

413

13

y 1

Propagation of the Dahlia

A Bolles Dahlia Booklet

Propagation of the Dahlia

by

CHARLTON BURGESS BOLLES

Media, Pennsylvania

Member The American Dahlia Society
and The California Dahlia Society



COPYRIGHT, 1922, BY CHARLTON BURGESS BOLLES

Media, Pa.,
C. B. Bolles

SB413
.II13B65

*A List of the
Bolles Dahlia Booklets*

- 1 HISTORY OF THE DAHLIA
- 2 WHY GROW DAHLIAS?
- 3 PROPAGATION OF THE DAHLIA
- 4 CULTIVATION OF THE DAHLIA
- 5 DAHLIA GROWING COMMERCIALY
- 6 FERTILIZERS AND LARGE BLOOMS
- 7 THE ENEMIES AND PESTS OF DAHLIAS
- 8 THE HARVESTING AND STORAGE OF DAHLIAS

Price Thirty-five Cents per copy

(3 and 4 are Double numbers, Price 50c per copy)

Address orders to
CHARLTON B. BOLLES
Media, Penn.

© 1A678334

JUN 19 1922

no 1

Propagation of the Dahlia

PROPGATION of dahlias is usually by tubers, the "divisions" being planted like potatoes. Cuttings of new sprouts, and the succulent tips of branches, is the method practically exclusively used in England, and is employed in America by florists and growers of exhibition blooms to increase costly varieties, and to produce magnificent blooms, it being agreed that suitable cuttings produce better flowers than plants that are grown from tubers. Planting seeds is the third and only other method. Seedlings resemble parents very little, and nearly ninety-nine of every hundred are worthless, or at least are no improvement upon existing varieties. This method of propagation is employed to secure new and better varieties. While the prizes are comparatively few the work is fascinating, and the amazing glories of the present-day dahlia world are the results. There is no reason why more wonderful flowers should not be created. Only seeds from fine varieties should be planted. It is not worth while filling garden space with plants most of which are sure to be worthless unless there is a probability of some pleasing results, and the finer the parents are the greater is the likelihood of an occasional prize. Packets of seed from choice varieties, the result of hand-pollination, may be bought for one to three dollars a packet, with

three new packets offered in 1922 at ten dollars each, and another packet at twenty-five dollars.

Almost every dahlia catalog uses the word bulb. Dahlia tubers are not tubers — botanically; neither are they bulbs. A bulb is a more or less thick fleshy, usually underground bud, and generally has roots from the under side. The bulb's mission in life is to carry the plant's life over a bad season, or through a winter. Bulbs are always in scales or layers, like an onion, or with scales as is the case with lily bulbs. The bulb is the plant's storehouse, and after the plant flowers within the bulb new stems form, leaves and flowers. The bulb actually contains a new plant, which is protected and kept alive by the reserve food and energy collected in the bulb during one season's growth, for the plant's successor.

The bulb is the plant's last will and testament; is the plant's soul, transmigrating, but to appear in the same form as before. The plant above ground dies, the roots below ground likewise die; the bulb hibernates, goes to sleep like a bear, and in this dormant state can be stored, shipped easily across oceans if need be. Planted properly in due time it awakes, never realizes that it has left its happy home, the embryonic plant develops luxuriantly and with the same perfection and beauty as its parent. The dahlia "tuber" is a fleshy, tuberous root. Unlike the white and sweet potato, there are no eyes (buds) in the fleshy root itself.

It is simply a storage place for water and plant food for the next year's plant. The buds are on the crown, the point of union of the "neck" of the dahlia root with the main stalk of the plant. Buds are also here and there upon the surface of the stalk, where they are likely to dry out and die during winter storage. Hence the great importance of not "breaking necks" when digging dahlia roots. A broken neck soon dries at the point of injury, cutting off the moisture supply contained in the enlarged root ("tuber" so-called) from the bud at the junction of neck and stalk. The woody stalk evaporates its moisture during storage, and the bud dies as a natural sequence. The broken-necked "tuber" retains most of its plumpness. If planted a network of white roots will be put out, but there can be no sprouts, for sprouts are developed buds, and the tuber-like root mass has no bud. It will do its level best to fulfil its mission in life, but it is as unproductive as a fossil. In dividing a field clump it is absolutely necessary that part of last season's base, or stem, goes with the neck of each tuber. Each "division" as commercial growers call the fleshy roots, must have at least one healthy bud attached to it.

Propagation (multiplication) by the "division" of tubers from field clumps is the commonest method of increasing dahlias in America. In England one never sees tubers for sale, only the "green plants." There are nearly, perhaps quite, five hundred growers and

dealers of dahlias in this country, and their catalogs usually offer tubers only. The commercial grower commences to divide his clumps as early as late January if he has large stocks, storing the separated tubers in closed boxes to prevent rapid drying from the cut surfaces. The amateur waits until nearly planting time, to avoid several handlings, and to delay cutting as long as possible, the tubers naturally keeping better in the clump.

Making divisions is not easy, and carelessness will certainly result in loss through the destruction of the buds ("eyes"). Thoughtful care must be exercised, and a few suitable tools provided. A short butcher's knife and a hammer to sometimes help the blade through the toughest, fleshiest parts, will answer the amateur very well. With some hundreds of clumps to divide additional equipment of saw, chisel and mallet will be found almost necessary for time saving, as puzzling combinations of roots are encountered. The curved blade of the family grape fruit knife will sometimes cut through otherwise inaccessible inner masses of fleshy roots, between tubers. A punctiliously prompt replacement of this borrowed knife in case of accident is strongly recommended.

A hack-saw with several spare blades is well worth having handy, and is better than the butcher's fine toothed saw.

A block of wood six inches square and four to six inches high is almost indispensable. A six inch length of a two by three beam would answer about as well. A support for an edge of the clump is afforded by the angles of the block, and prevents smashing of tubers and breaking of necks which would follow if the clump was laid on the flat workbench and there received the force of the cutting tool.

Clumps often present an unpromising exterior making it difficult to decide where the first division should be started. The only rule is that observed by wise parents in child training. Take the trail that looks most likely and follow it, and when the trail divides, again take the most likely looking one. Amateurs usually can wait until about planting time, when the clumps can be sprinkled, provided with a little warmth, or set in moist earth, moss, or sand. Half inch sprouts will soon appear and decidedly help to determine where the division cuts should be made.

The storage period being over and planting at hand wounds upon the fleshy bulk of the tubers are of small moment, but great pains should be taken that necks are not damaged, and most of all that the "crown" or enlarged head of the neck, where it joins the main stalk of the plant, is not injured. Dahlia tubers unlike white or sweet potatoes have no eyes although occasionally one tuber in ten thousand will be found with an eye. Breeding dahlias with fine healthy eyes dotted

over the tuber mass, as with the potato, so that the tuber could be cut into pieces, as the potato is in planting, and multiplied half a dozen times, would seem to be indicated as a nice problem for the enthusiastic creator of new varieties. But until this happy result is obtained it is imperative that the eye in the crown end of the tuber's neck be not only uninjured when making divisions, but that a neat little piece of the main stalk be cut off with it. If the beginner has never divided field clumps he might start upon his least valuable varieties. After dividing half a dozen clumps he will have confidence. Better still, ask a friendly neighbor who has had more experience to cut several clumps for you. Watch his every motion and you will soon be able to do it yourself, particularly so if you have a good tool equipment, for an inch chisel is sometimes a very present help, and will save you a broken knife blade.

One tuber to an eye is all that is needed, but sometimes the necks of two tubers join at the same point on the stalk. The smaller of the two can be discarded, or the stalk so cut as to preserve both roots, which should be planted as one.

Small tubers are quite as likely to be excellent as as larger ones. Some varieties produce small roots. Madame Marze, and some other gigantic flowering sorts grow very large tubers. The strength and vigor of the sprout is the only thing that matters. Some growers maintain that with any variety the medium and small-

sized tubers often produce the finest and most brilliantly colored flowers.

Tubers two and three years old are often very large, sometimes weighing two or more pounds. At least two thirds, even three-fourths, should be cut off and thrown away when planting. New roots and new tubers normally start at the base of the sprout. But with these old "grandfathers" a good many roots start from the end of the tuber farthest away from the sprout. Much of the plant food gathered by these roots is absorbed by the fat old tuber, which grows larger and larger, finally weighing several pounds after a few years, and more or less hollow, like a squash. The so-needful new roots at the base of the sprout are greatly discouraged and make only a partial growth. A poor plant with few blooms is quite likely to be all the gardener has for his pains, with a few, undeveloped tubers at harvest time, instead of sturdy reduplication, thirteen-fold, which is the normal average yield of fine plants.

