

CLASSIFICATION OF IRISES

Presented at Convention 2011 by Gwenda Harris

I am to talk to you about the curious and complex business of *Iris* classification and would like to acknowledge the assistance of Tony Hall who has ensured that this information is as up-to-date as possible.

Then Judith Neilson will chair a panel ready to answer questions on most subjects, but particularly on classification. Judith already has a few questions in hand, which will serve to introduce the panel, but please take a note of anything you would like to ask.

We are in a good place. Betty Adams of the Nelson Group, was noted for being one of the Society's more informed members, Karen Glasgow was a former Editor and President and Nell Edwards had this garden full of irises and alpines. All three researched and contributed interesting articles on classification and other subjects for the Bulletin and the tradition seems set to continue. In the 1980's Betty Adams wrote that *Iris* classification had reached a reasonably stable framework. I suspect I am about to rock that boat. In the 1980's for example, irises were in the Liliales, but now they are in the Asparagales Order.

Irises belong to the Iridaceae along with other familiar plants like crocus, freesias, gladioli and watsonias. The Iridaceae overall can produce flowers on more days of the year than any other plant family and is one of the few families that can flower in any type of soil, situation or climate. This does of course depend on your growing a wide range of species and/or hybrids. The three main groupings according to size are Subgenus *Iris* – the bearded irises; Subgenus *Limniris* – the beardless; and Subgenus *Scorpiris* – the Junos.

I will pass around a pictorial chart showing some Mediterranean plant families. Interestingly, *Hermadactylus tuberosus* – the widow or mourning iris- is depicted. It is one of those awkward plants that is sometimes included with the irises and sometimes not. In 1993 when this chart was published it was not included, but recent molecular work has now shown that it should be *Iris tuberosa*. Some other species that were ousted in the past are also included again for instance *Iris domestica* (syn. *Belamcanda chinensis*) and *Iris dichotoma* (syn. *Pardanthopsis dichotoma*). I will also pass around pictures of some Mediterranean irises to compensate for their exclusion from the family chart. Although irises are believed to be Eurasian in origin, other members of the Iridaceae may have been Gondwanan. When Gondwana split up one collection of Iridaceae went to South America and another to South Africa. Australia was left with *Orthrosanthus* and *Patersonia* species and that primitive, monotypic, endemic Tasmanian *Isophysis tasmanica*. New Zealand has only some of the *Libertia* species.

Contemplating the fossil records some samples, like leaves from the *Ginkgo* tree are still easily recognised, but others are a mystery. The rate of evolutionary change does not appear to be constant. Some plant lineages continue to diverge over many generations, others remain relatively unchanged or have become extinct. Probably what started the plant classification process was the need to know which plants were edible and which were poisonous.

The oldest pictured iris is on a fresco at Knossos on the Isle of Crete. Greeks revered the form and colours of the Iris and Aristotle was the first to coin the words "Genus" and "Species". Egyptians saw the iris as a symbol of power and majesty and many appeared in religious paintings in the Medieval period. Irises were planted on graves in Muslim countries and it is believed that Chinese gold miners brought *Iris albicans* to New Zealand for this same reason. The word "species" in Latin means "kind", that is different kinds of organisms that can breed with one another, but not usually with other groups. There are about 260 *Iris* species and a huge number of other irids – all members of the Iridaceae.

Carolus Clusius (1526-1609) was a Flemish botanist thought to be the first truly scientific botanist. He developed the concept of the Botanic Garden, introduced the tulip, and named 12 *Iris* species. He apparently said "long experience has taught me that irises grown from seed vary in a wonderful way." We can all probably relate to that.

Dr Rodionenko, Tony Hall and others suspect that the Spurias are the most ancient of extant *Iris* species and DNA work at Kew has shown that *Iris speculatrix*, that Berry Judd used to grow so well, and which is sometimes associated with the Evansias, is sister and probably ancestral to that group. Arising in

Eurasia the *Spurias* migrated rapidly because their waterproof seed pods can travel by wind and water. When they reached the Iberian Peninsula it is thought they may have lost their rhizomes and evolved into the bulbous *Iris xiphium*. Dr Rodionenko also linked *Iris lactea* and *Iris foetidissima* with the *Spurias* and Kew's DNA work certainly confirms the latter. Dr Rodionenko's comments on the ability of geographically widespread species to hybridise freely has been demonstrated by the hybridising work of Tomas Tamberg in Germany. And Dr Rodionenko started me into crossing forms of *Iris lactea* and *Spurias* as I had a good collection of both. I did try, and will continue to do so, but they so rarely flower at the same time.

