THE STORY OF THE BEGONIA

CHAPTER 1

History was never a favourite subject of mine. I must have been badly taught because I used to dislike it intensely. Sitting among my begonia blooms, however, with their exotic colours and huge heads bowing and supported by stakes, I have often wondered about their past. Through what devious ways have these plants and the few species that I keep, found their way into this atomic age and into this modern all electric greenhouse? For the past three hundred years the story can be fairly easily unfolded and has been told in words and pictures but beyond that WHAT?

Let us for a few moments put the time clock back, back, back. Climb with me high up in the Drakensberg Mountains of equatorial Africa and under the burning sun watch a black primitive man, almost in appearance like an ape, squatting outside a cave and eating a plant, the Bush Begonia {B. Sutherlandii}. Now let us go further east to Asia and in a steaming jungle track in Assam, pause for a moment while a brown skinned native stoops to pick a gaudy leaf of a Begonia Rex and stick it in his hair. East again, and let the mists of time swirl us into the ancient civilisation of China here a wrinkled old yellow pottery painter has a spray of B. Evansiana laid before him to copy. Across the Pacific and can you imagine the olive brown heel of an Inca warrior crushing the bright scarlet flowers of B. Davisi as he stumbles through the warm mists of a Peruvian mountainside two thousand years ago? Sometimes it was a small place, sometimes a large one, from Java to Mexico, from Brazil to the Indian Ocean the begonia family were spanning the world.

Of course, we are away ahead of history in calling these plants begonias. It wasn't until the middle of the 17th century that explorers, priests, sailors and medical men of all nationalities began to bring leaves, pressed flowers and some living plants to Europe. Each had their own name and what names! Totoncacoxo coyollin, tajeria narinampuli, aceris fructu herba anomala, and so on. It was not till 1690 that a French botanist, Charles Plumier, named one of these plants after his patron, the Governor of Santa Domingo, Michel Begon. Thus the family name arrived and the first chapter of begonia history was written.

CHAPTER 11

In our very brief introduction to this long and varied story in , we skipped blithely back through time and whizzed round the tropical belt of our Earth at an even faster rate than Yuri Gargarin. In order to do our story justice, we will have to slow down and move step by step. But what size of steps are they to be? Look for a moment at these facts. We know that the first begonia was described in drawings in 1649 by a monk, Franz Hernandez, in Mexico. It was a tuberous type with single bell-like drooping flowers. Let us now take a step of nearly a century and a half to the year 1789 and we find a Swedish botanist living in England with the delightful name of Jonas Dryander, busy describing the 21 species now in Europe, which has been brought in from Java, Madagascar, India, Japan and the Americas. If we now take a hop to 1847 we find that Europe has between 70 to 80 species in cultivation. Another step of over a hundred years brings us to our present time with over a thousand species described in the books and many, many thousands of hybrids derived from these. We can thus see just how enormous this story has become and to give you the full details of the discovery and development of each species and its hybrid varieties would bore you and me stiff quite apart from using up innumerable bulletins! We will content ourselves with brief sketches of some of the more interesting happenings in the begonia world.

But first, how are we going to classify this mixter, maxter of plant life? How are we going to bring some sort of order to this heterogeneous collection of begonias? For even in the begonias that I have personally seen or read about one has a stem one and a half inches {B. Prismaticarpi}, one a stem of fifteen to twenty feet {B. Luxurians} and one has no stem at all, the leaves and flower arising direct from the tuber {B. Octopetala}. I've found begonia leaves with hair and some without, some with red veins and some with green and some leaves shaped like the Castor-oil Plant, the Maple and even like the Palm tree. I've seen begonia flowers like miniature apple blossom, like the Fuchsia and you are familiar with the Rose and Camellia centres of our modern varieties. Some begonias can be found in the mountains of Ecuador at a level of 10,000 feet and they can be seen clinging to the crevices of cliffs in the Philippine Islands, their leaves wet with spray from the ocean breakers. What a family! What a shower! But don't despair, my friends, for there is one broad fact emerges when we examine these plants. We can separate our begonia family into four classes because of the difference in their rooting systems. Even this method has been mucked about a bit by different botanists in different parts of the world but the generally accepted basis is as follows:-

<u>One</u> The tuberous rooted begonia is probably the most popular in the world today and this is certainly true in Scotland. In fact some growers know no other type. When we deal with this class in more detail in some future bulletin you will find that even here we can sub-divide it into Single and Double flowered, Scented, Pendula, Multiflora, etc.,

<u>Two</u> The fibrous rooted class is next in popularity and this is very much so in America, where they make collections as house plants. For that matter how many houses do you know that have its B. Haageana sitting on the window-sill with its hairy green and reddish leaves?