Presumably it is about planting time when you divide your clumps. But if by reason of inclement weather or other unexpected sidetracking of opportunity you cannot plant the tubers immediately after division see that they do not dry out. Cover them carefully in boxes and they will keep a fortnight; the cooler they are the better. If when divided, or at planting time, sprouts more than an inch long are found they should

be cut off quarter of an inch from the crown. Invariably a stronger and better sprout will follow. The tubers are planted six inches deep in the garden, upon the side, flat not vertically, sprout uppermost; two feet to thirty inches or more apart in the row, the rows four feet or five apart, all according to the variety, and the amount of land at one's disposal. The more room the plants have the better the blooms, for they are rank growers, gross feeders, and need ample space for roots, branches, and the access of the needful and invigorating flow of air and sunshine. Cultivation is of far greater importance than fertilizing, and both of these factors are treated at great length in the chapters respectively devoted to them.

The first step in dividing the clump is to tap the hard, woody stem and jar off as much of the dried earth as possible. The wood-like stem is then laid on the block and the stem chopped off with one blow of a hatchet as close to the tubers as seems safe. Some stems remain moist all winter for two or three inches above the roots. Cut off the dry inert top, but leave all of the green stem, which usually has one or more eyes. Very large stems had better be sawed off, a fine-toothed butcher's bone saw being used, if obtainable. This saw will be found exceedingly helpful in separating massive clumps into several parts for more convenient subdividing.

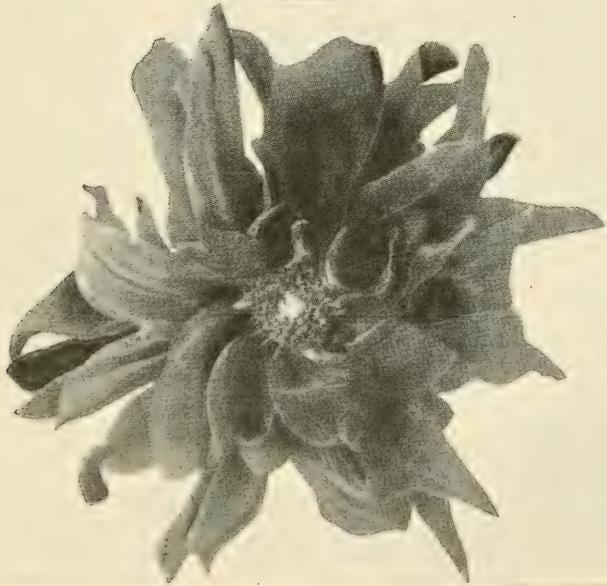
Sometimes the chisel can be used to split vertically downwards through the hard stalk several times, the clump being supported on some part of the block in such a way as to prevent damage to individual tubers. In this manner v-shaped portions of the stem can be removed with the tubers, affording a generous amount of stem with each crown neck-end, ensuring an undamaged eye from which a fine sprout can start. Where splitting this way is impossible the tools must be so manipulated that some piece of main stalk or mass is cut or gouged off and left attached to the crown. The crown must always have some surrounding tissue detached with it. Otherwise the bud may be damaged, or not be included at all, and the tuber "go blind," that is be without a bud.

Multiplication by cuttings is the second method of increasing dahlias. The finest exhibition flowers are borne by plants derived from cuttings. If you do not possess a greenhouse, a cold frame, or a sunny home window, and cannot manage proper light, warmth, shade, and fresh air, why not make friends with some florist or private greenhouse owner. It should be easy to arrange for the handling of a few dozen cuttings more or less. The "green plants" listed in some dahlia catalogs are cuttings, and may be excellent. On the other hand propagation by cuttings is sometimes carried so far, considerations of profit being the chief motive, that many of the green plants are weak and good for nothing.

Fifty plants from a clump of tubers is about or quite the limit of safety. After that number has been secured the production of vigorous plants is very uncertain. It will always be safer for the amateur to buy tubers rather than of green plants. "Green plants" offered by growers who have glass can be superior to tuber grown plants, but human nature sometimes falls into the sin of carrying multiplication by cuttings too far, "for revenue only."

Green plants have this advantage: transplanted from the middle of June to July first they only make moderate growth by the time the hottest weather arrives; they are then still young and vigorous, in prime condition to maintain themselves against the heat and dryness so hurtful to dahlias. The gardener's good judgment in the use of water, if any be needed; and constant cultivation will carry such plants safely into September, when blooming will begin, and if the flowers are desired for exhibition they will be produced at exactly the right time by plants that in are perfect condition.

Dahlias may be grown almost exclusively from cuttings at the beginning of a commercial growing enterprise, to gain as much planting stock as possible, in the least costly way. Amateurs also multiply plants from expensive tubers. Many new varieties are offered by commercial growers in their catalogs as "green plants only," the financial returns being better than if the limited stock of tubers was sold by the single root.



Peony types of Dahlias



Frau van Der Zypfen

Propagation by cuttings is comparatively easy if one has a good cold frame, or a greenhouse. The field clump is taken from storage in February or March, and covered with sifted humus-filled earth, or with leaf mould, or sand, or even spagnum moss, or peat. Any medium that will hold moisture is suitable, and at first should be slightly damp but not wet, lest fungus and rot form. Air temperature of from 60 to 65 degrees is just right. As soon as the eyes start to sprout water may be liberally applied, in order that the sprout growth may be rapid and vigorous.

Clean, moist sand is best for rooting the cuttings. The amateur with only a few dozen cuttings can sterilize any doubtful sand by baking it an hour in the kitchen oven.

The sprouts are ready when they have three (or even but two) sets of leaves. When only a few cuttings are needed, or the supply of field clumps of a given variety is ample it is an excellent plan to cut out the "heel" with the sprout — a little bit of the stalk where the sprout starts. A new plant is a greater certainty this way. But if many plants are needed from a limited supply of tubers a maximum of fifty vigorous plants may be obtained from a single clump of roots. Some growers boast that they can multiply a single tuber into five hundred plants, by cutting cuttings from cuttings. But experts claim that the plants will be weak and inferior.

To obtain as many plants as is safely practicable, the cutting is taken from the sprout with a sharp knife immediately below the set of leaves next the tuber. This will leave a stub on the root from the base of which new sprouts can start unharmed. If the cuttings are for plants to be used for growing exhibition flowers the wise grower discards the first shoot, fat and stocky and promising though it be, as better plants and better flowers come from the sprouts that follow the first ones. On either side of the stub left on the tuber two other smaller shoots will in due time appear, and should be cut for rooting when the requisite number of sets of leaves have formed. It is important that a sharp knife be used, and that the cut be close to but not through the joint formed by the first set of leaves. If the cut is made too far below the joint formed by the leaves one of two unpleasant results is apt to follow. Though your plant may be vigorous, only a small mass of fibrous roots will be formed, but no good tubers to carry over the winter. Or a clump of tubers may be produced that will not produce eyes the following spring. "Fibre cutting" is the name the experts give to the handling that has so disappointing an ending.

Having made the cuttings properly the lowest pair of leaves should be trimmed off close to the stem, and the stem buried in sand nearly up to the second pair of leaves. A bottom heat of 70 degrees should be provided if possible. The amateur could do this on top of

a hot water radiator regulating the heat by the radiator valves, and more or less insulation under his boxes. A good thermometer should be employed.

After the cuttings are carefully and firmly set, the joint where the first set of leaves was trimmed off being level with the sand, water moderately using a fine spray and spraying the cuttings at least daily, twice a day if needful, to prevent wilting. Keep the sand moist, but not wet. Provide ample ventilation, but no draughts. The stagnant air of a close house or room would mean failure. Be sure that there is abundance of fresh air, whether house or cold frame. If the air is dead, and either too dry or excessively moist, many of the cuttings will fail to root.

Shade the cuttings from direct sunlight. In about three weeks the cuttings will have started tiny hair-like roots, and should then be transferred to flats, or to three-inch paper or clay pots. During the three weeks the cuttings are starting rootlets the stubs of the sprouts left on the tubers will each make two side shoots, to be cut off in due time, and rooted. And so on, until the limit in the vigor of the tuber sprouts has been reached.

In transferring the delicately rooted cuttings from their rooting bed to boxes, or preferably into three-inch pots, the fullest measure of success will be attained by using a compost, six parts excellent fibrous loam, two parts thoroughly rotted horse or cow manure, two parts sifted leaf-mould, one part coarse sand.

Plants raised from cuttings are pretty sure to produce better blooms than those grown from planted tubers. But, and this is only one of the many things that tend to take the joy out of gardening, such plants will sometimes fail to produce good tubers. Where one multiplies a variety into many plants by cuttings a few disappointments like this ought to be bearable.