Dykes had also noted that the flowers of the *Spuriae* resembled those of *Iris xiphium* and that both of those and *Iris foetidissima* exude droplets of nectar from the base of their flowers, which may have something to do with a sometime pollination by ants. Dykes collected *Iris maritima* from the marshes between Provence and the sea and then puzzled over similar *Spurias* found in Asia, the Caucasus and Kashmir. He also noted that the shape of the ovary in the *Spurias* was different from that of every other iris except some of the Louisianas, and thought the latter might be the *Spurias*' American counterpart (although it could just as easily be a parallel adaptation to a similar habitat). Louisiana seed pods also have that waxy waterproof pod which enables them to float and form new colonies in the Everglades and swamps of southern North America.

Botanists who are responsible for the formal classification of irises are subject to the International Code of Botanical Nomenclature – a type specimen must be designated, given two Latinised names (written always in italics), housed in a Museum or Herbarium, described in Latin and published usually in a botanical journal. (However, new, revolutionary rules were agreed at the XV111 International Botanical Congress held in Melbourne in July, 2011. (I have still to become familiar with these). Before publication the paper needs to be peer reviewed by often as many as five other scientists to make sure that the information is as accurate as possible. Unfortunately, irises are often too chunky to make really good Herbarium specimens and sometimes the Latinised names cause confusion. Does “biflora” mean two flowers on a stem OR a plant that flowers twice a year? Tony says, definitely two flowers on a stem.

In the C19, professional botanists made these classifications and calculated a country's natural products. Amateur botanists, mostly women, largely identified plants and Botany became a popular subject to teach to children. The word “botany” reflects the C19 tensions between the study of plants, their vital processes and interactions with the environment, a domain now of specialist garden societies, and separate from the “new” laboratory-based botany taught in Universities.

History of Classification

The history of classification starts with Carl von Linne, better known as Linnaeus (1707 – 1778). He was Swedish, a doctor, botanist and gardener and the author of the binomial or two-word classification still used today (although watch this space!) - a “genus” for the section of a particular plant family, in our case genus *Iris* and a “species” name used descriptively. For example *Iris halophila* (salt-loving), *Iris maritima* (by the sea), *Iris graminea* (grassy), *Iris crocea* (golden), or *Iris albicans* (white or whitish). Alternatively, the species epithet can identify the place where it was found *Iris persica* (although confusingly, this species is NOT found in present-day Iran or Persia). Alternatively, the epithet can honour the person who found it, for example: *Iris forrestii*.

At first one might wonder how such different-looking plants as *Evansias* and *Onco*'s can end up in the same botanical family. Some have beards, some crests and cane-like stems; roots can be stolons, rhizomes, bulbs or swollen appendages, etc. Recent work by Tillie *et al.* has shown that bulbs have evolved independently in different groups of irises and *Iris verna* (which has a minute beard on its falls) has been moved from being the single representative in series *Vernae* to a major division of genus *Iris* that includes all those groups and/or species that exhibit a pronounced ridge, beard or crest of sorts and often an extensive root system.

Although Linnaeus shocked some of his contemporaries, he classified plants according to their reproductive parts – the sexy bits. And iris parts come in threes: 3 stigmas and 3 stamens; there are also 3 standards, 3 falls, and a 3-chambered capsule or seed pod except for *Iris tuberosa* which is uniquely 1-chambered. Another complication arose because Linnaeus worked pre-Darwin, in an age when plants were thought to have been created all together by a master-designer. Linnaeus classified 24 irises as well as all other plants known at that time.

Charles Darwin, aged 22 embarked on HMS Beagle, as naturalist in 1831 for a 5-year journey. Although the expedition visited New Zealand, Darwin found the native people more interesting than either the flora or the fauna. Most of his discoveries were centred on islands like the Galapagos and on South America. His famous study on finches was carried out on this voyage. Before the publication of 'On the Origin of Species' in 1859, he was so anxious about the effect of his findings that he immersed himself in a 10-year study of barnacles, until other scientists began to reach the same conclusions he had himself reached, and he was forced finally to publish.