<u>Three</u> Next we have the rhizomatous begonias from Asia and the Americas and from which the modern strain of Rex Begonias originated. The characteristic habit of the rhizome, of course, is that the roots creep over the surface of the soil.

<u>Four</u> The begonia that grows from a bulb is the smallest class in the family and originated from B. Socotrana found in 1880 in an arid island in the Indian Ocean. It is the seed parent of the Winter Flowering Begonias and because of the fact it is worthy of future mention in our story.

In order to understand what the hybridists have done with the early plants in their labours to produce our beautiful modern blooms we will have to digress in our next chapter and discuss the question of heredity and what takes place in the cells and the sap. We might even tell you how to produce a BLUE BEGONIA .

CHAPTER 111

In this chapter, I promised that we would discuss the structure and function of the cell, the basic unit, on which depends the nature of the vital actions of the begonia plant in growth, form and reproduction. It is a subject which can be coloured by your religious beliefs as to the origin of life. However, whether you believe in the Biblical version and Christ, Mohammed, Buddha or Lenin, the science of genetics and cytology have been used by begonia breeders through the years whether they knew the meaning of these words or not. Somewhere in the primeval past as the Earth's surface cooled, as the atmosphere was formed and the gases condensed into liquid oceans and the moon exerted an ebb and flow of tidal energy, a vital spark was produced that became LIFE with the power of reproduction. Has our recent probing with men, animals and plants into space suggested another theory that it may have come from outer space or another plant? Somewhere one of these living units became a plant thing living on land and, throughout its struggle for existence, its environmental factors have carved a pattern into the make-up of its cell so that it became different from other plants – the father plus mother of begonia was born.

All individuals, whether they be plants or animals, owe their identity to the materials received from their parents and these are present in every cell. The pollen {male germ cells} and the egg-cells {female germ cells} transmit these materials to the next generation. The union of these specials cells in fertilisation combining certain qualities of the parents forms the mechanism of heredity. The study of the cell, its constituents and its mode of multiplication is cytology and every begonia is built up from myriads of cells, differing in function depending on whether they form the skin, leaf, flower or stem pulp. Let us take a simple cell and see what it looks like if we isolate is under a microscope.

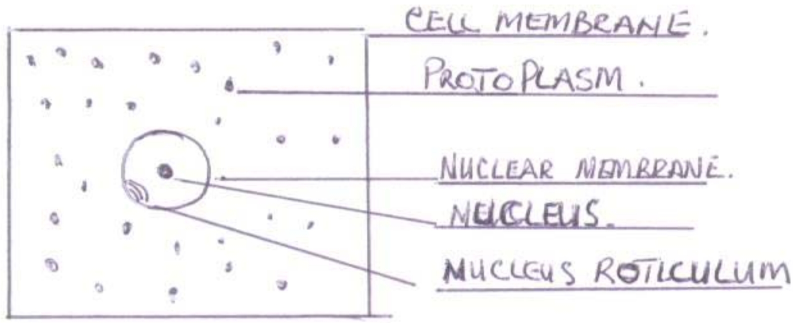


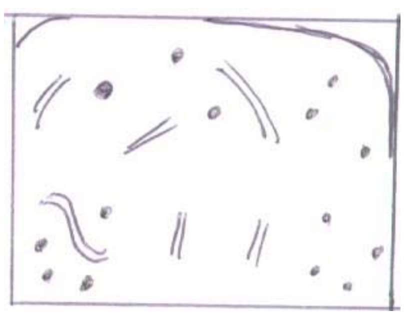
FIG I.

See Fig 1.
Around it is the cell membrane or wall which divides it from other cells and holds in the cell protoplasm. This protoplasm streams about the cell carrying liquid which maintains the tension and shape of the cell. Dotted over it we find little granules of starch, fats and proteins. Centrally there is the nucleus, which is the controlling point of the living materials. It is denser than the cell protoplasm and is surrounded by its own membrane and contains the nucleolus and reticulum.