Expensive varieties may be additionally propagated by cuttings in the late summer, or early autumn, "pot-roots" as they are called in England being grown; and stored in their pots in the root cellar over winter. The following spring they will make just as good plants as tubers many times as large, and the plants will produce excellent blooms and tubers.

One grower claims entire success in increasing stocks of exceptionally fine sorts by his cuttings from large plants in August and September. These autumn cuttings are selected from side branches, but not from those bearing flower buds. Tips of twigs and branches are cut with four sets of leaves. The knife must be sharp, and the cut made just below the second set of leaves from the tip, the two leaves nearest the cut trimmed close to the stem, to reduce evaporation of moisture from the tiny fragment of a plant, which is now entering upon a struggle for survival. Each cutting is placed in a two inch flower pot filled with sand and leaf-mould in equal parts, very finely sifted and thoroughly mixed. Or they may be placed rather closely

in boxes, and after well rooted transferred to three inch pots. Keep the cuttings cool and shaded from the start. Under these conditions they will, after rooting, rapidly make "pot-roots" (small tubers nearly as large as peanuts). As autumn draws to a close let the plants finish their growth naturally. Do not allow the pots to freeze, and store until spring in the pots. Transplant in the spring, shaking out the ball of earth, treating carefully as a single plant, without disturbing the roots.

In making autumn cuttings from mature plants it is important to choose stock that is vigorous and healthy and the branch tips selected must be succulent enough to snap through, like a "snap bean" when bent at right angles. If the green growth bends and crushes, but does not break off it is too old for rooting.

Mid-summer and autumn cutting making is not a new idea. Sayers wrote in his "Treatise on the Dahlia," Boston, 1839, "Another, and I think the best, method of managing the dahlia, is to grow plants from cuttings in pots, in summer, to preserve them during the winter. In this method there is an advantage of removing the roots in an easy and speedy manner; an advantage is also gained of protecting them late in the fall from frost and other causes of injury, as the pots can readily be placed in a frame or other convenient place for protection. Mr. Samuel Sweetser of Cambridgeport, Mass., manages dahlias in this manner to excellent purpose: the plants are grown in moderate sized pots,

which are taken into the greenhouse in the fall and placed away in a convenient place. If the earth about them is too moist they are placed in a dry place, and not removed until they are thoroughly dried, when they are placed away under the stage of a greenhouse, on shelves, or other places, until they are desired to be started into growth, when a little of the top soil may be taken from the pots and the pots plunged into a frame or other place to vegetate."

Propagation by planting seeds is the third and only other method of increasing dahlias. Growing seedlings is simple, and can be done by any one. Seeds sown in greenhouse, cold frame, or in a home window will produce plants, blooms, and large tubers by the end of autumn. In regions where the growing season is long, where sweet corn may be planted May tenth, sow the seeds early in April. Earlier planting means plants so large by transplanting time that they are hard to handle. Where summers are very short seeds may be started in late February. In California seeds may be sown in the garden itself April first, and blooms secured in August. If one part formalin to fifty of water be used, two quarts of this weak solution to every square foot of soil before sowing the seeds, damping-off fungi will be lessened, perhaps entirely killed. The solution is also somewhat beneficial in stimulating the growth of the seedlings.

Sow the seeds about an inch apart in good soil that has been sifted, and to which a third of sand has been

added. After the soil has been well mixed with the sand (sifting together two or three times will accomplish this), and nicely leveled, the very best thing to firm it is a brick, which should be placed here and there upon the surface and tapped with a wooden mallet, or a short piece of wood. Do not consolidate the soil too much, settling it half an inch or less. Tapping the brick with a hammer will crack it clean in two. After sand has been sifted upon the seed the brick can be used again, and tapping with the closed fist will answer this time.

Sift sand over the seeds until they are covered a quarter or even a half of an inch. The seeds sprout vigorously, and unless thus well covered will push themselves entirely out of the light soil, dry, and die. Water thoroughly when sown, using a very fine sprinkler, a spray, or a piece of cloth trailing over the sand, hanging out of the watering can, to prevent the sand being washed into heaps, uncovering the seeds. Do not water again for a week, and if the boxes are kept cool enough they will remain moist enough. Watch, them, however. If they become too dry the sensitive sprouts just emerging from the seeds will suffer, perhaps die.

Cover with boards, paper, or if flats (boxes) are used lay sheets of glass over the boxes, to reduce evaporation. Uncover when the seeds are up and protect somewhat from strong light for a few days. White paper or cheesecloth, hung before the window, or over cold frame glass will suffice. If boxes are used they can

be kept out of the way, in the dark, until the seeds germinate, not failing, however, to bring to the moderate light when they begin to sprout. Keep the boxes in a cool place until germination takes place, for the more slowly they start the better the plants. Quick sprouting means leggy, delicate young plants. A temperature of sixty to sixty-five degrees, Fahrenheit, is just right both for germination and for growing.

Some of the seeds will be slow in coming up. Watch them. If any are six weeks in sprouting take particular note and care of such, for the finest and most worthwhile flowers as to color and form are likely to come from these late starting seeds. Some experienced growers deny this, claiming that dahlia seedlings are a law unto themselves (which merely means that their human friends do not understand them fully), and that the most beautiful and the sturdiest seedling plants and flowers sometimes come from the weakest and sometimes from the strongest sprouting seeds. This may be true enough, and the majority of fine flowers still be borne by plants from the six-weeks slow germinating seeds.

After the seedlings are well up they should be given full sunshine or they will grow too slender. But keep them cool all the time.

One grower had an interesting experience. A box containing one hundred seedlings over six inches tall was forgotten and left out doors one spring night. Frost killed every bit of foliage leaving nothing but the



A New Seedling



Amber Queen, a single Dahlia usually having more than eight petals

stems, which also turned almost black. The box was carelessly tossed under a tree. The weather improved, in about a fortnight tiny leaf shoots appeared in the axils of the frost killed leaves, and the stems gradually became leafy again. The plants were neglected, often dried out in their box to almost the extinction point, were sometimes flung a little water, and finally were transplanted. They grew steadily to maturity and produced normal seedling blooms, and excellent tubers.

If from all your seedlings you have two plants out of each hundred that are worth keeping after they have shown what sort of blooms they can produce you are doing well. One grower started with thirty thousand seedlings; three years afterwards he had reduced all these plants to exactly eleven.

If you are a very busy person, or have not the facilities for "shifting" the seedlings from flats or cold frame to three-inch pots when two or three sets of leaves have formed, and later into larger pots, as the mass of fibrous roots seems to pretty well fill the pots, you will do well to plant in boxes in five inches of soil, having the top of the box one inch higher to make watering easy, and dropping the seeds two inches apart in each direction. In rich soil these plants, though crowded in the boxes, will do well, and can be transplanted directly into the garden after all danger of frost is past. Some of the little plants will have tubers as large as peanuts if they were started early. Set them deeply in the

garden row, six inches at least, disturbing the rootlets as little as possible. By watering exactly right the box soil can be made firm enough to be cut into squares with trowel, and after the first few plants have been transplanted each square of earth with its plant can be lifted without much disturbance of roots. Use bone meal, and otherwise fertilize and cultivate in the garden exactly as for plants started from tubers. When blooming begins if you have experience enough with dahlias to give you some standards for comparison pull up and throw away each plant that shows itself not worth keeping. This will allow more space and plant food for the others, for at transplanting time you can set the seedlings as close as fifteen inches, if your garden space is at all limited. But if you do plant thus closely you must certainly thin out the undesirables as fast as their flowering reveals them. Where flower pots are not used, and they are not necessary though truly desirable, boxes so constructed that they can be "knocked down" will prove convenient. If also divided into two-inch squares, checkerboard fashion, by strips of wood in one direction, and two-inch pieces the otherway, and these pieces well oiled to discourage the clinging of soil, the little plants can be taken from the box in undisturbed cubes of earth and transplanted without interruption of growth. Paper flower pots could be used. Plot the size of your boxes so they will contain square "pots" of strong manila or waxed butcher's

paper without loss of space. Have one side of the wooden box detachable by using brass (not iron) screws, or hooks, or pinned "knock-down" style, and the paper pots can be lifted out intact for transplanting. Use a block of wood of the pot size desired, fold the paper about it, fasten with a touch of paste, tube glue, or mucilage, to retain shape until packed in the box and filled with earth. Such a plan is a good one to follow with tomato, pepper, cabbage, and other plants started early in the season. The final transplanting of all seedlings without root disturbance is greatly to be desired.

Do not make your boxes too large. A wooden box fifteen inches square, filled with five inches of earth is quite heavy, while a twenty-inch box is almost too heavy. When the boxes are planted in the home window it is desirable that they be set out of doors on fine days as spring advances to harden the seedlings, but shielded from nippy winds, of course. Convenience in weight and size will be much appreciated, while "knock-down" boxes possess the added advantage of storage in little space when put away until another spring comes round.

