PAEONIA

Volume 7, No. 2 June, 1976

REQUIRED READING –
1. "The Peonies" by John C. Wister, $3.50 from American Peony Society.
2. The Bulletins of the American Peony Society.

SUGGESTED READING –
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The PAEONIA is authorized by Miss Silvia Saunders.

Our leader and teacher in hybridizing is Roy Pehrson.

Editors are Chris and Lois Laning, 553 West F Avenue, Kalamazoo, Michigan, 49007.

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Suggested yearly contribution to cover expenses of printing and mailing is $2.00.

NOTE FROM CHRIS (On what else? P. CALIFORNICA!!!)

With the protection and heat that they received, *P. californica* plants grew and developed fairly well this past winter and spring. They did not bloom, however, as I had hoped. Even now though, they are still green. So when you consider that they are reverse cycle plants — growing in November, December, January, February, March, April and May, you sense that they have done well.

Next spring I hope to have blooms on those *P. californica* plants. Maybe I'll beg some more stored lacti pollen from Don Hollingsworth or else from a plant of '**Minnie Shaylor**' so as to again try the difficult cross: *P. californica* x lacti. Also, I plan to save pollen of californica and apply it on lacti when they are in season.

Reasons for attempting this cross:

1. Winter blooming (January at Santa Barbara, California).
2. Several flowers per stem (4 or 5).
3. Yellow and brown coloring can be seen in the flowers.
4. No dormancy of seeds (germinate often in two to six weeks after planting).

p.s. Plants resulting from the pollinating of lactiflora with *californica* pollen are now three years old but look to be completely lactiflora.

NOTE FROM DON HOLLINGSWORTH (1-9-76)

Chris, this article contains an interesting runout on inheritance using the color pigments of the anthocyanin family in Streptocarpus (Cape Primrose, according to Merriam-Webster dictionary) but precisely the family of chemicals that gives the red color in peonies. The writer supports the analysis of "color dropout" as in 'Moonrise' which you and Roy discussed in Paeonia. This also makes sense of the color things in a way I haven't been able to unravel from other references.

THE CONTROL OF VARIATION IN GARDEN PLANTS

From Volume 84 (1959) of Jour. Roy. Hort. Soc. - by Watkin Williams

. . . . . All flowers have a certain basic loveliness that makes criticism indelicate. They never fall below the basic standard of perfection,, but frequently rise to such heights so as to enable us, according to our inner selves, to recognize the exquisite from that which is merely perfect. Such is the splendour of the flower garden as it regularly and accurately unfolds its galaxy of shapes and shades, that we might pause and ask: of what is this splendour made and by what means is it determined and controlled? We can unfortunately give but a very imperfect answer to this most stimulating question.

As we search for the secrets of constancy and variation in living things, we must look for processes which are permanent yet capable of change, We have to explain why, if we plant a seed from a lily, we can with unreserved confidence expect it to grow and unfold perfect in all its details, as lilies have always unfolded, except perhaps for changes in size, form or colour. Liberal with points of detail but demanding rigid conformity to essential codes: that is the order by which living things have solved the eternal struggle for a place to exist now and through time.

The process of development and variation becomes even more intriguing when one considers that immediately after fertilization the new individual is no more than a single, microscopic cell; an embryo of one cell seemingly without even a sign of the potential stored within its controlling structures. This embryo cell, initially different but hardly distinguishable from similar cells with which it is surrounded, contains the entire code from which the structures we admire so much in living things are developed. Apart from the nourishment which it derives from the mother plant, it is self-sufficient. It controls its own destiny, absolutely and without reference. This much can be proved by excising the very small embryo from the mother plant and growing it under sterile conditions on a nutrient medium. It will develop slowly but perfectly into an individual like its parent. The fact that so much is contained in so little imposes severe limitations on the search for the ultimate secrets within the young embryo cell. Nevertheless, there is one redeeming feature in that its very size confines our attention to essential structures when looking for a solution to the problems of continuity with change that are inherent in reproduction.

The only structure that is permanent and constant in all functioning cells is the nucleus. As its name implies it is the central or nearly central body on which all the functions of the cell are dependent. Even the nucleus, when considered as a whole, has not in all its parts the constancy required to explain why "like begets like". Certain parts of the nucleus, such as the membrane which surrounds it and the viscous fluid it contains are dispensable; they may come and go. The same is not true of the sometimes thread-like, sometimes rod-like structures that are contained within the nuclear wall and are immersed in the nuclear fluid. These are the chromosomes* which carry faithfully from one generation to the next the code of development that the embryo will obey during its growth into a mature plant. Alterations to this code can be made only within very narrow limits. Major changes run the risk of irreparable damage very often resulting in death of the individual.