William Dykes (1877-1925) did not make a classification of irises, but he wrote a monograph 'The Genus Iris' published in 1913, and this has proved enormously useful to both botanists and gardeners. He collected irises from all over the world, grew them in his garden, cross-pollinated some and observed the results. He set out to raise every known species of *Iris* from seed. He was a schoolteacher and then secretary of the Royal Horticultural Society and achieved an amazing amount before being killed in a car accident, aged 48. The British Iris Society has honoured his memory with the Dykes Medal, the highest award for iris breeding.

The very readable 'The Iris' by Brian Mathew was first published in 1981 and has since been updated. It contains a key and splits the genus *Iris* into subgenera, sections and series but does not purport to be a thorough botanical revision because many iris areas were still in war zones - and that is still the case. However, as Anna Pavord wrote recently "it is harder to get this man to acknowledge his achievements than it is to get *Iris falcifolia* to flower" *Iris falcifolia* is a curious iris, close to the Regelias with a scattered beard on both standards and falls. Brian Mathew is a taxonomist, author of many papers and books on irises, small bulbs especially crocus, and other plants. He is an outstanding speaker on all these subjects. He has noted that one needs to have the right sort of mind for classification work. His breakdown of the genus in 'The Iris' was based on the very important work by G.H.M. Lawrence in 1953, a reclassification of the genus *Iris* by Rodionenko in 1961 and the later work of J.J. Taylor, 1976.

The British Iris Society published an English translation in 1987 of 'The Genus Iris L.' by Dr Rodionenko from St Petersburg. This was first published in Russian in 1961. His classification is not entirely accepted by Western botanists. Dr Rodionenko, spent more than fifty years studying irises, a period interrupted by the war, in which he nearly lost his life.

When I stayed with him he took Alison Nicoll and I to the St Petersburg Botanic Garden, summoned the staff, armed with spades, and said "What would you like to take home?" It was so disappointing, as the garden was full of irises, especially *Sibiricae*, at peak bloom. It is always difficult to get plants through Customs, but impossible if they are irises in full growth.

His book is interesting for many reasons, but I enjoyed his speculation on what the ancestral iris may have looked like, "a light-loving perennial of open spaces or woodland clearings like ... *Iris unguicularis*." Tony Hall agrees and adds that this is the most primitive of all iris flowers and certainly ancestral to the whole of the beardless irises. Food for thought.

Zhao Yu-tang and Jim Waddick's 'Iris of China' was published in 1992. China has more species of native iris than any other country, but because China has not always been accessible many were first described from elsewhere, for instance, *Iris japonica* and *Iris tectorum* from Japan and *Iris lactea* from Russia as well as *Iris ruthenica*, *I. maackii*, *I. sibirica*, *I. sanguinea* and *I. typhifolia*.

The cultivation and hybridisation of irises were not of particular interest to Chinese horticulturists.

Wilson suggests that Mathew, Lawrence and Dykes all emphasised characters such as crests, seed arils, and types of underground organs as similar structures, but these do not necessarily indicate that the plants share a common ancestor. There are so many reasons why classifications prove difficult, but a complicating factor may be that the Iris Genus is so ancient, so mobile, and so promiscuous.

Then there are 'lumpers' and 'splitters'. Some botanists see every tiny difference as a reason for splitting or separating out species, series, or sub-series. Others are prepared to 'lump' them all together until more research results are available. Dr Rodionenko tends to be a splitter and his classification has a number of differences to those used by the British Iris Society and the American Iris Society. This does not necessarily mean that one classification is 'right' and the other 'wrong'. However, some are more 'natural' attempts at classification. As Jean Witt notes in the introduction to the SIGNA Checklist of *Iris*

species, “we are not unmindful of Dr Rodionenko's alternative classification system but the United States is reluctant to let any garden-worthy plant escape from our favourite genus”. Bob Pries of SIGNA reminding us that Taxonomy is now renamed “Plant Systematics” claims that the American Iris Society's Iris Encyclopedia – in preparation – represents a dream of assembling all iris knowledge in one place. It is a noble thought, but I am reminded of Anne Blanco White's comment when 'A Guide to Species *Iris*' went to print that it would very shortly be out-of-date.

