell-yellow of this species with the blue of *I. histrioides.* Its dark blue spotting on a cream ground with a yellow flash is stunning. The cross has since been repeated and other named varieties ('Frank Elder', 'Sheila Anne Germaney') are now available. All are sterile - even though both parents have the same chromosome count (2n = 16) – and as such constitute a dead-end from the breeding point of view. Passing over the now almost unknown albino variants of *II. reticulata* and *vartanii*, in the 1970s, William van Eeden was able to produce the near-white 'Natasha', which is now grown commercially in reasonable quantities. *I. pamphylica*, a white form of which appeared in plants grown by John Amand, is (in its typical manifestation) best described as brownish-purple, the hafts greenish but shot through with purplish veining.

As is well known, Anderson thought that his cross involved *I. danfordiae*, not *I. winogradowii*, though subsequent study has revised his opinion. So why is it that I have been successful in hybridizing *I. danfordiae* and other people haven't? It isn't just a matter of using a 'wild' (i.e. a fairly recent introduced diploid) *I. danfordiae.* Significantly, both other species used when making these crosses (viz. *I. sophenensis* and a species close to *I. reticulata* from Çat, south of Erzurum (eastern Turkey) that represents an undescribed taxon) have the same chromosome count as *I. danfordiae*: 2n=18. All other examples of *I. reticulata* have a chromosome count of 2n=20. Forward thinking also played a part; it was necessary to see beyond the first generation blues. I knew that crossing two pure species would initially result in similar progeny, but anticipated that their range of expression would broaden significantly in the second generation and beyond. Beyond this, I was lucky that the high level genetic switches, which I outline further on in this account, worked the way they did, turning on and off the blues/purples and yellows.

For several years, I have been distributing limited numbers of my hybrids among specialist growers in Europe. Few of these have been given clonal names to date. (Ed. There has been a suggestion that the hybrid *I. danfordiae x sophenensis* should be christened *I.* x *mcmurtriei*: this name has not been published to date.) One of the first public outings in Britain took place last January, when a pan of a first generation hybrid, 89-AC-9, was shown to the RHS Joint Rock Plant Committee by Tim Loe (Launceston, Cornwall). To convey some ides of its appearance, this is a dwarfer, darker 'take' on 'Katharine Hodgkin', the mid blue flowers having a yellow suffusion. But what really generated interest among the Committee members was a series of pictures showing some

[*] Formerly *I. histrioides* var. *sophenensis*. The late Frank Kalich provided me with material of this species.

of the F2 seedlings, which further develop yellow/blue combinations, but also come in various intensities of spotted light blue/greens, *I. danfordiae*-like mixes, and whites.

Dutch bulb growers tend to feel that there isn't room in the market for an influx of new varieties, and it has been problematic to demonstrate the markedly different appearance of the F2 crop, not least because it will be a few years before their numbers are increased to the point where I have sufficient to spare. The good news is I now have access to a lab in Holland with proven results for increasing reticulate irises using tissue culture techniques, and have initially engaged them to make small increases of a dozen clones (100 to 250 bulbs of each). How can I best convey their merits… well the best way is to let the pictures speak for themselves. A small number have been used to illustrate this article; a more comprehensive array can be found on my web site, www.Reticulatas.com

Overview of Results

First Generation (= F1). 'Nice, but they're just blues', as Dutch bulb specialist Wim de Goede understandably observed when he first saw them six years ago. Significantly, they grow well here in south-eastern Canada, unlike some of the well-known clones mass-produced and mass-marketed by bulb growers in Holland. Over the course of six years, some 56 blues have resulted from eight crosses. They range from light to dark blue; three or four are blended with yellow in different degrees of intensity, which tends to give them a muddied appearance. In one, the yellow is manifested as streaks and blotches on the fall, which has the potential for the transmission of interesting effects in its seedlings.