After transplanting cultivate the seedlings faithfully; top fertilize as flower buds appear, pinch off all flower buds till mid-August, for the best blooms will come in September. The flowers are no better the second year; except as the result of better treatment,

that is all. Give the seedlings the best possible care the first season, secure decisive blooms, throw away the ninety odd per cent of worthless plants, starting your second year with only those that promise most. It is absolutely futile to waste time upon inferior dahlias these days.

Besides buying dahlia seed you can grow seed from your choicest varieties, accepting the fertilizing done by bees, or crossing selected flowers yourself, which is the self-respecting, scientific method. Cultivate the seed-producing plants constantly. If the soil dries out it means failure. Do not use the first flowers, they are practically worthless for seeding. Most dahlia flowers that have seed follow blooming will show a center just before fading. As the petals die, a few at a time, after the seed is growing, they must be pulled out. This is a very important matter. Go over the flowers every other day until not a petal is left. The pod or seed case will by this time be almost closed. In four or five weeks it should be fit to cut, but leave it on the plant until frost seems certain. If frost is probable any evening before the seed case is entirely ripe then it may be cut, even if ripening is not fully accomplished. Cut with a long stem, and place the stem in water, in a dry, airy place, where it is warm. Change the water and clip half an inch off the stem twice a week. After ten days hang up head downwards to dry. The seed case will

commence to open. Do not disturb it until completely dry. If then the pod has a crisp feel the seed is probably excellent.

The reason for picking off the dead petals so faithfully is that rain, fogs, dog days, even the heavy dews of autumn, will water-soak the seed husks. A rot much like the waxy rot of peach orchards often forms on the fading blooms in damp weather and will spread rapidly, if the dead petals, and all dead flowers are not removed. Carry the dead flowers away from the garden. Burning is the safest disposition of them.

Flowers late in pollen production are to be preferred, but since nearly six weeks are needed for the growth and ripening of the seed, protection against frost is important. If the seeds are sappy when touched by frost the germ in the seeds will be killed. As a first frost often is not followed by another for ten or fifteen days completely protecting the seed bearing plants on very chilly nights is obviously worth while. When the seed pod seems nearly completely formed it can be taken into the house if a frost kills the plant. If the seeds are well developed they will ripen in the house. If undeveloped when frost comes they will not ripen indoors,

A perfectly full, double decorative does not seem to the average amateur, as a likely prospect for either hand or insect fertilizing. Indeed, insect fertilization seldom happens. The pistils, at the base of the petals, are covered and hidden by each closely lapped row of

petals. Unless fertilized by hand these fine and most desirable flowers will not bear seed. Every other row of petals should be cut out with manicure scissors, exposing the forked, recurved stigmas at the base of the petals, upon which pollen of some flower you desire to make the cross from can be placed with a camel hair brush, or the flower can be itself used, brushing and shaking its pollen upon the flower from which you have amputated every other row of petals. Apply the pollen two or three times a day until the flower has opened fully and has completely bloomed. The flower opens in circles, exposing the pollen-receiving parts successively, until at last the centre of the flower is reached, about five days later.

The first few flowers that bloom upon a plant are not suitable for seed production. Allow the late blooms, say just before mid-September, to fully open. Clip the petals of the tight double flowers if necessary. To cross-fertilize selected flowers tie a paper bag (to exclude wind and insects) over the flower chosen as the mother flower at the moment the bud is nearly, but not yet, open. Generally speaking the mother flower controls color in the seedlings, and the pollen flower controls form and size. It is also believed by some that style of bush, foliage, and tuber is determined by the mother plant. Some experimenters insist upon always using a white flower to receive the pollen, claiming production of varying colors is better accomplished thereby.

Use the pollen of a large flowering variety upon a small variety mother flower and at least half of the offspring of such a union will produce large flowers. A peony type flower is a good one to choose for the mother, being loose petalled, with a good sized open center. Select your color in the mother flower remembering this flower will largely dominate the color of the seedlings. A cactus pollen parent may be employed, if one wishes to do so. It takes about five days to complete the hand-pollenizing of a flower and the paper bag should be carefully kept upon the mother flower all this while, lest winds and insects bring pollen from other flowers, the bag being removed for the shortest possible moment each time the pollen is supplied to the successively developing pistils. When the petals have faded, and the pollen-receiving parts have increased in size the seeds have started to form, and the paper bag may be removed.

The pollen-bearing flower can be cut when fully open and kept in a vase of water in the house, where wind will not remove the pollen dust. The pollen will increase in quantity upon the cut flower, and when there is abundance the flower can be carefully carried to the garden and rubbed, face to face, upon the mother flower, or the brush can be used. Very careful and exact seed growers first wash the face of the mother flower with a strong, light spray, or a hand syringe, lest perchance even under the protecting bag the flower be self-pollinated.

Some of the seedlings of the cross-pollinated plants will in all probability be found to be hybrids between the two parents while others will be found to be exactly like the mother plant, showing that cross pollination had not been accomplished with all of the disc florets. From these seedlings the hybrids are selected for the next year's crop and the flowers resembling the mother are discarded. Any desirable hybrids can be perpetuated indefinitely by dividing the roots. If seeds of the new hybrids be planted the second year, a wonderful variety will, in all probability, be the result.

Almost all seedlings are worthless. But "what's natural can't be desperate." If you plan to grow seedlings upon a large scale buy the very best seed obtainable from several remote regions, California, New England, and Great Britain. Change of climate, change of soil, excessive food, are the three prime causes of variation in plants. Select from the blooms of this seed only the most promising two or three plants out of each hundred, and use these flowers for mothers. Choose your pollen from the very finest varieties obtainable, that you raise from purchased tubers. You could ask neighbors who have costly and exceptional sorts to cooperate with you to the extent of donating pollen bearing flowers, and you could return the favor with some of the seeds of which their flowers are the pollen parents. You start your career, therefore, as a grower of seedlings, by buying the best possible seed, and only the best; and

a few tubers of exceptionally fine and established sorts. When autumn ends you should have some seeds that may prove worth while.

Having crossed your first seedling generation with the finest dahlias obtainable perhaps you will be one of the fortunate people, and have a new variety in your second generation that is worth naming and introducing to the gorgeous dahlia world that is already in good and regular standing. But to be sure of this you must grow your second generation two years to test its permanent or "fixed" character. Four years have now elapsed. You should grow your child a fifth year, and at least one thousand miles from its birthplace. Complete change of climate is the ultimate and acid test. If your seedling holds its color and form and other good qualities a long way from home you have a treasure indeed. Not a few eastern amateurs complain of the poor showing made by some of the expensive tubers bought in California. The California growers undoubtedly receive some very uncomplimentary letters from the Atlantic and Eastern States. What probably happens is that California bred dahlias, apparently "fixed" and stable enough in their native soil and climate, show unpleasant and backward variation when transported three thousand miles and given soil, atmosphere, temperature, in combinations unfamiliar and, to them, not exactly suitable. These far-travelled varieties often recover wonderfully the second or third year, and adapt themselves to their new environment with true American flexibility.

The enthusiastic and hopeful grower of seedlings keeps on, each spring sowing more seeds, his own, and those purchased in distant parts. Some autumn he may be rewarded with a flower the fame of which will eventually be sounded from the Atlantic to the Pacific.

If you believe you have a seedling of exceptional merit name it, and record it with the nearest horticultural society, and with the American Dahlia Society, 198 Norton Street, New Haven, Conn. Cultivate your selected seedlings, that you believe have lasting merit, with the greatest care, and supply ample plant food judiciously, that they may show all that is in them. Unless well cultivated and well fertilized they may not fully disclose all that they are.

In his annual address before the American Dahlia Society in New York, September 28, 1921, President Vincent said: "With its widely separated trial grounds, one near Storrs, Conn., and the other at College Park, University of Maryland, the society is well prepared to test any and all new varieties of dahlias. The expense to an originator is so small that we do not believe any variety ought to be put on the market unless passed at the trial grounds, and if the buying public would only buy the new varieties that have been passed upon by competent judges there would not be so many so-called wonders forced upon growers. The number of visitors to the trial grounds and the interest shown is evidence of the wide-spread popularity of the dahlia."