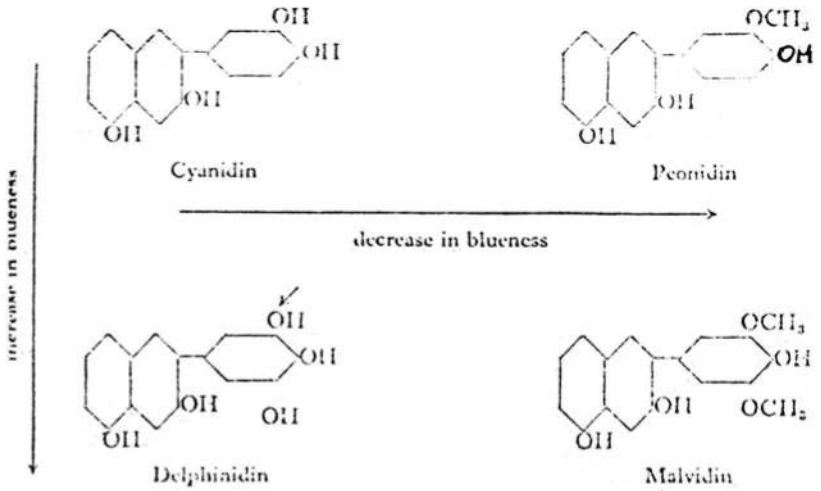
* The word chromosome means colour body, owing to their affinity for certain colour dyes.

Each individual species possesses a constant number of chromosomes — most forms of *Narcissus poeticus* have fourteen, while *Morus nigra* has 308. It is only in exceptional circumstances that species show any variation in their characteristic number. In most cases loss of a chromosome is fatal, while in some, gains quite frequently prove advantageous.

Chromosomes are separate assemblies of codes of development. The complete set characteristic of any one species is the entire code for that species, and anything less than the complete code disrupts the whole organization of development. Each individual chromosome assembly carries a certain number of the unit parts of the code, each of which is specific to a single cell process. Johannsen in 1909 called these, the basic units of continuity and change in reproduction, genes. For most purposes we must regard individual genes as reprehensibly narrow specialists capable only of one single function. For example, one may be a code for conditioning a colour in a rose petal, and as far as is known it does little else; another may merely govern the development of the petals. It is because of this extreme specialization that none of the genes forming the exact complement for a given species is dispensable. Gene function cannot be taken over by a *locum tenens*.

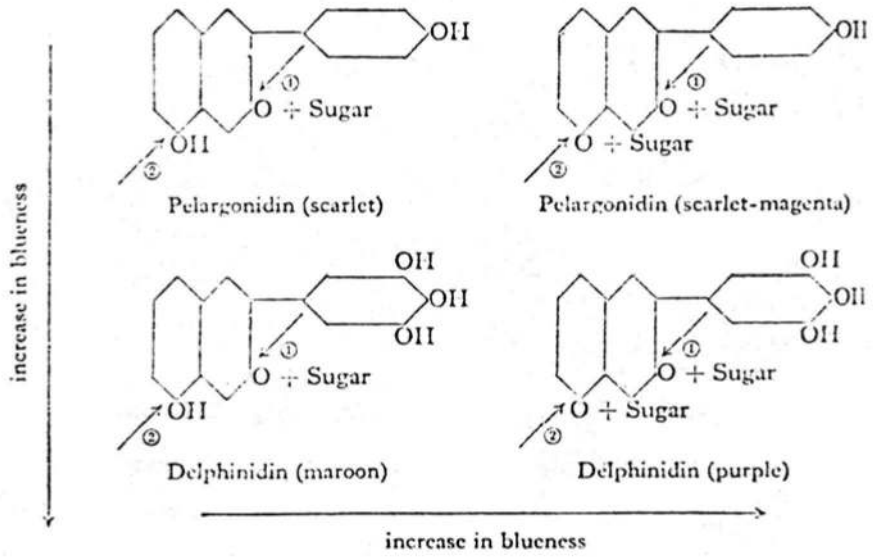
Gene function may however be changed within limits, sometimes with an effect that is both advantageous to the plant and pleasant to the eye of man. The genes producing the blue colours of lupin can be changed, modified, or recombined to give the most exquisite range of colour as seen in the Russell Lupins, while the gene for petal number in the garden stock can undergo a modification that gives increased number of petals as in the double-flowered, strains of *Matthiola*. But perhaps the most spectacular, it is certainly the best understood, gene function in plants concerns the development of petal colour in garden flowers. Many great names have been connected with the elucidation of this fascinating subject, perhaps I may be permitted to mention here only one of those -- W.J.C. Lawrence, whose patient work on *Streptocarpus* at the John Innes revealed much of what is now known about the inheritance of flower colour variation.