Second Generation (= F2) Significantly different, with a number of hard to predict excitements. The following generalized categories are presented here in tabulated form to give an idea of what has resulted so far:

Parentage	**Blue**	**White**	**Yellow-Blue**	**Spotted Light Blue-Green**	***I. danfordiae*-like**
F1 x F1	8	9	5	0	1
F1 x *danfordiae*	1	8	9	5	8
involving "Çat"	1	1	1	0	0
Total to date:	**10**	**18**	**15**	**5**	**9**

The Burden of Proof

Stop for a moment and put yourself in my shoes. Let's turn back the clock to 1994 when the first *I. sophenensis* x *danfordiae* (hereafter abbreviated to as *sxd*) hybrids started to bloom. There were 16 clones from three crosses. These were expected to be sterile, even though they produced what appeared to be nice fluffy pollen. I knew full that attempting crosses with generally incompatible, possibly infertile plants was likely to be a waste of time. But in this case I felt I had to try. The best chance, long experience with other groups of irises had taught me, would be to self them. So that's exactly what I did: lo and behold, 130 seeds were produced from eleven successful crosses. (Chromosome counts show that *II. histrioides* and *winogradowii* are genetically different, but share a value of 2n=16; *II. danfordiae, sophenensis* and "Çat" are 2n=18.)

Reporting that the first hurdle had been overcome to friends like Brian Mathew, I was well aware they would be sceptical. Even though the seed appeared to be good (i.e. fertile), there was a chance it would die when it tried to germinate (lethal genes).For example, out of the more than 300 crosses I've made with diploid *I. danfordiae*, producing over 4800 seemingly good seeds that should have

bloomed by now (1997 & prior seed) only one, possibly two[1], have produced blooming bulbs other than the hybrids with *II. sophenensis*, "Çat", and of course *danfordiae* selfs.

Five years later, in 1999, two of the F2s bulbs bloomed. The first was 94-HW-1; I couldn't have asked for anything lovelier. Having anticipated that the veining of *I. sophenensis* (a dominant trait of this species) would take years to breed out, I was astounded to gaze upon something just as lovely as 'Katharine Hodgkin'. I'm glad to report it's proving to be vigorous, more or less doubling every year, with 13 blooms in 2002.The second hybrid, 94-GU-1, was a more conventional, small pale blue.

In 2000 more of the by now six year old F2 seedlings bloomed, along with a couple from 1996.Surprisingly, many were white, with a similar pattern to 94-HW-1: viz. a blue style-arm and blue and yellow markings beside the fall blade's ridge. One of them, 96-DZ-1, is remarkable for the snowy purity of the predominantly white flower, offset by the soft blue style arms, with blue veining that merges into the pale yellow zone around the fall ridge. Another newcomer was a *danfordiae*-like clone from a back cross to that species. More significantly, I also received a first glimpse of a beautiful new pattern that for the moment I'm calling the "spotted light blue-green" group: 96-BN-1.It was breathtaking: large blue-green spots on the fall blade, with a predominant yellow central blotch. The style arms have a blue ridge, with the inner portion being light yellow-green. In total six new F2 seedlings flowered for the first time.

The following year, a further thirteen were added to the list. Many of these were yellow-blue combinations. Of particular interest was a hybrid, dating from a 1995 sowing, that wasn't growing where it should have been; presumably I dropped the seed when it was being planted. Its unusual pattern marks it out as a *s*x*d* back-crossed onto *I. danfordiae*. Similar to 96-BN-1, it can be distinguished by the near absence of yellow blotch on the falls. Another of special interest that year was 94-AT-2, which has dark brown falls on a rich yellow background. The yellow shows through mainly around the similarly coloured ridge in the middle of the fall. Its style arms are several shades of dark blue.

By 2002, the number of new F2 *s*x*d* hybrids had increased by 36, bring the total to 57! Of particular interest were: a 'Sea Green' (the colour transmutes to bluish green as the flower matures); three more representatives of the Spotted Light Blue-Green group (one didn't have any yellow, so it was actually an entrancing spotted powder blue); and two cream hybrids without much blue influence, one of which regrettably appears to have a poor constitution. Furthermore, three second generation clones involved an as yet unnamed new purple species I collected near Çat, Turkey. One has tentatively been named 'Storm', with reference to its falls, which have dense black veins on a bright yellow background (the style arms are dark blue).In sharp contrast, a sibling is cream with a yellow zone around the fall ridge. The third clone is a slightly lighter yellow than *I. danfordiae*, with black markings on the fall and dark green style ribs. The long term implications are unclear; for example, one of this year's yellow-blue hybrids had a distinctive orange cast to it. Doubtless it will take a number of generations to stabilise this characteristic. But imagine, an orange reticulate iris!