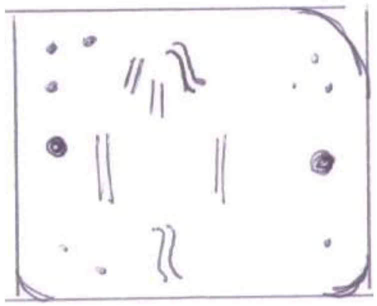
If we were to look now at a begonia cell at a point of active growth such as a root tip or the top of a growing shoot, we could see its mode of multiplication – in other words how one cell becomes two.

Figure 1 above is the Prophase or mature stage. In the following phases I will make the nucleus larger than normal because it is here that most of the activity takes place.

Figure 2. is a further stage in the Prophase but we now see that the nuclear reticulum has broken up and little threads begin to scatter within the nucleus. These threads are called Chromosomes and are vital to the cell in that they carry the units of heredity, the Gene.

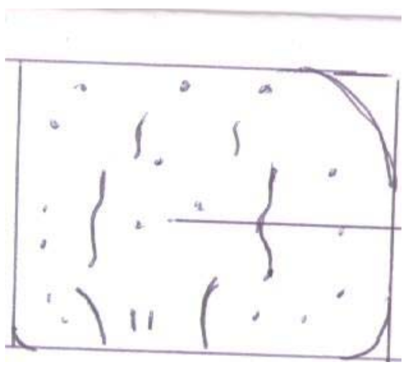


In Figure 3 still in the Prophase, we note that the chromosomes have split longitudinally but are still lying haphazardly and twining all over the nuclear space.

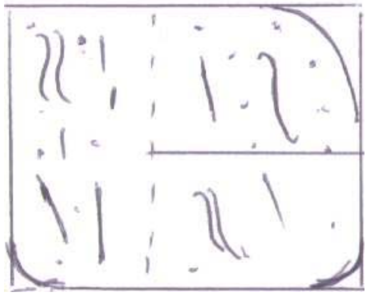


In Figure 4 we come to the Metaphase. We now see that the nuclear membrane has disappeared and that the nucleolus has formed two poles at opposite ends of the cell. Most interesting of all is that the chromosomes have moved into the centre of the cell and now lie roughly along the equator. Here they start the 'Dance of Life'.

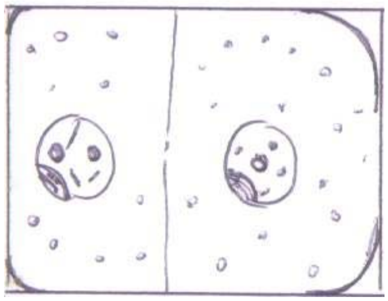
Down through the ages this square dance has been taking place in the cells of all living things. Nature, the 'caller', with tiny positive and negative electrical charges and chemical changes have called the steps – 'Honour your partners' and so on. With grace and ability, the chromosomes split completely and separate and the partners say Goodbye for ever and move to the opposite poles



{Anaphase Figure 5}. Gradually the space widens between the partners making the equator an empty dance floor and then a cell plate appears forming a wall.



{Telophase Figure 6}. The music of the dance fades as the wall becomes thicker. The nucleus begins to reform complete with its membrane and the chromosomes twist and twine their way into their reticulum home.