The most important single group of colour producing compounds in plants belong to a group known as the Anthocyanins. They produce the scarlet, red and blue shades which predominate in garden flowers. There are three basic anthocyanins — pelargonidin, cyanidin, and delphinidin. Pelargonidin, named after the scarlet of *Pelargonium*, is a compound producing, as one would expect, scarlet colour in the petals, while cyanidin is the basis of the red and magenta hues of roses, and delphinidin taking its name from the blue *Delphinium*, conditions mauve, purple and lilac tones. These basic anthocyanins are capable of chemical modification in several different ways, thus producing shade differences in the basic colours. A little of the detail of this chemical change might be of interest to show how modification of basic colour pigments is achieved. The following diagram indicates how changes in the anthocyanin molecule brings about colour differences.



The change from cyanidin to peonidin is one which brings about a decrease in blueness of the flower, while the change from cyanidin to delphinidin increases the intensity of blue. In the transformation of cyanidin to peonidin the anthrocyanin molecule is modified at the arrowed position through a replacement of a hydrogen atom (H) by a methyl group (CH3), and this simple chemical substitution is the basis of the difference between a dark red rose and a brighter red paeony.
Again we note that cyanidin changes to the bluer delphinidin by addition at "boxed" position of a hydroxyl group (OH). The addition or removal of hydroxyl groups is the most effective chemical way of turning on and off the intensity of blue in the petals. Delphinidin in its turn can be made less blue by substitution of a methyl group for the hydrogen atom (H) at the "boxed" and "arrowed" positions in the diagram.

Before the gene control of these chemical changes and their effect on flower colour is considered, one remaining chemical change must be introduced. This involves the addition of sugar molecules and can be diagrammatically represented as follows:



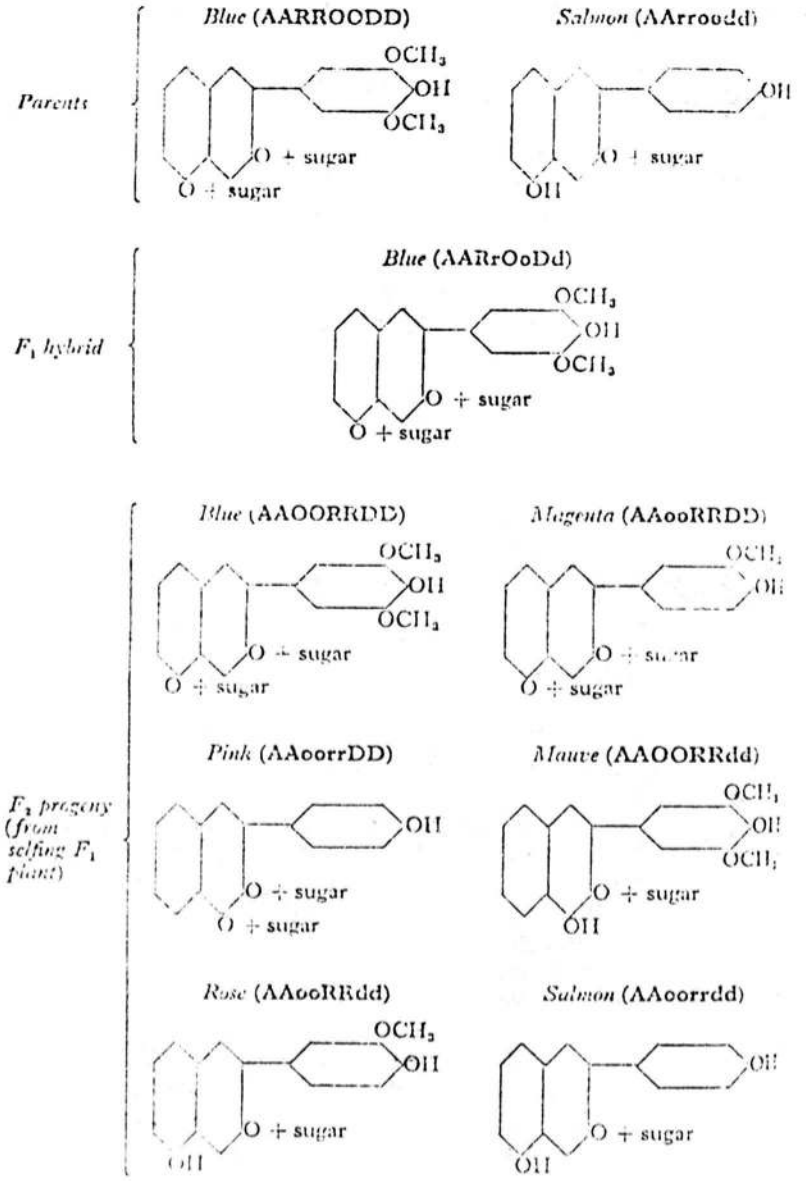
In the above scheme molecules of sugar have been introduced into the basic anthocyanin structure, and with increases in the number of sugar molecules the colour of the antlocyanin pigment changes from being less blue to being more blue. A second sugar addition at arrow position (2) by replacing the hydrogen atom in the hydroxyl (OH) group in scarlet pelargonidin brings a change of colour approaching magenta while a similar addition at the same position in maroon delphinidin transforms the colour to purple.