On the other hand, I can now smile and say, "whites are easy". I have fifteen, the majority with blue style arms and blue markings on the upper part of the fall; a further three are cream with a yellow flush. The best to date are 94-HW-1 and 96-DZ-1, plus the cream 96-BN-3. Based on current maturation rates, it will be 2005 before I see the first flowers of third generation (F3) *s*x*d* hybrids (intercrossing the initial second generation hybrids in 1999 was unsuccessful).

Patience Is A Virtue

Creating new cultivars is a slow process. From sowing the seed to the securement of a flowering bulb takes five years. At that point you have only one flower. If the bulbs double reliably, then in

[1] I have four clones from *I. hyrcana* x *danfordiae* (89-A-1/4). It's clear when you see them that this was indeed that cross. There is also have a strange, sterile, *I. histrioides*-like hybrid that may actually be a cross with *danfordiae* (92-X-1).

five more years there will be 32 flowers. In a sense this number increases significantly to 1024 in a further 5 years, but in commercial terms (where millions of bulbs are required) this figure is insignificant. Like their parents, these hybrids do produce bulblets. By replanting them close to the soil surface every year, they can dramatically increase the number of blooming bulbs. If the bulblets aren't moved up to the soil surface, many will simply die out because they are too deep to get a leaf up the following year. One significant factor has been the discrepancy in the rate of increase where bulbs and bulblets are grown on in Toronto rather than Holland; by way of illustration, after nine years, 22 bulbs of 94-HW-1 (three of flowering size, down to 10 bulblets) could be expected to have been 'bulked up' to a total of c. 21,000 flowering-sized bulbs here (726,405 in Holland); even more dramatically, the total bulb count would be 510,200 in Toronto (6,000,000 in Holland) These figures, calculated in 1999, are based on typical rates of increase in Canada for *s*x*d* hybrids up to that point, supplemented by actual rates of F1 increase in Holland. The recent Canadian rates have subsequently proved slightly optimistic, further emphasising the advantage of sending material to Holland at the earliest opportunity, with a view to commercial production. Did you know that in Holland, large bulbs tend to give two blooms per bulb? Some of my F1 bulbs, returned to me from Wim in 1999, were large enough to give three, though the third flower was much, much smaller than the first two.

After a number of years the work gets out-of-hand, even for a semi-commercial enterprise. In 1999 I replanted my 1989 *s*x*d* hybrids into an area of 135 sq. ft. The following year, just to keep up the momentum, this area should have been doubled (or rather increased to 400 sq ft, since the overall count had been tripling). Unable to provide this space, or take on the workload involved, I have nonetheless expanded the growing area; in 2002, well over a thousand hybrid bulbs came into bloom.

This is a hobby gone somewhat overboard. For each of the last five years, I have sown more than 10,000 seeds. The job takes six days to complete, even after the aluminium tags used to mark the rows have been prepared in advance. As each row is planted, a map of the area is drawn up, which makes finding where a particular cross is in the bed reasonably quick, to say nothing of coming in handy if a tag accidentally gets pulled out. To keep the space used each year to a reasonable limit, the rows are only 4 cm apart; the seeds are sown at intervals of roughly 6 mm. This is might seem crowded, but when taking into account an overall germination of at best 30%, coupled with c. 8% losses, there is enough room.

It's taken quite a number of years to get to this point, and commercial production is still some way off, but there are presently four Dutch growers trialling material; a process that takes at least three years. In their first year, only a very few of the clones bloom. There are several reasons for this. In many cases I am releasing varieties that only just bloomed for the first time this year, or last year. Hence I keep the largest bulbs for further hybridizing, passing on those likely to bloom after one growing season. By the end of the second growing season they should have increased enough to be assessed for pot culture. One of the things I need to find out is whether the laborotories bulbs are large enough to bloom a year later, or whether they need an additional growing season to get up to bloom size. This will influence my strategy. It will also be interesting to see how the rate of increase for *s*x*d* clones there compares to that of other reticulate irises. Moreover, we need to gain experience in hardening off the finished (ex flask) bulbs.

No commercial agreement has been signed to date, but I anticipate this development in the not too distant future. By involving several growers, each working on different clones, my hope is that this will lead to the best possible outcome. My goal is to partner with each of them. If they are successful, then I'm successful. If they aren't, then I'm not. Of the whites, I am particularly fond of 94-HW-1 (96-DZ-1 is also being assessed). One grower has the five 'spotted light blue-green' clones, of which I favour 96-BN-1.