The planting at the Storrs, Conn., Trial Grounds begins June first, and the last plants submitted arrived July 2, in 1921. The plants are set five feet apart each way. Fertilizers are well rotted cow manure, plowed in, and three ounces bone meal about each plant. Wood ashes are scattered over the entire surface twice during the season. No water is supplied, even during dry spells. Each plant is kept to one stem, the top pinched out to produce branching. Disbudding is not done, for it would interfere with the natural growth of the plant, and new varieties must be judged as they are. All the varieties are scored by the judges, of which there were eight in 1921, and a plant must score eighty-five points to be awarded the American Dahlia Society Certificate of Merit. The scale of points used in making the awards is:

EXHIBITION VARIETIES		COMMERCIAL VARIETIES	
Color	20	Color	25
Stem and Foliage. . . .	25	Stem and Foliage. . . .	25
Substance	15	Substance	25
Form	20	Form	15
Size	20	Size	10
	100		100

Every dahlia grower should belong to the American Dahlia Society. Its Bulletins are well worth the annual membership fee, \$2.00, as they contain articles, information, and advertisements of much interest and value.

Dahlias belong to the great composite family of flowers — the largest in the world — which includes asters, daisies, sunflowers, zinnias, chrysanthemums, to name but a few. The so-called flower that these different plants bear is a composite or aggregation of several, sometimes many, tiny flowers known as florets. Each seed in a sunflower head is the product of a distinct flower (floret — literally little flower). Each dahlia bloom is composed of many florets, and each floret can be made fertile and seed-bearing by its own pollen, or the pollen from any other floret on that individual flowerhead, as well as by pollen from a flower grown on a different and distant plant.

Mid-September is the best time to hand pollenate because, apparently, the best and strongest efforts of the plant are then made. The obtaining of pollen from a cactus parent flower can be accomplished better at this time than earlier. A rather inferior cactus bloom, that only slowly opens fully, should be chosen, and this will be found on old rather than the newest growth. If this flower's center is poor, tending to be open, and promising to show yellow, pollen may be obtained from it, not otherwise, for the cactus dahlia does not readily yield pollen. The flower can be cut and kept indoors. When the selected mother flower is ready if your cactus pollen parent is of the tubular petal variety cut the petals back about two inches, split twenty or thirty of these petal-tubes and peel them open back-

wards, much as a small boy does the long stem of a dandelion. This will expose the pollen at the base of the tubes, and allow you to rub the pollen surface upon the face of the selected mother flower. If a tubular petalled cactus bloom is selected for the mother flower the same method will have to be employed upon it. With cactus blooms pollen seems more abundant in scarlet and crimson than in orange; white blooms have little, and pink flowers almost none; dark maroons also have very little pollen. Decorative and single dahlias can be crossed with cactus.

Dahlia pollen is moist, may be lumpy, and is perishable. Allowing the pollen parent flower to become fully open as a cut flower indoors saves all the increase of pollen as the flower ripens from day to day, and the vitality of the pollen is not lessened in any way.

Experiments with the transportation of dahlia pollen should be tried. Pollen bearing flowers might be expressed or mailed a thousand miles. The U. S. Department of Agriculture has transported pollen for the breeding of citrus fruits. Some kinds of pollen have been sent half way round the world by mail, and found vital and suitable for use after the long journey.

When the grower reaches the dignity of raising his own seed the obvious advantages of wide horticultural and botanical knowledge will become apparent. If he has read and studied somewhat he will know that the character of the whole plant is more important than the

character of any one branch or part. The more symmetrical and uniformly well developed the plant is the greater is the likelihood that its seeds will transmit a majority of its characteristics. Just now the popular demand is for gigantic dahlia blooms. The breeder seeking such results should grow his seeds on plants that bear large flowers on all branches, and not select an immense bloom on a plant that only has inferior blooms for the rest of its output. The one gigantic bloom, "the only pride and joy" of the plant, is not likely to transmit the characteristics of producing large flowers. It may be a far larger flower than the average flowers of a plant that produces all its flowers about the same size, but the gardener should choose flowers for seed production from the plant all the flowers of which are nearly alike of good size. The potato grower knows that small potatoes from a hill where there are many potatoes, though small, will give him better results than the planting of two or three immense potatoes, when those two or three are the only offspring of a plant. The plant of many tubers is productive, and size may be bred into the offspring; the two or three big tubers have an unproductive parent, and the following generations will not only not be as large, but there will be few of them. Immense kernels of corn from a gigantic ear selected from the crib should not be planted. The ear very likely is an "only child," and each of the kernels in all likelihood will product a corn stalk that bears but

one ear, and that a very ordinary one, not as large as its parent. On the other hand selecting as seed corn two fair ears, born on a single stalk while in the field, and while the characteristics of the plant as a whole can be noted, is likely to result in the kernels producing stalks that bear two ears, instead of but one. Very poor plants sometimes produce one or two big fruits; inferior dahlias sometimes show one or more large blooms, but the seeds of such plants are far more likely to reproduce the inferior average of the parent than the unusual quality of the accidentally large fruit, or flower.

Having selected a plant of good average qualities as the seed bearer, the large and heavy seeds of that plant will generally give better results than the smaller seeds. The larger seeds will transmit greater uniformity of crop, increased vigor, often increase the earliness of the variety, sometimes increase size of flowers and fruits, and usually exhibit a greater capacity for seed production, which means greater flower production.

On the other hand the grower of dahlia seeds should remember the curious fact that seeds when exceedingly immature give feeble, but precocious offspring. Such seeds will not weigh more than two-thirds as much as those fully ripe. They will produce, if they live, more abundant but smaller blooms, occasionally slightly different flowers. The explanation probably lies in the chemical constitution and content of the

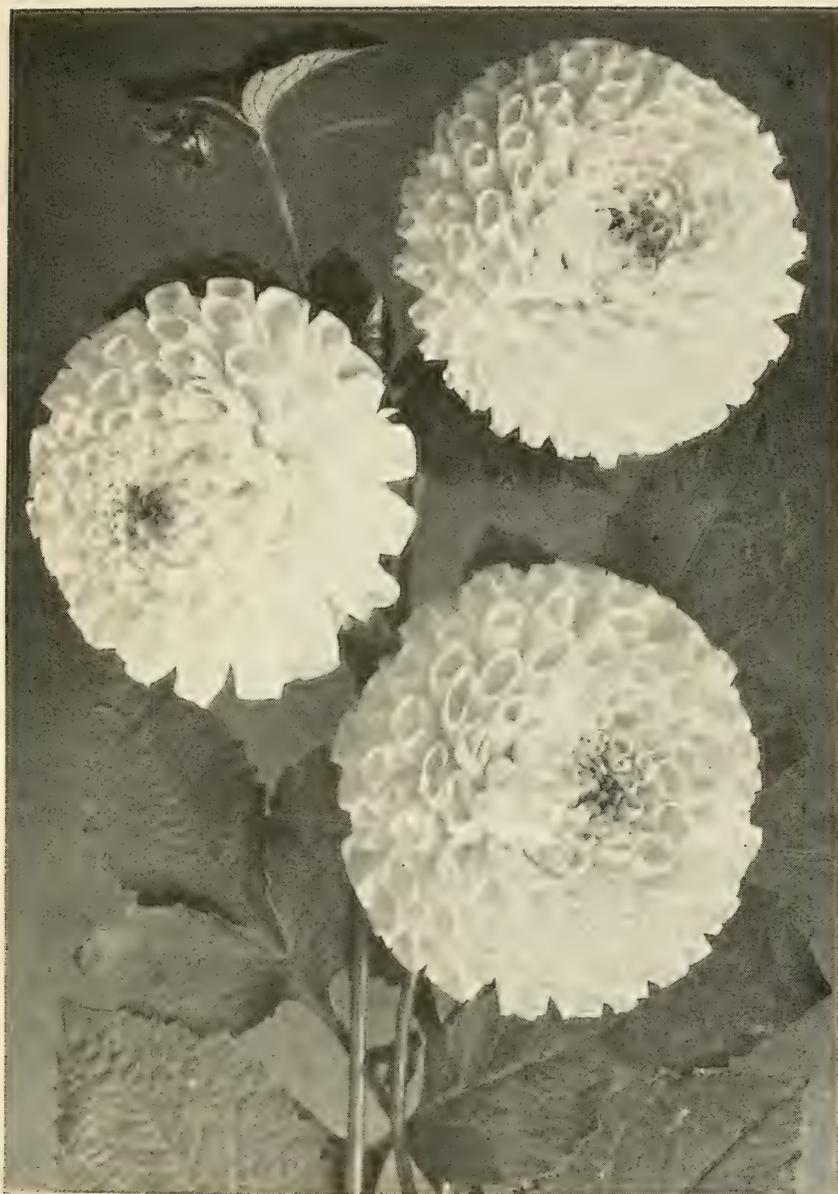
undeveloped seed substance. The seed has not reached the stability of maturity, and is more susceptible to stimulations, nourishments, and irritations.

There seems to be no doubt but chemical changes take place in seeds. The chemical status or content at a given age may result in changes in the seedling plant. Florists have noted that old seeds produce weak plants, and they plant old seeds in the hope of securing new varieties. A writer as far back as 1858 affirms that while one-year old seeds of Ten-weeks Stocks yield single flowers, seeds four years old produce mostly double flowers.