In summarizing the changes in anthocyanin structure that are related to colour differences, one need only remember three simple facts: Firstly, an increase in the number of hydroxyl (OH) group increases the blueness of anthocyanin pigment, secondly, increases in methyl groups (CH3) pushes the colour slightly towards the red and away from blue, and, lastly, increases in the number of sugar molecules makes for intensity of blueness. This information gives us most of the basic knowledge required to understand the manner in which genes control flower colour.

Each of the changes described in the chemical modification of anthocyanin molecules is controlled by a single gene. When a hydroxyl group becomes methylated, or a sugar molecule is attached to the structure; it is a single gene that provides the code by which this change is effected. If the gene itself be changed so as to be incapacitated, the particular function that it is there to perform will fail.

If the change is not one of incapacitation but of a qualitative modification within the gene to form an altered gene structure, the function performed by the new code will also be changed.

This relationship between gene and pigment can be very clearly demonstrated through the known genetic system controlling colour in *Streptocarpus*, The development of new forms of *Streptocarpus* centres mainly around two species? *S. rexii*, a blue-flowered species which was introduced into this country in 1826 and, *S. dunnii*, a red-flowered species introduced to Kew in 1884. Prior to the introduction of *dunnii* only blue-flowered *Streptocarpus* were grown here. Crosses between *dunnii* and *rexii* released a whole range of new colours ranging from ivory, through pink and magenta to mauve and blue. The genetic control of these new colours has been established by numerous careful breeding experiments and the salient features of the system can be appreciated by considering the result of crossing a salmon-coloured form of *Streptocarpus* with a blue-coloured form and studying the segregation given by the hybrid (F1 generation). Six colour types appear in the F2 generation of such a cross and the nature of the pigments and the genetic constitution of the forms are represented in the next diagram.



The genes involved in the system are four in number and are lettered **A**, **O**, **R** and **D**. For a very important reason which I shall not mention, each plant carries two of each of the four genes. If a particular member of a pair expresses itself in the F1, it is described as dominant, whereas if it is not expressed in the F1 hybrid it is termed recessive. (Dominant genes are given capital letters in the preceding diagram while the recessives are in small type.)