I understand that to at least some degree the growers all sell into the same market. My vision is that you will be able to buy these hybrids from your local garden centre. Here in Toronto, most garden centres only sell *I. danfordiae*, together with a popular blue hybrid such as 'Harmony' or 'Joyce'. Already, my seedlings have resulted in an extraordinary range of colour combinations,

from white, through pale to bright yellow, and on from bicolours, brownish-yellow, violet pink, subtle green to blue/yellow mélanges. Reflect on the fact that half of the 80,000 seeds I've planted to-date still have to bloom over the next five years.

Hybridizing Goal

My goal is to create interesting new hybrids that do well in the average North American/western European garden. On a number of occasions I've heard people complain that they've bought named varieties, only to have just a few leaves come up after a couple of years. The same problem has occurred here; I've now just about lost *I.* 'George' again - the 25 bulbs I bought in 1999 are just about gone. To test the longevity of currently mass-produced stocks, around seven years ago I bought a dozen bulbs each of *II. danfordiae* and *I. reticulata* Hort. from a local garden centre. As expected, they all bloomed the following spring. I left them alone and the following year they each produced 24 flowers. In the third year, and essentially every year since, there have been only about six flowers from the latter, and none from *I. danfordiae*. This might seem good from a bulb growers' perspective because it essentially means people have to buy more bulbs, but in truth it isn't: buyers end up disappointed and won't buy more bulbs. My experience with daffodils is that some will do well, and some won't. It's just a matter of finding the ones that like my conditions. On a couple of occasions I've imported a dozen or more from Ireland. They all do well at first, but invariably a couple will vanish, one or two won't do as well as the others, but the remainder will flourish and form large clumps.

Ideally, you should be able to plant reticulate irises, leave them alone, and have them bloom consistently year after year. In theory each would form a clump, an equilibrium point in terms of number of bulbs and flowers. I've seen this happen when the bulbs are initially spaced well apart, but not when they are in close proximity. I tend to either have my bulbs tightly spaced, or I replant them year after year to get maximum increase. (Ed. The dreaded 'ink disease', where the bulbs are stained by fungal invasion, and die off at an alarming rate, is most prevalent in long-established, non-divided clumps.)

Genetic Switches

Now that I have a reasonable number of F2 *sxd* progeny, a point has been reached where analysis of the high level genetic switches involved can proceed. A preliminary reviewal would have led to the wrong conclusions (based on the number of the whites in the second year, or the high number of yellow-blues in the third year). The first thing to make clear is that blues and purples are anthocyans (water soluble in the cell's vacuole), and yellows, oranges and pinks are carotenes (fat soluble in the cell walls). True red is also an anthocyan, but unfortunately irises are not able to produce the chemical that reflects 'fire engine red' back to our eye (like geraniums and roses).If you know bearded irises, you will be aware that reds of a sort are possible, resulting from a combination of suitable shades of purple and yellow. The distance between the eye and the flower governs the illusion of red. This is what makes the falls of one seedling, 94-AT-2, appear dark brown.

Another point to realize is that there are various shades of blues and purples contributing to the exact colouring seen. Each is controlled by one or more switches. Thinking of the flower as a chemical factory, genetic switches control what compounds are produced, and hence what colours are reflected back to our eyes, from light to dark blue light waves, to violet, through various shades of purple. Similarly with yellows, there are a number of switches at work, though with the yellow-orange of *I. danfordiae* so dominant, the impression is given that there is only one. If these anthocyans and carotenes don't combine felicitously, you end up with a muddy mess.

Clearly there are some high level switches at work, controlling whether blues predominate, and similarly, whether yellows come to the fore. Since both *II. sophenensis* and *danfordiae* are pure species, we can assume their genes are for the most part homogeneous dominant, or recessive. Since all of the F1 seedlings were blue, clearly blue is dominant, and yellow recessive. Analysis of the results so far shows that a single recessive gene is responsible for 'turning' yellow on, while two dominant genes are responsible for making blue hues visible.

At some future point, I anticipate a clearer understanding of what lies behind the 'spotted light blue-green' pattern, as well as the yellow streaking or blotching effect. Of course by that time there will be other mysteries. Somewhere hidden in the genes is the pronounced veining of *I. sophenensis*' that I had expected would be extremely hard to breed out. Yet the only F2 hybrid in which it has shown up in directly is a striking dark blue seedling from 2002, 97-CC-3.