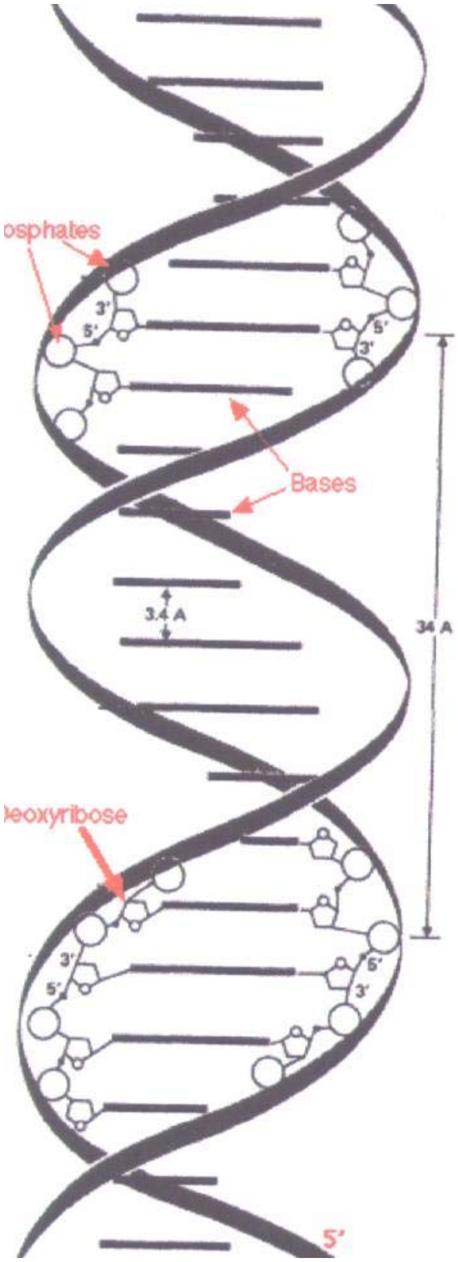


{Figure 7}. The 'Dance of Life' is over and the dancers rest. That part of that begonia is that little bit bigger. During a begonia's growth, be it stem, leaf, flower or root, this division and reduplication is going on all the time. Without this process, we could not take vegetative cuttings and be sure that when the cutting grows into a plant that when the cutting grows into a plant that it will be exactly the same as its parent. The secret of course is in the Gene, and, if you are still with me, we will discuss this in our next chapter.

CHAPTER IV.

In the last chapter we studied the begonia chromosomes as they took part in the 'Dance of Life'. We saw how they split and separated, how one cell became two with identical nuclei and thus how each part of a plant grew bigger and so to maturity. In this chapter we intend to dig deeper into what makes a begonia tick and if I were to give the subject a heading I would suggest the tile 'Rosary of Heredity'. We are almost ready now to discuss in simple language how the characteristic of the Begoniaceae, that is the family, the species and their varieties are maintained. It is a most complicated and difficult subject. It would be very easy to get bogged down in science, biology, chemistry and all the technical terms. We will try to avoid this and make the subject at least readable if not scientifically accurate.

Let us go back for a moment to our dancer friends the chromosomes. The number, size and shape of the chromosomes are the same in all the cells of a given plant and for that matter throughout the whole of that species. Take for example that popular house plant from Brazil, B. Haggeana. It has 48 paired chromosomes in the nucleus of each cell. B. Metallica has 70, B. Socotrana has 28, B. Fuchsoides has 60, while B Rex has been given 32,33,34,42,43 and 44 pairs of chromosomes by different observers. This latter fact shows that it is not easy to count these microscopic filaments. We have tried on two occasions to get a chromosome count of the double exhibition begonia but have to report failure. The nearest we can get is that the number is probably a multiple of seven.



Although the number of paired chromosomes remain constant in each cell of each plant, the length and shape of each chromosome varies. Let us take a closer look and we find that each chromosome is made up of two strands of living beads. Each strand is identical with the other, one being originally derived from the male seed parent and the other from the female. They lie tight and often twisted together. Each bead is called a GENE and is the unit of reproduction of hereditary material. Let us just remember them as the Rosary of Heredity. The beads or genes are built from complete organic chemical compounds. As every modern schoolboy knows, we can break these chemical compounds still further into chemical elements and that these elements are made up of molecules and that the molecules are build from a number of atoms, which, of course, have been in the news over the past years. We now know that each atom has its own miniature solar system with a collection of neutrons and protons {+} forming the sun or nucleus and the negative electrically charged electrons moving round like the stars. Now I ask you, did you feel like splitting the atom when you took that last cutting?

It has taken Nature 2,000,000,000 years of evolution by natural selection to produce one strange chemical substance that we find in the gene. It is a remarkable substance call deoxyribonucleic acid {DNA for short}. It is remarkable because it can tell other chemicals how to fashion a begonia seedling in the likeness of its parents! It is, however, not indestructible. A slight change in the chemical compounds of the gene or genes will mean a change in one or more characteristics of the plant. Take, for instance, the growth factor. The genes which control growth control the rate at which cell reproduction takes place, and are affected by the energy rays of heat to take one example – seed germination and plant growth. But these are reversible for it we take away the heat, germination and growth slow down. If on the other hand you bring a hormone weed killer into contract with the genes controlling growth, the plant will rapidly overgrow, its functions will fail and it will die.