Professor Maretta Colasante, the Italian botanist who spoke at the Tauranga Symposium maintains that the terms used by Iris Societies are misleading. *Iris lutescens* in Italy can vary from 3 – 50 cms in height: hardly a dwarf. Nigel Service who has searched exhaustively for wild (mostly bearded) species throughout Europe describes this species as very diverse and variable in the British Iris Society's 'A Guide To Species *Iris*'.

Chromosome numbers can also confuse. Quite different numbers can imply a greater genetic difference than there is. Similar numbers can indicate a close relationship even if the populations are geographically widely separated. Pacific Coast irises and the Sino-Siberians share a chromosome number of $2n=40$ and they cross quite easily. This may imply that they share a relatively recent ancestor; because they have been physically separated they may evolve separately.

Dr Simonet of France, in 1932 was the first to study cell structure and count chromosomes. Each cell in a given plant has the same number of chromosomes except for the reproductive cells – the pollen and the ovules have half the number and these combine at fertilisation, as long as each chromosome has a mate and all goes well in this “fancy dance of the chromosomes”.

Iris chromosome numbers range from $2n=14$ to $2n=108$. Angiosperm (flowering plant) numbers range from $2n=4$ to $2n=250$. Chromosomes contain a single thread-like molecule or small particle of double-stranded continuous DNA and protein – an impressive feat of packaging. A length of this able to reach from the earth to the sun would weigh only half a gram. Even a cell of the common trillium, wake-robin, contains 68 metres of DNA. It can only be seen under a light microscope.

So classification has moved from Linnaeus' 'sexy bits' to focus on the difficult task of attempting to reconstruct evolutionary history, including the fossil record, and examine both physical appearance and genetic information. Findings are shown on a branching tree diagram known as a clade which is a group composed of an ancestor and all its descendents, having considered leaf anatomy, root systems, seeds and pods, geography and how mountains, rivers and oceans provide a physical boundary - and divergent gene pools. As well as study the reproductive system, botanists now count and compare chromosomes, analyse pollen and DNA. Tony Hall has allowed me to show you the latest clade drawn up for his work with Junos. Like so many published clades this one consists only of the DNA results of molecular sequences, and none of the above-mentioned disciplines.

I suppose the DNA analysis resembles a sort of up-dated x-ray examination. One collects the plant material, keeps it cool or dry on silica gel for transport to the laboratory, grinds it in liquid nitrogen, and freezes it at -80 degrees centigrade. It is then precipitated in ethanol with ammonium acetate to produce a symmetrical amplification of double-stranded DNA which can be seen after electrophoresis and staining with ethidium bromide – a liquid which can be harmful to human tissue, producing a vapour which can irritate eyes and throat. I have only done it once!

More recent work

Because the Iridaceae family is so ancient and has such a long history of cultivation, plant breeding and selection, it is, especially in New Zealand, a particularly complicated group to study. In my attempts to grow *Iris clarkei* from seed I have frequently needed to go back to square one. I had great germination with *Iris clarkei* and built up a big population, solid stems and that distinctive butterfly-like marking on the falls – but in such a range of colours. “A hybrid swarm” said Tony Hall, dismissively. A hybrid swarm occurs when two species cross and the resulting hybrid then crosses back to one or both parents. It is also called local introgression and the Louisiana irises of southern Louisiana have been models for understanding this kind of plant behaviour.

In the 1930's there were thought to be 80 Louisiana species. Further work has now recast them into four basic species, plus numerous hybrids. Some botanists believed that introgression (and also reticulate

evolution) was relatively common and an important force in plant evolution. Although this view has been challenged, recent molecular studies have supported the hypothesis (and the bearded irises are a good example). *Iris nelsonii* for instance, is a diploid hybrid of three species: *Iris fulva*, *Iris hexagona* and *Iris brevicaulis* - that is, a hybrid of two of those species crossed with the third. The sequence is not yet known.