Bear in mind that these plants have 18 chromosomes, so while there may be a number of hybrids that resemble *I. danfordiae*, there's a good chance that they have one or more chromosomes from *sophenensis* (just not ones affecting their appearance).Also remember that for something to be possible, the potential has to be there. Then it is a matter of breeding through a number of generations in order to realise the characteristic. You may have noticed that the standards are 'missing' on the *s*x*d* hybrids. But if you look carefully you will observe their presence; it's just that they have been greatly reduced in width (0.3-3 mm, c.f. typical *Iris reticulata* standard width of 7 - 10 mm).This betrays the influence of *I. danfordiae*, which only has short 'bristles' for standards. One day I will have *s*x*d* hybrids with 'normal' standards, but this certainly isn't one of my priorities.

Tip of the Iceberg

The reticulate irises currently known are very likely just the tip of the iceberg. There are doubtless many new expressions of *Iris reticulata* sitting unknown in the wild. Unfortunately, my experience is that wild imports survive only a few years in my garden. But by using them in hybridizing programmes, their genes are transmitted to clones with hybrid vigour.

The Future

What of the future? As I have come to learn, it holds wonderful, unexpected surprises. It has been amazing to see the unprecedented colour combinations unfold each spring. I'm keen to break away from the singular lemon-yellow of *I. danfordiae*. Doing so should add a whole new dimension to my hybrids. I also have high expectations from the injection of "Çat", a plant likely to add purple to the current mix of blue and yellow, and more importantly, unlock potential hidden patterns. It's not that the genes for those patterns aren't in *II. sophenensis* and *danfordiae*, it's just that they might be homogeneous, and thus couldn't otherwise be turned on (benefits of genetic diversity).The only catch is that it, like the diploid *danfordiae* I collected, is a bit on the small side. As an aside, it was my stock of *I. danfordiae* that RBG Kew used for a cytological study in late 1980s, so resolving the species' chromosome count[2].

Cultivation

Reticulate Irises like a well-drained soil (e.g. sandy loam / sandy topsoil), with plenty of moisture in early spring. (They are to be found in eastern Turkey, Iran and the Cuacasus, in mountainous areas where the summers are very dry, but snow melt means that the ground is moist, or even temporarily sodden, at flowering time.) However, the soil should be fairly dry around the time the leaves are starting to turn brown (late April/May in the British Isles).A position in full sun, or at the very least where the sun's rays penetrate for half the day, is recommended. It is best to thin them out/replant every other year, preferably in a new site to prevent the threat of the equivalent of 'rose sickness'. In Holland they are treated on a rotational basis, like crops, replanting in the same area taking place only every ten years. Amateur growers are unlikely to have the space, or the time, to replicate these methods.

Here in Toronto, these irises generally start blooming towards the end of March. They last for about three and a half weeks, with individual flowers lasting seven days or longer, depending on temperatures. On warm days, they exude a wonderful perfume. *II. sophenensis* x *danfordiae* hybrids tend to bloom at the beginning of the season. In 2002, blooming commenced much earlier

[2] The Identity Of Iris 'Katharine Hodgkin' - A Cytological And Morphological Approach, by Margaret A. T. Johnson & Brian Mathew, published in Kew Bulletin Volume 44, #3 (1989).

than usual, starting on February 23rd and continuing for two months (late April is when these irises normally *finish* flowering).I suggest planting several clones, known to bloom at different times, varying between ‘forward’ and ‘cold’ spots in your garden: that way, you'll extend the flowering season, and even get to enjoy those particular hybrids twice.

Remember, the bulbs need to regenerate, so the last thing you want to do is disturb them while they are in growth. Some gardeners find daffodil leaves messy and so they either cut them shorter or tie them up: I certainly don't advise this maltreatment for reticulatas. Wait until the leaves start to turn brown, only removing them when they come away with a light tug. Otherwise you are only ruining next year's bloom! A pinch of a low nitrogen fertilizer at the beginning of the bloom season is good for bulb regeneration. And be aware that the flowers form in late summer; undue desiccation at this stage will inevitably lead to disappointment. But those who obey the easy-to-follow rules can anticipate a vibrant, varied display; the names that I have coined (*II.* ‘Star Light’, ‘Tiger’, Sea Green’, ‘Storm’, ‘Surreal’ and the rest) are provisional at present, but give an indication of the extraordinary colour breaks that have arisen.