Growth is only one characteristic of the control exerted by the genes. They control everything! Rooting systems, big or little tubers, thick or thin stems, tall or short plants, red or white haired leaves, single or double flowers, to mention a few. Another chemical change may produce a mutation. This may be in the form of a ‘throw-back’, a change of colour, a change from a single to a double flower, or vice versa. Unfortunately, most mutations are lethal and the begonia dies.

Now let us take the next factor that we have to consider that is the balance of power that exists between two identical beads in our Rosary of Heredity. Each bead exerts through its positive and negative electrical charges of its chemical elements an influence on its opposite number and on its neighbours – and I mean opposite. If, for example, one gene says, ‘We will make this plant tall’, the other might say, ‘No! a short plant for me’. If the first gene has a ‘dominant’ influence and the other is recessive’ then the wishes of the first will prevail and we will have a tall plant like ‘Tommy Milligan’ or ‘Miss Rankin’. If the second gene is the dominant one then we have a small compact plant like a seedling of mine, ‘Blair Atholl’, which never grows more than 12 to 15 inches. This sounds all very nice and neat in theory but, in fact, we cannot say that this is strictly true for all the genes which have a say in the control of height. For those of you who wish to take the matter further, I would recommend you to study Mendel’s Law of Segregation, where you will find it possible for two dominants or two recessives to come together on our string of beads but for the majority of times it will work out as I suggested above. Growing begonias for their flower is our main interest so in our next chapter I hope to discuss how our Rosary of Heredity affects the size and shape of our exhibition blooms.

Chapter V

In Chapter IV, the Rosary of Heredity was the title and we discussed the effect that the string of dominant and recessive bead-like genes in the chromosome had on the growth and habits of the begonia plant. We also stated that in this chapter we would see how they could affect the size and shape of our exhibition blooms. John Ruskin once said, "When leaves marry, they put on wedding robes, and have feasts of honey – and we call them flowers". To the grower of begonias, whether he be a show fanatic and puts everything he has got into the great day or whether he owns a tiny plot and invites his neighbour from over the wall to come and admire a bloom, the flower of the begonia is it reaches its maturity is the end result of the grower's work and the crown of the plant's life.

On the stage, before the ballet, opera or play blossoms forth as a production ripe for the public eye, there has been weeks and months of work by the cast, producer and back-stage technicians getting it ready, and even before that, it was an idea, a brain-child of the author, who also spent weeks and months moulding it into shape. In the same way, the perfection of a begonia bloom lying on its board on the exhibition table is the result of patient care by the grower but before that it originated as the hope of the hybridist, the man with the camel hair brush or the wee tuft of cotton wool, who married the male pollen to the pistil of the female flower. Anybody can cross begonias but unless thought and care go into the choice of the parent plants, we get a conglomerous lot of poor seedlings instead of an improvement in the species. In other work the haphazard hybridist is doing more harm than good and is doing no service to the growing public. We cannot emphasise this point strong enough.

What then do we aim at? The answer is simple – the perfect begonia flower or failing that at least an improvement on the existing varieties. What is a perfect begonia? If we asked a dozen growers we would get a dozen different answers so let us get down to the elementals and find out what makes a flower and analyse its components. To some of my readers this may sound too simple but have you ever pulled a bloom to bits and found out what makes it tick. We very much doubt if more than a few of you have done this. You should be as familiar with the anatomy and physiology of your plant and flower as you are with the percentages of your fertiliser or the components of your compost.

When the begonia plant stem grows from the tuber, it gets taller and thicker with its cell reproduction obeying the orders of the dominant and recessive genes and the chemical DNA. Leaf stems appear on alternate sides bearing the leaves, the factories of plant energy. The joint space between stem and leaf stem is called the axil and from the first, second, third and even fourth axil new plant stems appear which can be used as cuttings or allowed to stay on to give a balanced bushy exhibition plant. From the fourth axil and above the flower stem starts to sprout and from this point, we, as aspiring hybridists of a perfect double begonia, are very interested. The heredity factors of the existing varieties of double begonia plants have produced at least ten varieties in the flower stem – long, medium or short, thick, intermediate or thin stems, hairy or smooth stems and those with an upright growth habit or those which angle away from the plant stem. For our begonia creation we would want a medium length of fairly thick stem, the hairs do not matter, but we want the stem habit to grow out from the plant to carry the bloom clear of the foliage and away from the next bud. “T.P. Toop” is an example of the upright habit where the flower is tight against the stem, so much so that some growers remove every second bud to allow room for expansion. ‘Miss Rankin’ on the other hand can usually hold its bloom away from the plant on its medium thick, medium length flower stem.