In general, the recessive condition represents a state of the gene where its prime function has been somehow impaired or lost through a change or a mutation in its structure. This is certainly true for the recessive genes for flower colour. A study of the diagram reveals that in salmon-coloured flowers of *Streptocarpus* there is only one dominant gene, the three genes **o**, **r** and **d** are all present in the recessive condition. In consequence of this, the structure of the anthocyanin molecule producing salmon-coloured pigment is the simplest of the six different types given. When a dominant **R** gene is added, as in the rose-coloured flower, a new function is introduced and a methyl group (CH3) is added. This is the only change as compared with salmon. The further introduction of the dominant **O** gene adds a second methyl group resulting in a change of colour from rose to mauve. The addition of the dominant **O** and **R** genes have transformed the simplest types of anthocyanin molecule — pelargonidin, to cyanidin and delphinidin derivatives. The transformation is achieved through two independent, gene mediated steps. Finally, the role of the dominant **D** gene has to be considered. The pigments producing salmon, rose or mauve colours in *Streptocarpus* contain only one sugar molecule, and plants having these flower colours have a recessive **d** gene. The addition of a dominant **D** gene in the pink, magenta and blue-flowered types mediates the addition of a second sugar molecule to the anthocyanin, and, as with the previous examples, this is the only function of the gene **D**.

Blue-coloured flowers are the result of all these three different functions being performed together in the same plant. When one function is omitted a colour reduced in blueness results, and when all three functions are missing the pigment produced is salmon coloured. The role of the gene A in the diagram has not been mentioned, and it will be noted that only the dominant form of this gene exists in the six colour types derived from the cross. The simple explanation for this is that in the absence of A, no anthocyanin pigment of any kind would be produced and the flowers would be cream, ivory or white. Thus A is basic to the formation even of the simplest type of anthocyanin molecule, and its presence is a prerequisite for the functioning of the other three genes.

The control of pigment development is the best-known example of the detailed control of variation in plants. It demonstrates the way in which the genes on the chromosomes act, and the kind of function genes and only genes can perform. The code of information that is borne separately by the assemblies of genes in the chromosome complement is a chemical code, and through it the whole chemical basis of development and form is established. Through the guarantee of permanence given to the chromosomes at reproduction, and the tolerance of change in the detail of the gene, the continuity of the main characteristics of species is established without imposing severe restrictions on the range of variability.

A friend asks Don Hollingsworth; "I've wondered about something — when a person is going to graft some tree peonies onto roots, does it make any difference if it is an early blooming plant, medium or late?"

Don's Reply:

About roots for grafting, most grafters apparently use P. lactiflora roots. If it makes any difference about the flowering season of the variety used, I've found nothing about it in print. However, it seems to me that some varieties might be better for reasons of their inherent ability for whatever it is that a graft has to do (growth, that is) to succeed. I understand from what I read that the first thing that happens when a graft knits properly is that the callus growing from each of the cut areas grow against each other making an interlock. This supposedly works best when the parts are held together firmly, thus the importance of a snug wrap or tie. Then the cambium growth begins to bridge through the callus from each direction when it makes contact (assuming there is no resistance, rejection - chemical? - inherent incompatibility), the new vascular tissue which forms from the cambium will become continuous through the graft union which is necessary for enough water, etc. to pass from one part to the other. This still isn't enough, however. Other changes have to take place as needed to connect the vascular tissue thus formed continuously through the storage root and to new white roots which will collect the moisture necessary to keep the leaves alive when they grow next spring. As you are probably aware, root pieces tend to put out the new roots at the bottom end. We have to graft on the top end, so then the vascular connections have to become continuous all the way through the root piece, no doubt using the previously formed connections for most of this. Now, in addition to whatever the root contributes through its growth, stored food reserves, etc., it is supposedly essential to have growth substances -- hormones, enzymes, ? — which are produced in the buds. Since the buds are cut away from the nurse root, it is the scion bud which has to supply the required substances. Reath and Seaman both have reported that it is the scions with big fat terminal buds which most often take. This suggests strength and health of the scion wood is more important than the nurse root.

In my experiences this fall (1975) only one nurse root rotted of 118 or so grafted. However, more than 60 scions rotted. This would seem to support the conclusion that the root is not so much a factor in failure as the scion. Health and sanitation, I believe, are extremely important in grafting. Reath wrote in his last March article that he uses 5 year old lacti seedlings for roots. If he grew these on new ground they would be free of nematodes. If seed from very vigorous and healthy rooted (rot resistant.) kinds were used to grow the nurse root plants, this should increase the yield of healthy roots. I used roots of seedlings and named kinds. The named (or numbered) parents, I kept note of which used on the tag put on the graft. If 1 can keep this up for awhile, maybe we can eventually conclude whether some nurse roots are very bad but it may be difficult to be sure if the differences are not very much. Also, those seedlings Reath used should be free of viruses that may be harbored in old varieties. (Fruit tree grafters have found that there are viruses which don't show outwardly that greatly limit graft success.)

