

- 1933 Crosses *farreri* x *veitchiorum*, *farreri* x *prolata* and *lawrencei* x (x *macaulayi*) made; earliest cultivated specimen of *G. ornata* in the Edinburgh herbarium.
- 1934 A.M. to *G. x stevenagensis* (*sino-ornata* x *veitchiorum*) and *G. x wellsiana* (reputedly same parentage); earliest specimen of *prolata* x *veitchiorum* in the Edinburgh herbarium.
- 1935 A.M. to *G. x macaulayi* 'Kidbrooke Seedling' (seedling from *G. x macaulayi*); earliest specimen of *G. 'Shawii'* (selection from *G. x carolii*—*farreri* x *ornata*) in Edinburgh herbarium.
- 1936 F.C.C. to *G. ornata* and *G. 'Devonhall'* (selection from *farreri* x *ornata*); earliest specimens of *G. x carolii* (*lawrencei* x *farreri*), *G. x macaulayi* 'Kidbrooke Seedling' and *G. 'Glendevon'* (selection from *sino-ornata* x *ornata* in Edinburgh herbarium.
- 1937 A.M. to *sino-ornata* x *ornata* subject to naming (subsequently known as *G. 'Glendevon'*); first specimens of *G. 'Edina'* (*prolata* x *ornata*) and *G. 'Devonhall'* (*farreri* x *ornata*) in Edinburgh herbarium.
- 1938 A.M. to *G. 'Glendevon'* (confirmation of 1937); production of *G. 'Inverleith'* (*farreri* x *veitchiorum*) and *farreri* x (x *stevenagensis*), subsequently called *G. 'Fasta'*; first mention of *G. x bernardii* (*sino-ornata* x *veitchiorum*, the reciprocal cross to x *stevenagensis*) in the literature.
- 1939 Earliest specimen of *G. x bernardii* in the Edinburgh herbarium.
- 1941 Earliest specimens of *G. 'Inverleith'* and *G. 'Davidii'* (seedling from *G. 'Edina'* in Edinburgh herbarium.
- 1942 First mention of *G. 'Davidii'*, *G. 'Shawii'*, and *veitchiorum* x *ornata* (subsequently 'Orva') in the literature.
- 1945 A.M. to *G. 'Orva'*, and earliest specimen of this in Edinburgh herbarium; first mention of *G. 'Farorna'* (*farreri* x *ornata*, the reciprocal cross to 'Devonhall') and *G. 'Fasta'* (*farreri* x (x *stevenagensis*)) in the literature.
- 1953 A. M. to *G. 'Inverleith'*.
- 1958 F.C.C. to *G. sino-ornata*; A.M. to *G. 'Sinora'* (*sino-ornata* x *ornata*); earliest mention of *G. x carolii* in the literature.
- 1961 First mention of *G. 'Kingfisher'* (seedling of x *macaulayi*) in the literature.
- 1968 A.M. to *G. 'Susan Jane'* (selection from *G. 'Inverleith'*).

New Lilies by Embryo Culture

by Dr. CHRIS NORTH

THERE ARE about eighty wild species of *Lilium* and several have been intercrossed to give such well known garden plants as the Mid Century Hybrids like 'Enchantment', the Olympic Hybrids and the old Nankeen Lily (*L. x testaceum*). However, by no means all the species combinations of lilies derived by plant breeders can be achieved simply by carefully manipulated artificial cross pollinations. In many cases crossing fails not only because the particular hybrid combination is itself inviable, but because something goes wrong during seed development and no germinable seeds are produced.

The process of fertilisation and seed development in flowering plants is complex and fascinating. Contrary to popular belief, the pollen is not itself the male sperm; it is a specialised organ which produces a tube to grow down to the waiting egg cell and carry two male sperms,

one to fertilise the egg and the other to fertilise a group of attendant cells known as the polar nuclei. The fertilised egg develops into the new embryo hybrid plant and the fertilised polar nuclei become a tissue called the endosperm which acts as a kind of nurse to the embryo and, in lilies, persists in the seed as a food supply to tide over the new plant until it can develop a green leaf and fend for itself. Without the endosperm the embryo cannot develop as it is unable to obtain its nutrient supplies directly from the mother plant.