Next we come to the floral receptacle which starts at the sepals, the two green petal-like leaves which enclose the flower buds and protect their young existence. There are no variables here worthy of note for the hybridist, the one sepal growing above and to one side and the other below and to the other side of the flower buds. Beyond the sepals, we have the flower stalk bearing the central double male flower and on one side a single four or five petalled female flower with its tripartite stigma and ovary joined to the flower stalk by its own varying length of stem, while opposite to this, another small stem carries a spare double male and single female flowers. There are two common variations of the above, namely, two female flowers one on each side of the central male or as occurs frequently in ‘Rhapsody’, one female on one side only. In some floral arrangements these side flowers enhance a bowl of begonias and with the pendula type they help the plant to droop but the exhibitor usually removes them as soon as possible to allow the extra sap to feed the central male and so increase its size. The hybridist will of course remove the male and keep the female for fertilising purposes. For our purpose we can ignore the above variations in the production of our perfect bloom with the one exception that we would try and breed a nice long stem on the side flowers for easy removal.

We are now left with the flower stalk and the petals of the male flower. The flower stalk started at the joint where the sepals appear and ignoring the side flowers, it has about eight important variables. We have seen the length vary from half inch to one and three quarters. It varies in thickness and the tip varies in that if it branches {and this depends mostly on the genes and to some extent on the grower} you may have a flower with a single centre or an ugly one with two, three or more centres. The petals grow round the flower stalk with a slight overlap so that the sixth petal is exactly in the same line as the first – in other words, it takes five petals to encircle the stalk. The first dozen petals and sometimes those at the tip carry at their attachment to the stalk an ill developed androecium {male generative organs} and these can be seen as flat green staments covered with abortive pollen and nectar. Due to the selective efforts of the hybridists of the past, these should not obtrude and spoil the beauty of the bloom but the tendency is there is the heredity of the cells and when the plant has been badly handled and the grower over zealous, we still see these coarse monstrosities even on the show table. For our perfect begonia we will thus need a thick flower stalk of about one and a quarter inches long with no tendency to branch at the tip and with unobtrusive stamens.

With regard to the petals, we can demonstrate over thirty six variables and all of them are evident in present day varieties. We use the term variable in a fairly loose broad sense as you have probably realised. The number of petals can vary from under thirty to over sixty so let us say that the variables are few, medium or many – after all its DNA that decides. These may be short, intermediate or long and may be narrow, medium or wide and even here we may find good wide long first petal and short seconds. The petal may be thick, medium or thin, the latter tending to flop on the show board and be a bad ‘keeper’ in the greenhouse while the former tends to coarseness. The surface texture or skin should have a fine lustre but some are indifferent and others bad. Veining on the petal is a matter of personal taste, some varieties have marked veins, some slight while others require to be looked at against the light to see any at all. Good veins are necessary to maintain the cell tension at the edges where the sap flow is poorest. The petal edge may be gently curved, wavy, frilled or crinkled with or without scalloping, while the petal itself may incurve, remain straight or reflex. The centre of the bloom may be rose shaped, camellia or wedge and these may be strong or weak depending on the tip of the flower stalk {single and multiple centres have already been mentioned}. The petals may be self coloured, bicoloured or picotee and finally the flower may be scented or not.

Those of you, who do the pools and work out permutations, will realise that there are over a million possibilities in the production of a flower among the variables in the petals alone. If you would like to try this interesting facet of begonia culture please do not be put off by the enormity of the factors involved but take a leaf from the punters – names ‘bankers’, if both parents have for instance the following ‘bankers’, a bloom which only grows a single centre with wide, long, medium thick, incurved petals then the chances are that the seedlings will also have these qualities and if the flower stem and stalk are satisfactory half the battle it won. But please by choosey! Even if it means that you have to grow several generations of seedlings to achieve one factor. The end result will more than justify the labour – the perfect begonia.