It is a general and well-known rule that nutrition greatly influences variability. Seeds that are nourished the best will probably produce more double flowers than will seeds produced by half-starved parents. The amount of useful plant food a plant has, that is, food in such a dissolved form that the plant can assimilate it, is probably the all-important factor in the growing of seeds from which new varieties are hoped for.

Seeds for the breeding of striped flowers should be taken only from those blooms having smallest stripes because there is always reversion towards too broad stripes, and the broader the stripes of color, the less diversified the colors of the flower.

In breeding for new varieties with each succeeding step the number of individuals must be doubled. Many thousands of seedlings are required to go beyond the



Dreer's White, the finest white of its type



Flora, a fine Hybrid-Cactus

ordinary range of variations, and each further improvement requires doubling the number of specimen plants. If ten thousand seedlings of the dahlia (or of any plant for that matter) do not give a profitable deviation, twenty thousand seedling descendants must be planted; then forty thousand of the third generation, eighty thousand seedling descendants of this line will be required next, and so on. All this work, be it remembered, is required for the improvement of a single quality, a stiff, long stem, for example. Wise breeders try to evolve only one quality at a time. It's obvious that "there's a reason."

The success of the plant breeder depends upon careful observation of variable forms, growing large numbers, in order that there may be more opportunity for variation; and in discovering the unusual, (often through accidental observation), and setting it apart.

Plant offspring, even from seed, are the material continuations of the parents and consequently can be expected to be like them. Nevertheless "The most invariable thing in nature is variation." In the plant world as in the animal world mutilations, curious formations due to accidents, injuries, etc., are not transmissible. "Wooden legs are not inherited, though wooden heads are."

As L. T. Bailey well says: "It is very important when selecting seeds from plants which seem to give promise of a new variety, to sow seeds of each plant

separately, and then make the subsequent selections from the most stable generation; and it is equally important not to trust to a single plant as a starting point, whenever there are several promising plants from which to select." And Vilmorin says: "Cross-breeding greatly increases the chance of wide variation but makes the task of fixation more difficult."

Visitors to a large dahlia field are quite apt to ask the grower how new varieties are originated, and often remark that they suppose new sorts are produced by splitting tubers of different colored flowers and "grafting" the tubers. It has to be explained to these poorly informed would-be horticulturalists that the tubers, and the sprout cuttings, of any plant almost without a single exception in millions of specimens, "come true." The "grafted" split tubers would "come true," each to its variety, if an "eye" (bud) was preserved on each one. They could not possibly blend and produce a new variety. At State Agricultural Colleges an apple tree will sometimes be grafted with one hundred different varieties of apples as a demonstration of grafting to the students, and each grafted bud produces its own sort of apple, but there is no blending into new sorts between graft and graft.

These home gardeners will also most earnestly inform the commercial dahlia grower that when they have planted red and white dahlias side by side the tubers have "mixed" and produced flowers that were white, splashed

with red. It is well-nigh impossible to convince them that this is something that nature never allows, never could bring about. Should any of these visitors adopt a Japanese child it would not occur to them to expect that soon the little Oriental would begin to develop the physical characteristics of an American youngster, and that the American child, sitting at the same table, take on some of the complexion and facial features of the Japanese. This could not possibly occur, the two children could not "mix." It would be absolutely impossible.

For exactly the same reasons, it is absolutely impossible for one dahlia tuber to "mix" with another and different variety, even though they were planted in the same position, and the tubers and stems mingled in one crowded, confused, tangled mass, touching each other. New dahlia varieties can only come from seeds, when the pollen of one dahlia flower is carried by insects, wind, or by the gardener, to the flower of a different variety; or from "bud variation" — mutation the botanists term it, when for obscure and at the present state of our scientific knowledge unknown reasons the plant "sports" and produces a bud, and afterwards a flower sometimes very slightly, sometimes very decidedly different than all the other buds and flowers upon that individual plant. These sports or mutations are rare. Many occur in the wide realm of the vegetable world, with the hundreds of thousands of

different kinds of plants, in the course of the centuries and have beyond question played a considerable part in the production of varieties, but in the close range of the course of one short human life they can with strict literalness be said to be rare indeed.

Yet the unscientific home gardener will insist, unconvinced, that his white dahlias did produce red color, while growing side by side with the red sorts, and that the tubers "mixed." The amateur is partly right. His flowers did "throw red" although they did not, could not, mix. Peonies and some other flowers will do the same thing. Red color seems to have a persistency in flowers that cannot always be bred out of them. The dahlias that revert to red tints had a red ancestor somewhere, perhaps far back on the family tree, and now soil, climate, excess or lack of food, possibly some physical irritation, brings to the front the stronger and more dominant characteristics, just as brilliant auburn hair will sometimes be given some children in families that have not been "red-headed" on either side of the family for some generations. But the youngster does not have red hair because he is growing up alongside of some carrot-topped son of Erin, occupying the next desk to him in the schoolroom.

Again, a frail human memory may be the explanation. The tubers of red dahlias seem to winter better than some other sorts. The amateur puts his roots away as best he can in the fall, only to find that

the home cellar has been a poor storage room, and his tubers are about all killed, by drying out, or by rotting from too much moisture. He salvages a few sound tubers from the rubbish, and ten to one he gets red flowers. He is sure, oh, absolutely sure, that he saved some of his white dahlias, and that they have turned red because of the company they were in the previous summer. But the overwhelming evidence is that the lighter tinted flowers have tubers that "enjoy ill health," or at least that endure adverse conditions less sturdily than the roots that bear darker colored blooms. The roots of the red dahlias live through the winter, despite the deplorable storage treatment that causes sad mortality among less robust companions.

Composite flowers have rarely been found in a fossil state, leading botanists to believe that they belong for all the largeness of the family to comparatively recent times, and although the result of a long series of formative changes, still possess great variability.

While all the future's rosy hopes are dependent upon the dahlia's variability this chameleon-like quality is rather disconcerting when one wishes to fix color. "Dilute purple," says Wilhelm Miller, "and you get crimson-pink. This crimson-pink has two bad faults. It is inclined to be laid on unevenly in patches and veins instead of being evenly suffused, and it is so variable in quantity and quality as to make it a lottery what sort

of flower one is to get. There is only one pink dahlia I know of (A. D. Livoni) that shows no trace of a purple or crimson origin. I shall not have a particle of faith in the stability of any other dahlia advertised as pink until I see it. Whenever the words "lavender" "rosy-pink" or "violet" appear in descriptions of dahlias one may feel almost certain that they refer to this treacherous crimson-pink. Sometimes these tints are pretty well fixed, as the lavender in Arabella. The variety commonly known as Mme. Moreau would pass for a pink until brought side by side with A. D. Livoni, when the purplish cast of the former is evident. In "selfs" (flowers having but a single color), these shades are practically fixed and uniform, but variegated dahlias containing degrees of purple, crimson, rose, magenta, violet, lavender and pink can never be relied upon from descriptions. They may be any one of these shades for they depend upon factors in cultivation which are little understood and perhaps uncontrollable. Pure and delicate shades of pink can never be reached by such means. Plant food may deepen them all the way to purple in a single season and they are almost sure to revert to purple ancestors sooner or later."

Prof. J. W. Gregg, of the University of California, calls the attention of dahlia growers "to the fact that not all of the new creations have originated from seedlings, even though a great many people seem to assume that this has been the case. In looking back carefully

over the history of dahlia varieties it is clear that bud variation has been responsible for the origin of many valuable varieties of dahlias. Methods of propagation, together with variation in soil, climate conditions, and culture, have probably been the most important factors in bud variation. Bud variation in the dahlia is neither new nor recent. While growers continue to produce new and good seedlings they should, nevertheless, be on the lookout during the growing season for bud variations which are sure to be found in any sizeable collection and which may prove, if selected and perpetuated, most desirable acquisitions."

Chrysanthemums are examples of extreme variation. Just what causes mutability — variability — is not known. The one thing that we are sure of is that it takes place. It's the surprise that may come to you, to any one. There is an instance upon record with chrysanthemums where one variety produced a sport after twenty-five years of steady behaviour under cultivation; and what is still more curious this sport occurred in different localities the same season, the sport in each instance being identical. Another 'Mum now has sixteen named sports in colors of yellow, rose, purple, white and red.

The marvels of nature are little comprehended. The root system of a wheat plant about a year old averages 600 yards; the root system of a full-grown pumpkin vine averages $15\frac{1}{2}$ miles (22,280 yards). Try to imagine the root mileage of a great shade tree.