Trying to be as sanitary as I could this fall, I kept no roots that had a rot spot remaining on them. Most were "rot free" (relatively speaking) kinds though I used pieces of one seedling — older plant — that did have some rot in the root system. Also may have used a few hybrid roots but didn't keep track on that batch as there weren't enough of a kind to give a fair test.

The selected roots were cleaned up as for replanting, then re-washed using a scrub brush, not so stiff as to damage the roots though. After that they were dipped for 15 minutes or so in Chlorox, 1 part to 9 parts water. Then they were drained on clean newspaper until fairly dry, then wrapped in fresh newspaper, sprayed lightly with water to make it damp, and tied closed in new plastic bags — all the time keeping the cleaned roots away from anything used in diggings, other peony roots or packing that had been previously used. These packed roots were held at room temperature standing with tops up and bottoms down in the packing.

Scions were put into either clean or re-used plastic bags as gathered but brought directly in and washed under a running tap using an old toothbrush with limber bristles. They were dipped in the Chlorox sometimes or the cut was re-trimmed with a knife that had been dipped. The cleaned scions that were not used immediately were wrapped closely in new plastic bags and put into the refrigerator (not freezer) — meat storage tray — about 35-40 degrees.

When the graft was made, all cut surfaces were either covered by the binding (plastic strip) or painted over with tree wound paint. Also did the work in the laundry area which at our house is inside away from the work bench where I trim peony divisions and where whatever they harbor may be mixed up in the dust, etc. Last on the sanitation, I toss the finished grafts in a weaker solution of Chlorox for a while, then pile them with a damp newspaper covering while finishing the others. One other thing, I use two knives and have one in alcohol or 1:9 Chlorox between grafts while the other one is being used. That way if there are viruses, at least I'm trying not to spread them with the knife. Also do this between plants when dividing and trimming for replant.

Sounds pretty complex but is not really. Have some plastic waste baskets and buckets for the dipping — mostly salvaged things that look too bad for the kitchen, but are still sound. Use a coffee can with plastic lid to save the alcohol. Have an old pruning knife and some pruners for trimming roots and dividing . Use a good straight edged blade in a large clasp knife for grafting — also an Exactocraft knife with a big replaceable blade but like the clasp knife best.

Last, I packed the grafts in a plastic bucket with damp - not wet - new peat-lite mix. Vermiculite or peat moss alone or mixed would be OK too. I buy the peat-lite for "canned" tree peonies so have it on hand. Cover the bucket with a piece of plastic - not previously used for plants - and put it in a warm place -- room temperatures or a little higher. Then shake them out gently in about 3 or 4 weeks to sort out the rotted ones. Each one that failed gets taken apart carefully and gets a through inspection to see if I can guess what went wrong. Also write down what I did when grafts were made and list the different combinations made. Then when they fail I keep score on that. Those still OK after 6 weeks I hope can be counted winners. The survivors still in the bucket then get transferred to a window well for the winter.

LETTER TO CHRIS AND LOIS LANING, March 4, 1976
FROM FATHER JOE (Rev. Joseph A. Syrovy)

Dear Chris and Lois:

Last time I wrote to you we had a blizzard. Today we have an ice storm. It has been hailing, raining and freezing since early morning. Everything is covered with ice! Now I hope we do not get a big wind with it. Saw on TV that you also in Michigan got the same a day or so ago. We need the moisture here as I told you, but not ice. Farm experts say we needed at least ten more inches of rain to get way down into the sub-soil if we are to have good crops this year. As I said before, we are a part of the bread basket of America here in Iowa.

I thought I would write to you again soon, lest I mis-lay some valuable information I had from Brother Charles Reckamp which has lain dormant in my files these many years. It has to do with advancing the time of blooming of Tree Peonies. No doubt it could be used with the Itoh herbaceous. So if you think it valuable you might publish it in the PAEONIA. Please give him credit for it, as it is his idea.

To Advance the Time of Blooming - by Bro. Charles Reckamp, S.V.D.

Tree Peonies, and probably herbaceous peonies as well, can probably be made to accomplish 2 years growth in one by simply cutting off the leaves 3 months after buds first break — storing the plant in a more or less dry state in a sealed plastic bag at 25° to 35° degrees F for 2-1/2 to 3 months. After this remove the bag, place it in a light room at to 65°F to force next seasons growth. This procedure may be repeated as often as desired. Care should be taken never to disturb the root system if the plant is to bloom before its regular habit. Therefore, plant only one seed to a pot large enough for several seasons growth. After the desired seasons have been accomplished, remove the pot without breaking the ball of earth and plant in the field when dormant.