Did someone say “What about the colour problem”? What about the blue begonia”? We hope to discuss the mechanics of colour in chapter VI.

CHAPTER SIX - THE COLOUR BAR

If one takes an artist’s palette and squeezes some red oil paint and some yellow paint on to it, we can with a brush mix and produce dozens of variations of colour from yellow through orange to red. In the same way, if we take pollen with a brush from a red begonia and apply it to the pistil of a yellow begonia and supposing the ‘cross’ is a good one, then according to Abbot G.J. Mendel, who stated his findings ninety nine years ago, we should expect 50% in shades of orange, 25% of reds and 25% of yellows, if all the seed were sown and raised and if the dominant and recessive elements of heredity were not involved. You see, dear reader, how we keep coming back to heredity, cells, chromosomes, genes, molecules and eventually to atoms. If you still have them we would refer you back to the chapters on the “Dance of Life” and the “Rosary of Heredity”. We have deliberately kept the subject of colour out of our story so far, for if we go into the matter fully it can become very complicated and technical and the Secretary would have to issue a scientific dictionary with this Bulletin.

Let us therefore start with something simple such as a white begonia. Here it is a case of nature deceiving the eye, for, believe it or not, the purest white we know such as “Diana

Wynyard" or that fine "bloom" Allan King", raised and called after Scotland's greatest hybridist, actually have no colour and the cells are transparent. Cut the stem of either of these plants and you will get your fingers stained with a dark red juice but in the cells of the flower petals there is no true colour to be seen even when the bloom is at full maturity. Why then do we see a pure white? A sheet of glass is colourless and transparent but smash it down into a fine powder, gather the powder into a heap and the heap is white. This is due to irregular light scattered from the tiny bits of powdered glass, which themselves are still colourless and transparent. So it is with the petal of a white begonia. It appears dazzling white because your eye picks up light scattered from the myriads of cells which form its surface. We know of no such thing as a white chemical pigment in plant life.

This cannot be said for the other colours – the crimson, scarlet, reds and pinks or the gold, yellow and ivory or lastly, the dream of all begonia hybridists, the blue begonia. Floral pigmentation is due to chemical substances, the amount and nature of these substances have been proved to be controlled by a small number of genes in the chromosomes, the shop stewards of the plant. In other words, the breath – taking beauty of colour that overwhelms one on entering a begonia house in season is due to sap soluble <u>glycosides.</u> This term is given to the combination of one of more molecules of sugar with true colouring matter. These glycosides are to be found in the cell of the flower and if you remember our diagram of a cell, they are in solution in the vacuoles and are surrounded by protoplasm. There are two main groups of glycosides, the <u>Anthoxanthins,</u> which include colours from pale ivory to deep yellow and the <u>Anthocyanins,</u> which range through crimson, scarlet and red to all shades of blue. We will also mention here the Plastid Pigments for they form an important but smaller group, completely different from the foregoing in that they are insoluble in cell sap. They produce yellow or orange colours and because they cannot combine chemically with the glycosides they will cause a yellowing in a white begonia, intensify the yellow of a yellow begonia and form a background to a red anthocycanic to give a peach effect. So much for the plastids. We will start with the Anthoxanthins but at this stage we would remind the reader that in an article such as this simplicity is aimed at and for the keen type subjects such as methylation, malviden and 3:5 diglycoside can be found in plenty botany books.

<u>Anthoxanthins</u>

These sap soluble glycosides are responsible for the yellow colour in the begonia petal and also in the sexual organs of the flower. They fall into two main classes, the Flavones and the Flavonols – for the chemically minded among you the latter have hydroxyl groups {-OH} attached and the more hydroxyls the yellower the bloom becomes. Compare for example "Tommy Milligan" with its ivory petal and pale yellow centre with a colour like "N.M. Agnew" or the saturated yellow of "Sam Philips". In begonias which have no anthocyanins present, the anthoxanthins will be responsible for some or all of the colour, but if these two are mixed in the sap of the same cell or in different layers of cells of the same petal, then orange colouring will result {T.B.Toop" or "Ken Macdonald"}. In the deep yellow begonias such as "Saphronia" and "Champion Yellow" the flavonols present may be combined with another colouring agent called Carotene, which is said to be derived from the breakdown of chlorophyll and is responsible for the autumn tints and the change in colour of your post mature flower and plant. Incidentally, by boiling the dried petal in alcohol the yellow can be extracted and used as a dye but it would be a sacrilege to use the “cratur” for this, spirit meth, indust, will do!