Today, in this year of Grace, 1922, the dahlia is the most popular flower in America, and it is safe to predict that it will remain the most generally grown plant in the home gardens of the country because of the remarkable range of its varied beauty, and its ease of cultivation.

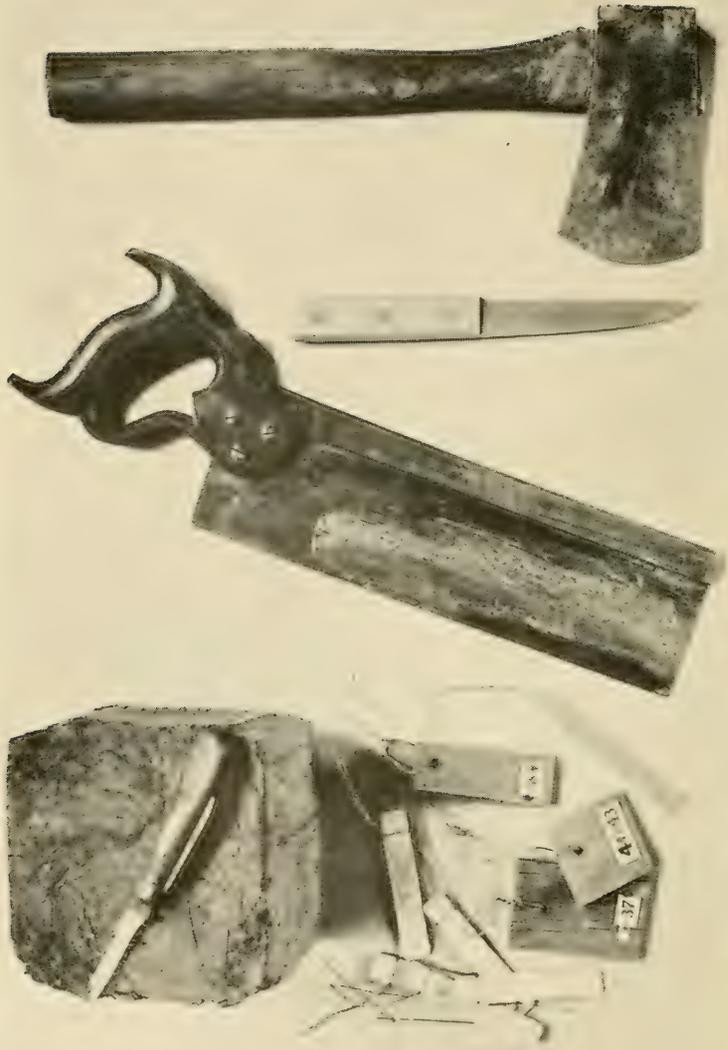
Maurice Fuld says: "The dahlia offers more opportunities for the amateur than any other flower I know of; he can do more with it than the professional and invariably he has the professional all beaten to a standstill; he can with ease breed and cross and produce any quantity of new dahlias all within the short space of one year; and to my mind this is the climax of joy in a garden."

When plants that have been under cultivation and observation for centuries are compared with the dahlia it will be realized that we stand only upon the threshold, historically and practically, of dahlia breeding, and that the possibilities may be anything.

There are many encouragements for the would-be creator of new and worth-while dahlias. Here are some of them: The simple change of seed from one locality to another generally gives a larger and better product, or even more marked variations. It will readily be seen that the procuring of seeds and roots from several widely separated localities is likely to induce changes, sports (mutations botanically speaking), particularly when cross-fertilizing is employed. "If a plant is once



Cerise King



Tools needed in dividing clumps

strongly modified in size, shape, color, other attributes are forthcoming." And immortal Darwin himself said: "Of all the causes which induce variations, excess of food, whether or not changed in nature, is probably the most powerful."

A grower in the eastern States has a dahlia with habits of blooming similar to the well known double daffodil, with outer rows of petals pure white, the center filled with pale yellow quilled petals.

The Cactus dahlia originated as a sport, or mutation, and was first presented to the public by the Royal Horticultural Society, in 1876. In 1872 M. J. T. Van der Berg, of Juxphaar, Holland, received a box from a friend in Mexico containing various kinds of bulbs, flower-roots, and seeds. The slow transportation of those days had allowed much of the contents to spoil. From one small and fortunately undecayed tuber a dahlia came into flower, bright red, attracting much attention. It was called a cactus dahlia in England because the bloom seemed a good deal like the flower of a variety of cactus.

The peony type of dahlia came from crossing single and cactus varieties, and was introduced into England in 1900. The collarette originated from two sports in 1899 simultaneously on different plants in the municipal gardens of the Parc de la Tete d'Or, Lyons. These sports were fixed and propagated, to delight flower lovers ever since.

A tall grass known as teosinte, also called Guatemala grass, has long been regarded as the ancestor, in far off centuries or milleniums, of one of the most valuable plants known to the world, maize — corn. Eighteen years ago Luther Burbank took this grass and tried to prove, by breeding, what botanists had only theoretical reasons for believing. He recently succeeded in producing an ear of corn on his teosinte, which he had improved and bred upwards by rejecting the inferior, and propagating the superior specimens of successive generations. His success is one of the most amazing results of his many wonderful breeding achievements, and is full of encouragement.

The important and very profitable "Lucretia" dewberry was found growing wild on a plantation in West Virginia. Without a doubt others equally fine are growing wild, waiting for some observant eye to note and appropriate them. The dwarf lima bean known as Henderson's was found growing along a roadside in Virginia by a negro about 1865. Burpee's Bush lima bean was found by Asa Palmer, Kennett Square, Pa., in 1883. His entire field of large white pole limas had been destroyed by cut-worms. In removing the poles from the stricken field he found one little plant, ten inches high. It bore three pods, each containing one bean. The three beans were planted in 1884, and two of the plants were dwarf like the parent. In succeeding seasons all plants having a tendency to

climb were discarded, and the Burpee Bush Lima was given the world. Kohl-rabi, a table vegetable, is the product of the crossing of the cabbage and the turnip.

The exquisitely lovely Shirley poppy is an encouraging example of the happy results following the accidental discovery of a mutation. This poppy was given the world by Rev. Mr. Wilks, Vicar of Shirley, England. He says: "There is no country under the sun (except perhaps Patagonia and Thibet) to which I have not sent seeds gratuitously. In 1880 I noticed, in a waste corner of my garden a patch of the common wild field poppy, one solitary flower of which had a very narrow edge of white. This one flower I marked and saved the seed of it alone. Next year out of perhaps two hundred plants I had four or five on which all the flowers were edged. The best of these were marked and the seed saved, and so for several years, the flowers all the while getting a larger infusion of white to tone down the red until they arrived at quite pale pink, and one plant absolutely pure white. I then set myself to change the black central portions of the flowers from black to yellow or white and at last fixed a strain with petals varying in color from the brightest scarlet to pure white with all shades of pink between and all varieties of flakes and dged flowers. The Shirley Poppies have thus been obtained simply by selection and elimination. By 'selection' I mean the saving seed only from selected flowers and by 'elimination' the instant and

total eradication of any plant that bears inferior flowers. It is rather interesting to reflect that the gardens of the whole world — rich man's and poor man's alike — are today furnished with poppies which are the direct descendants of a single capsule of seed raised in the garden of Shirley Vicarage as lately as August, 1880."

The beautiful purple beech, one of the most stately and desired of lawn trees, sported suddenly, and without any previous suggestion of the change, in two places simultaneously, in Europe. The exquisite double-flowering Bechtel's crab was introduced by a nurseryman near Staunton, Ill., about 1888, after it had been wasting its sweetness of perfume and beauty of profuse two-inch flowers in a single-flowering wild crab thicket for forty years, according to old settlers. Another case of a sudden mutation. Peter M. Gideon sowed over a bushel of apple seed, and one seed produced the famous Wealthy apple. He first planted a bushel of apple seeds, and each year thereafter he planted additional seeds for a thousand trees. He lived in Minnesota and at the end of ten years all his seedlings had perished, except one hard seedling crab. Then a small packet of seeds of apples and crab apples was secured from Maine. There were only about fifty seeds in the packet of crab apple seed, but one of these seeds produced the Wealthy apple. In 1915 on the white gladiolus named "Bride" a single stem bore a flower part red, part white. It is certainly known that this

parti-colored flower was the offspring of a pure white one, that had been such for generations. The little bulblet-like offshoots of the corm of this variegated flowering stalk were planted, and one flower stalk of these offsprings bore red and white flowers, while another plant bore red flowers. It follows that the original corm (bulb-like root) must have had some tissue cells in its composition capable of producing red pigment in the flowers. That the vegetable cells having this altered chemical constitution comprised about half of the corm is indicated by the position of the red and white flowers on the stalk. The first double petunia is known to have suddenly and accidentally arisen from ordinary seed in a private garden in Lyons, France, about 1855. From this one plant all double petunias of whatever variety have descended, partly by natural, partly by artificial cross-breeding. In the last thirty-five years the length of canna flowers has been doubled, and the breadth multiplied three times, so that this strikingly handsome flower resembles the best types of lilies and amaryllis.