Brother Charles adds a p.s. (as I asked about rooting T.P. cuttings).

p.s. Have always been reluctant about trying to root Tree Peony cuttings. Unless the percentage of rooting is high, it would not be worthwhile to sacrifice the scions from rare varieties. Grafting has been quite successful, although it takes quite awhile to get them up to good strong plants. I imagine rooted cuttings would be slow too, on account of the root system. (End of letter)

The above sounds interesting and also good solid advice from an old pro like Brother Charles. We are all experimenting with new ideas and I think it worthy of publication.

I mentioned in my last letter that I watered my T.P.'s, Itohs and Hybrid Herbaceous in December, January and February. I think it paid off as the buds have begun to swell on most of them. They looked pretty sick and shrunken. I guess T.P.'s can stand a lot of cold and even drought as they come from the colder parts of China originally — and they will not bloom where it is too warm. I have never protected my T.P.'s like Roy has in Minnesota with rose-cones or any other way and they always come through the winter without any damage. However, this past winter has been very unusual, drought, periods of extreme warm temperatures, then extreme cold, with the chill factor of -15 to -25. I notice that the Lutea hybrids, even the older ones ('**Chromatella**', '**Souvenir de Maxime Cornu**', '**La Lorraine**'), showed bud damage especially the tops, We shall see what happened when warm weather comes again and report to you.

I had unusually good success with Roy's seeds you sent me last fall. Some I planted outside , and then I used Don Hollingsworth's system of planting in plastic bags in vermiculite, warm and cold and refrigeration. I believe I had 75% germination. Finally transplanted yesterday into jiffy-pots in a mixture of soil and vermiculite, covered them with a plastic bag and put on the enclosed back porch, temperature about 40°. Will keep them pretty cool for some time. Then I might try Bro. Charles' idea with a few of them to try to advance time of blooming. As reported in PAEONIA before, I believe by Roy, that seeds sprouted in bags grow slower than seeds planted outside in the open. I have 5 pots of Roy's Best Yellow, and 7 pots of Roy's 2nd Best Yellow. I will plant the rest of the sprouted seeds in the next few days.

Woke up early in the A.M. (about 4:l5), was cold and noticed my electric blanket was off! Looked at my alarm clock; it was 2:50 A.M. when the electricity went off. So hurried down to the kitchen and made a wood fire in my trash burner or emergency stove, looked around for my two kerosene lamps, peeked out of the window and all the street lights were out! Here it is 1 P.M. — no electricity, temperature outside 19° according to my battery radio! How good it is to be a little old-fashioned and be prepared for emergencies in this electrical age! Besides keeping warm, I'll have a lot of good wood ashes for my peonies! Most of northern, north-east and our part of Iowa are without electricity due to yesterday's ice storm. We are promised relief within 24 hours. Last spring during Holy Week, due to a severe storm, we were without electricity for three or four days — and it was cold! So ending with "Put another log on the fire", I'll sign off and perhaps write a letter to Don. Oh, just rescued my newly sprouted seedlings from the back porch where the temperature had dropped to 35°!

INTERESTING NOTES FROM GRETA KESSENICH

The following letter was received from Norah Start, Research Assistant
Department of Biology, University of New Brunswick, Fredericton, NB, Canada.

Addressed to:
American Peony Society
20 Interlachen Road
Hopkins, Minnesota 55343

Gentlemen:
In our laboratory we intend to examine the possibilities of using a tissue culture technique for propagation of the Peony. Our preliminary search into the literature indicates that no work has been published in this area. However, we feel that work may have been done, or is being done and that you will be able to refer us to the source. We would appreciate any help you may be able to offer on this particular point. Would you also be kind enough to send us your list of publications and any literature pertinent to the culture and growth habits of the plant.

Greta gives the following information on the Hybridizers Workshop to be held at the American Peony Society National Convention, June 18-20, in Minnetonka, MN

1. The program has now been completed.
2. Don Hollingsworth will be the moderator.
3. Prof. Meyer will talk on tissue culture.
4. Discussion of tree peony, the imports and nomenclature, etc.
5. Grafting of tree peonies| demonstration.
6. Historical Cultivars
7. Nematodes