In some flowers in which both yellow anthoxanthins and red anthocyanins are present, there may develop a competition between the two and then it depends on the controlling genes what happens. Both types of chemicals are made by the begonia from the same starting materials and if the gene controlling yellow is dominant then a lot of yellow is produced to the detriment of the red and a delicately flushed apricot as in “Jenny Brownlee” is the result. Another point we must note at this stage is that if you have a begonia with a blue tendency {see later}, try crossing with an ivory – for some reason, not quite known, this forms a loose chemical combination that tends to increase blueness.

Lastly, a little experiment you might like to try at the end of the season. Place a plastic bag over a white, cream or ivory begonia plant and introduce strong ammonia vapour. With a little luck you might find you have a deep yellow or even a green begonia on your hands. A tip used by the carnation and tulip growers.

Anthocyanins

This group of glycosides are similar chemically but more common than the last and for the blue begonia aspirant the more important. They are responsible for the crimson, scarlet and red begonias and the blue of other flowers. The colour producing part of these molecules are derived from three basic structures called Pelargonidin, Cyanidin and Delphinidin and here we find that the addition of hydroxyl groups {-OH} causes a swing from red in the first to deepening blue in the last. There are, of course, other factors which affect this group of colours, mostly with the tendency to increase blueness such as alterations to the sugar molecules, co-pigmentation {see above}, the effect of tannins in colloidal solutions and the decrease of acidity of the cell sap. Let us dwell on the last for a minute.

You will all remember using litmus paper in the school laboratory for testing acidity and alkalinity and that when you dipped red litmus paper into an alkali it went blue. Many years ago, we crushed and macerated petals from that bluey crimson begonia “King George”, and steeped them in a dilute solution of hydrochloric acid. We then added an alkali, a solution of carbonate of soda. First the colour seemed to become redder and then when neutrality was passed and the solution became alkaline, purple and finally a lovely blue. The sap of your begonia is purple and finally a lovely blue. The sap of your begonia is acid. It is made thus by the plant in its leaf factory under the foremanship of the cell nuclei and the shop stewards, the genes. We have mentioned elsewhere that begonias tend to be acid loving with regards to growing conditions. If we grew them in an alkaline medium would we get a blue begonia? The answer, of course, is no! The plant would die before we could change the pH of the sap by the necessary amount and in any case there is no proof that acidity or alkalinity can affect a living plant colour except to a very minor degree. No! The answer is with the one or two shop stewards. If we can persuade them to leave the factory floor and raise the colour bar only then can we win, only then will there be an $-OH$ of a difference and only then a blue begonia ready for propagation.

What can we do about it? There are several answers. Keep on hybridising the begonias with any blue or purple tendency, such as the deep crimsons or those with a blueish sheen on the back petals like “Harmony” or “Murdo MacLean”, and hope that some day the dominant gene is bred out by a natural accident. You can also try the effect of colchicines or gibberellic acid as we have to accelerate mutations and give the hormones a kick in the pants, by dropping solutions on actively growing cells {buds} in the hope that somewhere the chromosomes will make a wrong step in the “Dance of Life”.

Finally, you can try the X-ray method. We planned this experiment several years ago but never had the time to pursue it. We give you the routine with pleasure and hope that somewhere someone might like to try it. Grow several cuttings of a begonia with blue tendencies e.g. “King George”, until they reach the point of giving pollen. Dissect and examine one under a microscope until you find a stage at which pollen is starting to form in the growing tip of the plant. Take one more cutting which have reached this stage and get a radiologist friend to give each plant a dose of X-Ray, about 50 rontgen units. Now grow the plants on, provided it survives the X-Ray, till pollen is produced and cross with another cutting of the same type. Collect and grow all the seed {if any} and you might have a blue begonia. If not, collect the seedlings with the blueness, cross pollenate and re-grow the following year for according to Mendel you should increase your chances by 1:3. If nothing happens, begin all over again the following year and award yourself a medal of honour. If on the other hand, you do get a blue begonia, you must keep it a secret, put an armed guard beside it and only tell me.

The End.

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