A major study that has been ongoing recently, to be published in the near future, is a monograph on the *Scorpiris* – or junos –irises by Tony Hall and Dr Arnis Seisums of Latvia. The research has apparently thrown up a number of surprises. Dykes listed 17 junos and was aware of three more described by Madame Olga Fedtschenko, but not included because he was unable to access seeds, bulbs or satisfactory herbarium specimens. Tony Hall lists 59 species and a number of subspecies in various natural or sister groupings and there are more than a few new species to be described. The DNA results, published two weeks ago confirm that the *Scorpiris* (junos) do belong in genus *Iris* and not as Dr Rodionenko has suggested, in a separate genus. Some species not previously thought to be have now been shown to be related, but we will have to await the monograph for details like the precise position of subgenus *Scorpiris* within *Iris*. Those of you who know Tony won't be surprised to learn that he describes the three main types of pollen found in junos as “hamburger-like”, “spiny” or “football-like”.

Pollen grains vary in their method of release from the anthers, in size, shape, type of aperture and outer wall sculpturing. They also vary in durability. Some grass pollen remains viable for only minutes while the pollen of other plant families may remain viable for years if properly stored. This is of great use to hybridisers. Most pollen needs electron microscopy in order for one to study its features clearly.

Another release due for publication about now, is the volume on Iridaceae for a new Italian Flora. Professor Maretta Colasante is the author of this volume and Tony Hall has worked with her on the English translation. Maretta has written a number of scientific papers and discovered four new $2n=40$ taxa probably ancestral to *Iris germanica*.

Whole suites of characters deemed to be relevant to plant classification go in and out of fashion over the years, making huge difficulties for those working on Floras, some of which take 50 years to complete. Consequently it is often really difficult to stabilise plant names.

Carol Wilson who 14 years ago spent 5 months at the University of Canterbury and has since been at the Portland State University and is now at the Rancho Santa Ana Botanic Garden in California, has published a number of papers on her work with *Iris* DNA, some of which has been funded by the American Iris Society Foundation and some of which she carries out in her spare time. There are approximately 260 *Iris* species and she has worked with 104 of them as well as 6 related genera. A paper on the *Californicae* in 2003, was the first DNA paper on a specific *Iris* group. It was helpful that all Pacific Coast irises have the same chromosome number and strong geographic cohesion, as most have narrow ranges in a relatively small area.

A paper on the *Limniris* (beardless) section published in 2009 shows *Iris sibirica* separated out and embedded with the *Laevigatas*, *Iris pseudacorus*, *Iris versicolor*, *Iris virginica*, and *Iris setosa*. Shock, Horror. When I queried this Carol Wilson explained that this finding had confused others as well. The sample used had been sent from a colleague in Georgia and was collected in the Caucasus, which should have been a good collection area as the type specimen was in a herbarium in Georgia. Carol had seen that, but it was too early in the season to collect live material. This work will be rechecked. Tony Hall says this emphasises the danger of unvouchered studies and may explain how *Iris falcifolia* came to be positioned with the junos in the 2011 paper.

Part of the confusion surrounding the *Sibericae* may have arisen because *Iris sibirica* was found in the wild in Russia and northern Europe while others were discovered in Yunnan, China – *Iris delavayi* (1895), *Iris wilsonii* (1907), *Iris forrestii* (1910), and *Iris chrysographes* (1911). Dykes would hardly have had time to flower these from seed before his monograph was published in 1913, and he would not have known about the chromosome differences. Dr Rodionenko separated them out but acknowledged that this view was not accepted by Mathew. However, the work of Tillie *et al.* supports the two groups, *Iris sibirica*, *Iris sanguinea* and *Iris typhifolia* and the other group containing *Iris chrysographes* and all the other remaining *Sibericae* species.

In a more recent and much broader study of genus *Iris*, Wilson (2011) has removed series *Unguiculares* from subgenus *Limniris* and placed it in its own subgenus *Siphonostylis*. The series

Spuriae has also been removed from subgenus *Limniris* and placed in the resurrected subgenus *Xyridion*, now broadened to include *Iris foetidissima*. Subgenus *Xiphium* has been enlarged to include the *reticulatas*.

Sometimes researchers' findings can make one feel that the world has turned upside down, and some growers undoubtedly would just rather get on with their gardening. That is fine, but for those of us who relish a little curiosity and complexity there is an ever-changing world out there just waiting to be discovered – and of course to be classified.

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