ANIGOZANTHOS MANGLESII

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Anigozanthos manglesii, the kangaroo paw of Western Australia, is a very striking plant when flowering. It grows in open Eucalyptus forests and is quite common in Kings Park in Perth, where in September its striking red inflorescences with violently green flowers stick out above the multicolored low flowering shrubs and herbs. Deep-blue masses of Leschenaultia and Dampiera alternated with yellow and orange and brown Oxylobium, pink Hypocalymma, yellow Hibbertia, or purple orchids, but the inflorescences of Anigozanthos almost eclipsed all these other striking flowers.

The plant itself is not at all striking; on the contrary, without flowers it resembles an iris, freesia, or any other similar plant with sword-like leaves which are not particularly neat, and of which the tips are usually almost black, as if they were singed. It grows easily from seed, and it can stand almost any temperatures above freezing.

After about a year, the oldest part of the plant may start to shoot. At first the inflorescence is light-green and somewhat fuzzy due to hairs on stem (and some on bracts), but then, as the stem elongates, the color changes, and soon the hairs have turned a brilliant vermillion red. Since the hairs are branched and feathery, they largely cover the green stems, and thus the whole stem looks red. At the end the flowers develop. The inferior ovaries (Anigozanthos is an Amaryllid) are soon fairly large, and, although they themselves are yellow in color, they are so densely covered with hairs that they become the reddest part of the inflorescence. The corolla on top of the ovaries gradually elongates and bends down in a graceful curve. It is deep-green, and whereas the hairs on it are first red or purple, these turn green before the flower opens, and turn red again after fading of the flower, giving it an olive color.

The green color of the stem is due to chlorophyll, and the yellow or orange hue of the ovary is caused by carotenoids, the same pigments which give the orange color to carrots. These pigments are not water soluble. Therefore when spinach or carrots, colored by chlorophyll or carotene, are cooked, the water in the pan does not become colored. But the red color of the hairs of Anigozanthos is caused by an anthocyanin, a highly colored pigment which is water soluble, and which is related to the red color of pelargoniums and table beets or the blue of pansies and larkspurs. We all know how the red color of the beet comes out into the water in which they are cooked.

A portion of the sword-like basal leaves, the vermillion red flower stalks, and clusters of Kelly green flowers of *Anigozanthos manglesii.*
Photo, L. B. Martin

These anthocyanins or flower pigments have other interesting properties. They change color as they become more acid or more alkaline. The red pigment of the Anigozanthos flowers possesses this property, and, therefore, when some red hairs of these flowers are placed in an alkaline solution, they turn purple, and change back again to red when put in an acid solution.

Using the amphoteric property of this pigment, some interesting experiments can be made with Anigozanthos flowers. When such a flower or a whole inflorescence is placed in a jar, in the bottom of which some spirits of ammonia are poured, the ammonia vapors will spread inside the jar and will penetrate slowly into the red hairs. These then turn purple, changing the color of the whole plant. When they are not left too long in the ammonia vapor, the hairs are not damaged. When the stem is then placed in a jar with essence of vinegar in the bottom, the vinegar vapors will counteract the alkalinity of the ammonia which has penetrated into the cells, and after some time the hairs—and the whole stem—turn the same brilliant red they were before. This can be repeated many times, and thus this plant could be made to conform with the color scheme of the room in which it is used!

The essence of vinegar vapors cause another change. The hairs on the corolla, which first were green, turn red too, and thus not only the color of stem and ovaries changes, but that of the flowers too.

All sorts of variations on this general theme can be produced. If a jet of ammonia vapor is directed on a short segment of the stem or on one flower only, this segment or flower only changes color. Or with the proper dilution of the vapor in-between colors can be produced.

In the Earhart Plant Research Laboratory of the California Institute of Technology a number of Anigozanthos plants were raised from seed. When they were big enough, they were transplanted and groups of four plants were placed in five different greenhouses under five different temperature conditions. In the hot greenhouse they were kept at 86° during day and at 73° during night, in the warm greenhouse at 80° and 68°, in the temperate greenhouse at 73° during day and 63° during night, in the cool greenhouse: 68° day and 57° night and in the cold greenhouse they grew at 63° during day and 53° during night. For many months the plants grew well under all five conditions, only somewhat slower in the cold greenhouse. When they were about ten months old, the plants in the cool and cold greenhouses, and a month later also in the temperate greenhouse, started to form inflorescences. In the warm greenhouse one plant has finally started to form a very poor stalk, but in the hot greenhouse no trace of inflorescence formation can be seen. This experiment shows that in *Anigozanthos manglesii* flowers can only be formed under cool temperature conditions. Therefore this plant flowers in spring when the low temperatures during winter have induced flower formation (in Australia spring comes in September, of course).

The temperature treatments caused other responses as well. In the temperate greenhouse much less red pigment developed in the hairs, therefore the stems appeared pink and the ovaries orange. Also a much smaller number of flowers opened; most of the earlier flowers aborted. Therefore, when one sees these plants growing outside, it is possible to tell what the growing conditions were during the development of the flowers.

Every plant is the product of its internal potentialities (hereditary background) and the environment under which it developed. To get a really first class plant it is not enough to select one with a desirable parentage, and to feed it properly; one has to take care to give this plant just the right growing conditions as far as light and temperature is concerned. We hope that the Arboretum, in cooperation with the Earhart Laboratory, will contribute much useful knowledge about the optimal growing conditions of some of the more spectacular garden plants. This is not just theoretical knowledge; through shading or growing plants in different exposures, a gardener has a fair range of possibilities, in his own garden, even without the help of a greenhouse.