In some wide species crosses in lilies, the egg cell fertilisation proceeds normally but the parent components of the endosperm disagree so that the endosperm cannot perform its proper role. The reason for this is not fully understood. The fertilised endosperm comprises the same genetic male and female components as the embryo, though in different proportions. Three female nuclei combine with one male sperm to produce the endosperm whereas equal parts of both components give rise to the embryo and it is probable that this imbalance of genetic components is associated with malfunction of the endosperm.

Faulty endosperm may permit normal development of the embryo and the production of seed but produce a poison which kills the embryo when the seed is soaked as is often the case with crosses between *L. speciosum* and *L. auratum*. More often the endosperm dies at an early stage of development so that the embryo is starved and either dies or ceases development and remains very small as we found at the Scottish Horticultural Research Institute when *L. lankongense* is crossed with *L. davidii*. Failure to produce germinable seeds from some crosses may be due to a combination of both these effects as when *L. pyrenaicum* is crossed with *L. carniolicum*.

If the small hybrid embryo is isolated from the mother plant and given an artificial food supply to take the place of the endosperm, it often will grow into a viable plant and give us a hybrid between two species which is otherwise unobtainable. Embryos are dissected from the developing seed by a surgical operation and each is transferred singly to a small screw-top glass bottle containing a nutrient jelly made of agar, essential salts and sugar. The operation has to be done under sterile conditions and the bottles of nutrient are sterilised in a pressure cooker and allowed to cool before transplanting the embryos. Bottles containing embryo are kept in warm, light conditions and when the embryos have grown into small plants with one or two leaves they are transferred to soil. In extreme cases one seed capsule from a wide cross may only contain one out of about a hundred potential seeds

with an embryo and only one in ten of these may develop into a plant which, of course, may be unique and of great interest to the breeder. As a rule the returns are better than this.

Sometimes the egg cell develops into a small embryo without fertilisation and the new plant then resembles the mother parent and is not a hybrid. Often it can be clearly seen whether the plant is of hybrid origin by the intermediate nature of the leaf and flower features, but for confirmation and for an early appraisal of the situation, the plant may have to be examined cytologically to see whether the cells carry chromosomes from each of the parents.

Most of the hybrids produced with the aid of this embryo-culture technique are sterile and do not produce seeds, so they can only be propagated vegetatively. This is no great disadvantage as nearly all lilies are easily reproduced vegetatively by bulbils produced on bulb scales.

Not all the hybrids obtained at the S.H.R.I. by this technique are of horticultural merit, but those of *L. lankongense* crossed with various Asiatic lily hybrids, including, for example, 'Enchantment', are especially promising. The plants have flowers of a wide range of colours and are pleasantly scented. They are especially suitable for growing in groups amongst shrubs and in the wild garden. Two cultivars, 'Ariadne' and 'Adonis', with pink and mauve-red flowers respectively, are already available and three others, 'Eros' (pink), 'Theseus' (red), 'Pegasus' (ivory) will shortly be available. A wider range of new material which will be selected this year can be seen at Mylnefield during the second or third week of July.

Two other Mylnefield cultivars of quite different constitution and from embryo culture are 'Europa' (*L. pyrenaicum* x *L. pomponium*) and 'Eureka' (*L. henryi* x *L. tigrinum* hybrid). The former grows vigorously in the garden and resembles a strong-growing *L. pomponium* with many scarlet flowers and neat narrow foliage. The latter has only flowered in the glasshouse but seems to be a vigorous plant like an early flowering *L. henryi* and produces some stem bulbils. Recently North American lily breeders have shown considerable interest in embryo culture and one hybrid produced in Minnesota of the Easter Lily *L. longiflorum* with a pink trumpet cultivar of the *L. leucanthum-L. sargentiae* complex sounds especially exciting.

Embryo culture is essentially a laboratory technique and may sound complicated, but is not out of reach to the enthusiastic amateur breeder. I shall be pleased to give further details to any reader who would like to try to make use of it.