Experiments with chemicals introduced into the soil might have interesting, and even valuable results, for botanists regard some color changes as caused by the presence of different chemicals in the soil. In New England the meadow-lily is yellow; in the Middle States it is red. Several flowers in the Swiss alps change their color with location. A bellwort produced white

flowers in one soil, blue flowers in a distant soil. *Hydrangea Hortensis* produces only here and there beautiful and much desired lavender-blue flowers. The writer once saw a thirty foot row of these plants, with deep shades of this color. But no landscape gardener can contract to produce this color, saying go to, now, I will place this color for you in your garden this year. It is popularly believed that the addition of a little alum to the soil will produce the color, if anything will. A vetch found in the Tyrol was yellow; the same species in Hungary was violet. In the central Alps the anemone is sulphur yellow, in the eastern Alps it is white.

A botanist, experimenting with the color changes in flowers, was able to turn yellow, blue, pink and red flowers to green by adding alkali, and turned them back to their original colors by acids. From his experiments he concludes that flowers have but three pigments, red, yellow, and blue, and that from these by various combinations all the other colors are produced.

In purple, violet, and blue fruits and flowers the color is diffused through the cell-sap. White flowers are white for the same reason that snow is — light is reflected from a multitude of tiny surfaces. In the flower these surfaces are the walls of empty cells. When the petals of such flowers become water soaked they lose the power to reflect light, and become almost transparent.

Many are the disappointments of the would-be breeder of new varieties. This is inevitable, but incidental. The rewards are joyous, sometimes profitable. Changes of soil, climate, fertilizers, methods of growing, promote changes of plant habit and growth, changes of color, form, profusion or scantiness of flowering.

Hybridizers distinguish between changes that constitute varieties and the profound, constitutional modification that results in a "break." Seeds sown in the spring produce new varieties of blooms by autumn. Twenty-five or fifty years are required to secure a "break" that is of importance. If the production of a "break" is desired the hybridizer's ambition must first lead him to Mexico. He cannot use any of the gorgeous hybrid dahlias offered in the catalogs to secure a "break." It cannot be brought about that way. He must employ one or more of the eight wild varieties to be found in Mexico today.

Plant breeding involves endless, minutest study, and the discovery of valuable facts by accidental observation. A writer in *The Garden Magazine* says of the creator of new dahlias: "He must needs see the blooms under artificial light, for many listless colors under daylight are gems under artificial light. As far as variety of color is concerned the dahlia is in a class by itself; future progress must be along lines than color; the greatest improvement during the past year has been

among the whites and reds; with few exceptions the California producers are making that State the cradle of the best American productions."

Will there ever be a blue dahlia? The breeder of a beautiful blue in this wondrous flower would make his everlasting fame and fortune. At least one nationally known dahlia grower has been trying it upon a considerable scale and has reported "encouragement." Other equally competent experts doubt the presence in the dahlia of the requisite constitutional ability to produce the color pigment so desired. If this greatly to be desired result is ever achieved perhaps it may come through the employment of chemicals in the soil to modify cell-growth and cell action in the plant.

It must be remembered that in all the floral world there is no such thing as a pure green, or a pure blue. There is no blue-green, or green-blue in flowers corresponding to these exquisite tints in the plumage of birds. At least one competent scientific botanist discourages the hope of ever producing a blue dahlia. Augustin de Candolle, (born Geneva, 1778), divided flower colors, according to F. Schuyler Mathews, into two classes, which he named xanthic (red, scarlet, orange, gold-orange, yellow, and green-yellow); and cyanic (green-blue, blue, ultramine-violet, violet, purple, and red). He insisted that the flowers of the xanthic series could pass into red or white but never blue, and those of the blue (cyanic) series could pass into red or

white but never into yellow. This theory has been accepted as correct. Both modification and revision, however are possible.

Hyacinths belong to Candolle's cyanic group, but there are no blue flowers, although there are purple, violet, cyanic red, and modified yellow. Dahlias are scarlet, red, crimson-red, and even pure yellow, but never pure gold-orange, or orange. They belong to Candolle's xanthic classification of plants that cannot produce blue flowers because of some chemical-constitutional deficiencies. Mathews says "At some time or other in the distant past the law of limitations fixed the range of flower-color. No new law of elasticity has since developed to remove the boundaries and thus aid the floriculturist in his ambition to produce what would prove to be a mere novelty."

The dahlia of the future may be one of the sugar sources of the world. It has long been known that the tubers contained a starch-like substance known as inulin, also called dahlin and alantin. It is a white powder, spontaneously deposited when the roots are treated with water. It is soluble in hot water, is colored yellow by iodine, and its chemical properties appear to be intermediate between those of sugar and starch. Chemists have succeeded in extracting from this substance a remarkable sugar called fructose or levulose, which is sixty per cent sweeter than cane sugar. Dr. R. F. Jackson, of the United States Bureau of Standards

has been experimenting to ascertain the best methods for manufacturing this sugar. Mr. R. Vincent, Jr., a famous dahlia grower, and president of The American Dahlia Society, and head of the large greenhouse and nursery business of Richard Vincent, Jr., and Sons Co., White Marsh, Md., has for several years been sending some tons of dahlia roots to an Industrial School, Schenectady, N. Y., and to the chemists in Washington. Extensive experiments have been carried on in both places. A corporation is financially interested, patents are being sought, and when obtained machinery will be built to handle the tuber production from five thousand (5000) acres. Of course, the bud end of the tubers can be used for propagation, and cut flowers can be also sold from the plants. This dahlia sugar can be used by persons suffering from diabetes. At present such sufferers must use saccharin or go without "sweetening." But saccharin, although intensely sweet has a bitter taste, and is unpleasant rather than agreeable. If the new dahlia sugar proves exceedingly palatable, besides being harmless to the human body, it will be one of the great discoveries of the time, and the commercial possibilities of the dahlia will be vastly extended.

Varieties of dahlias are being tested for the sugar content of their tubers, as it is assumed that, as with sugar beets, some varieties contain more sugar than others. As far as the experiments have progressed this variation in sugar value has been found.

What will the dahlia of the future be? Breeders ambitious for new varieties should lay to heart Elbert Hubbard's saying "Convince Nature that a thing is needed and she will produce it." The dahlia of the future will not need stakes, and it may prove to be a tree-like form, perfectly hardy, remaining in the ground the year round, even in northern America. It may have beautifully variegated foliage. Dahlia foliage at the present time has about six times as much variety as that of chrysanthemums. White-edged dahlia foliage, similar to that of variegated geraniums, abutilons, funkias and euonymus, has more than once made its appearance, but is evidently unstable and difficult to fix. Variegated varieties would be desirable to mix with those of plainer foliage. The future dahlia will have strong, long stems, holding the splendid flowers high above the foliage. It is the queen of the autumn now, but it is going to have a longer blooming season. It is a commonplace of talk that the dahlia is one of the most variable of plants, but we hardly realize how variable this marvel of the floral world really is. When dahlias were first grown as garden ornaments they only bloomed for a period of about ten days before frost. Now it is the easiest thing in the world in regions where potatoes can be planted April 10 to have dahlias in bloom June 25, and early flowering sorts will bloom June 15, and can be kept blooming throughout the season. The dahlia of today

is the largest, most brilliant, most gorgeous flower of the temperate zone. The dahlia of the future may be the largest and most gorgeous flower of any zone.

"I often think" (Pages From a Garden Notebook), "in looking at our industrial cities and their people, of that old figure of the warp and woof of life; and if these people, many of them so weary, so worn-looking, make up the warp of town life of our country, it is the sculptors, the poets, architects, and designers who brighten the fabric with threads of silver and of gold; it is the painters, the musicians, the planners of gardens, the growers and hybridizers of flowers who draw through that warp their threads of form and color. I thought of what those growers and hybridizers are doing for the joy of their country. The lovely wares they deal in, the experiments with which they are constantly busy; are there any others besides painters, composers, poets, sculptors, who can give to Americans what these are giving? We need flowers. Every man, woman, and child of us is hungry for flowers. No man can grow or even sell flowers successfully unless he values them more than money. But it is the hybridizer, the man or woman of gentleness and patience, of intelligence, perception, and deep love of the art, that brings into this tapestry of life a lovely curious pattern through their own threads of color, a freshness of design only to be wrought by the creative mind."

LIBRARY OF CONGRESS



0 000 920 358 8

